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Project

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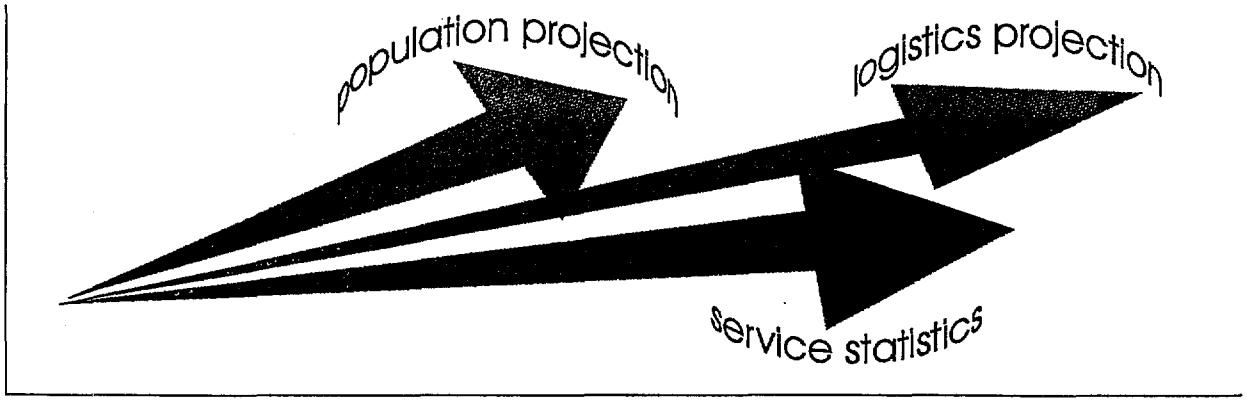
the ForeCasting Cookbook

A Commodity Forecasting and Requirements Estimation Manual for Family Planning and AIDS/STD Prevention Programs



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NOTE TO READERS

The document you are reading is called a "Cookbook" because it contains a number of different recipes, or methodologies, for forecasting for family planning and AIDS/STD prevention programs. It is intended to be a reference book that you can turn to for help and guidance whenever you are making a forecast using one or more of the different forecasting methodologies, when you wish to validate or reconcile forecasts made by different forecasting methods, or when you need to calculate quantities of particular commodities to procure based on your forecast of consumption.

Thus the Cookbook is designed under the assumption that you will *not* read it cover-to-cover, but rather that you will read particular chapters when you need to accomplish a particular task. Though the Cookbook is organized to follow the sequence of steps required to produce and validate a complete forecast, and then to estimate procurement requirements and monitor progress and performance over time, each chapter is written to be as independent as possible of other chapters without being unnecessarily repetitive. The exceptions to this general rule are Chapters II and III (*EXTRAPOLATION FROM HISTORICAL DATA*, and *CORRECTIONS FOR MISSING OR ERRONEOUS DATA*), which describe techniques applicable to *all* forecasts made from historical data.

All readers should review the *PREFACE*, which describes the purpose and intended audiences for the Cookbook.

The reader who is new to forecasting should study Chapter I (*INTRODUCTION*) carefully in order to understand the basic concepts of forecasting and requirements estimation; all readers should skim this chapter to learn the terminology used throughout the Cookbook.

Anyone who needs to prepare a forecast based on historical data (i.e., logistics data or service statistics) should review Chapters II and III (*EXTRAPOLATION FROM HISTORICAL DATA* and *CORRECTIONS FOR MISSING OR ERRONEOUS DATA*) carefully. These chapters describe the essential techniques for such forecasts.

Chapters IV through *VII* describe techniques for preparing forecasts based on four different data sources: logistics data, service statistics, population data, and distribution system capacity. Readers who wish to make one or more forecasts using these sources should study the appropriate chapter or chapters.

Chapter VIII (*ESTIMATING CONSUMPTION FOR NEW PROGRAMS*) describes special considerations for forecasting in new programs. This chapter assumes that the reader is

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familiar with whichever of the forecasting techniques described in Chapters IV through VII are needed.

Chapter IX (*ESTIMATING CONSUMPTION FOR AIDS/STD PREVENTION PROGRAMS*) describes special considerations for forecasting condom needs for AIDS/STD programs. This chapter assumes that the reader is familiar with whichever of the forecasting techniques described in Chapters IV through VII are needed.

Chapter X (*VALIDATING AND RECONCILING THE FORECAST(S)*) describes techniques for forecast validation by comparison of two or more forecasts. All readers who prepare forecasts should study this chapter.

Chapter XI (*REQUIREMENTS ESTIMATION*) explains how to calculate quantities of product which must be procured or obtained from donors once the forecast has been made. This chapter should be studied by readers who must make such calculations.

Chapter XII (*MONITORING THE FORECAST AND THE DISTRIBUTION CYCLE*) describes the process of monitoring progress over time in order to adjust procurement quantities and future forecasts. In many cases this task does not fall to the forecaster who prepares the original projections. However, he or she should make sure that *someone* undertakes this monitoring function; otherwise the forecasting job is not complete.

The *Appendices* to the Cookbook give detailed additional information for specific topics covered in the text. Of particular interest to general readers is Appendix 1 (*RELATED PUBLICATIONS*) which lists additional references and contact information for organizations that can provide further information or assistance. For the reader who desires a thorough understanding of *all* the techniques described in the text, Appendix 6 (*A FORECAST PREPARED USING ALL DATA SOURCES*) gives a complete example of a forecast and requirements estimate prepared using the techniques described in the text.

Please note that this version of the manual *does not* describe automated tools which can be used to ease the burden of the mathematical calculations needed for forecasting and requirements estimation, though a few of these are listed in Appendix 1. Future versions of the Cookbook will include these tools.

Finally, please note that the Cookbook is still labelled "DRAFT". This version is intended for review and field testing by individuals and organizations concerned with commodity forecasting. Any comments which will help us to improve future versions of the document are most welcome. Please forward your suggestions for improvements or corrections to the Project Director, Family Planning Logistics Management Project, John Snow, Inc., 1616 N. Fort Myer Drive, Arlington, VA 22209 USA. Phone: 703-528-7474. Fax: 703-528-7480. Thanks!

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PREFACE

Family planning and AIDS/STD prevention programs must properly manage their logistics systems if they are to be successful in meeting the demand for services efficiently and effectively. In particular, they must properly forecast the quantities of each method and brand of contraceptive (or condom) required, procure or arrange for the procurement of the required commodities, receive and clear products through customs as they arrive, distribute commodities through in-country distribution channels in a fashion that prevents stock imbalances, and, finally, dispense commodities in good condition to the clients who need them.

The purpose of this manual is to describe, in more or less chronological order, forecasting procedures and techniques that will be useful in forecasting contraceptive or AIDS/STD prevention program condom needs. Topics covered include general methodological considerations, data sources and alternative techniques for preparing forecasts of consumption, special considerations in forecasting for new programs and AIDS/STD prevention programs, methods for validating the forecasts, procedures for calculating quantities of contraceptives required based on the consumption forecast, and methods for monitoring the forecast over time.

This manual is intended to serve anyone who must prepare national level forecasts of commodity requirements. Thus the audience includes procurement and logistics management personnel in host-country family planning and AIDS/STD prevention programs, national and international donor staff and expatriate advisors, and external technical assistance personnel.

In an ideal situation, forecasting is not a periodic (annual or quarterly) activity, but is accomplished through constant monitoring of inventories, usage rates, and other information that may impact on future demand. If the logistics Management Information System (LMIS) of the program is properly designed and kept up to date, most of the information needed will be available to staff charged with the responsibilities of forecasting and procurement.

This manual does NOT, however, provide a complete description of appropriate LMIS forms and procedures, nor of the myriad other components of the logistics management system which must also be in place. These related issues are covered extensively in the various documents listed in Appendix 1.

This manual is the work of a number of people from USAID's Family Planning Logistics Management (FPLM) Project, both at John Snow, Inc. (JSI), and at the Division of Reproductive Health, Centers for Disease Control (CDC); the authors of the most important source materials are Mr. Jack L. Graves and Dr. Mario Jaramillo. As the reader will

quickly perceive, forecasting of contraceptive and AIDS/STD condom needs (like forecasting for most other reasons) remains more of an art than a science; accordingly, this manual is considered to be very much a work in progress. The authors welcome all comments, criticisms, and suggestions for improvements.

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I. INTRODUCTION

This manual describes the process of planning for the acquisition of commodities that are needed for successful operation of a family planning or AIDS/STD prevention program. This first chapter deals with the methodological considerations of forecasting and with the general processes of forecasting consumption, forecast validation, and commodity needs estimation.

A. OVERVIEW AND METHODOLOGICAL CONSIDERATIONS

Forecasting contraceptive consumption is as much an art as a science, especially in new programs which have no historical data. It is for this reason that this document is a Cookbook, rather than a single recipe.

Why do it?

One of the primary reasons for attempting to predict the magnitude of future needs is the time which transpires between the request for a resource and the arrival of that resource at the location where it is to be used. Because preparing an order and then sending, processing, approving, dispatching, and ensuring that it reaches its destination takes time, it is essential to have sufficient advance knowledge of the quantities which must be purchased or produced.

Another reason, perhaps the most important, for doing everything possible to determine in advance the amounts of a particular product required are the consequences that NOT having it available at a particular time would cause. In the case of contraceptives, the most obvious consequences would be the occurrence of unwanted pregnancies, program dropouts, the need for a couple to change from a method with which they are satisfied to another which they had not planned on using, the change from one brand name to another within a given method, the payment of higher prices for the same product, the loss of time and money caused by unfruitful visits to service centers, and the discredit accruing to the program as a result of not being able to provide timely services to their clients. In the case of an AIDS/STD prevention program, a condom stockout may be fatal to the client. To all this must be added the additional costs incurred as a result of underutilized services or emergency orders for commodities.

Short- Versus Long-Term Forecasting

It is useful to distinguish between short- and long-term forecasting efforts: though there is much overlap (indeed, it is difficult to get experts to agree on a definition), short- and long-term forecasts tend to be prepared by different staff members, for differing purposes, using somewhat differing techniques.

Projection of contraceptive needs over the short- and medium-term is undertaken primarily in conjunction with tactical planning to meet the immediate objectives of a logistics system: to procure appropriate amounts of each commodity to be issued throughout the distribution system and dispensed to users. The output of this type of projection exercise is clear: quantities of contraceptives needed over a fixed period of time, schedules by which they should arrive, budgets and cost estimates where appropriate, and if necessary, requests to donors for assistance in obtaining the products.

This function tends to be the responsibility of middle management, who must make these projections on a fixed timetable regardless of the quality of data available or the degree of specificity of their program's short- and medium-term plans. For these people, this Cookbook presents ideas and procedures which can be immediately applied to practical situations using simple methods easily understood by those directly involved with the management of supplies.

Long-term projections, which are more strategic than tactical in nature, require a greater knowledge of the history and evolution of family planning programs worldwide, as well as of the policies of national and international organizations and the determinants of supply and demand for contraceptive services and materials in a particular society. Long-term projections may be prepared by local program managers, or by a combination of program staff and outside consultants. Such forecasts are more complex to produce, requiring a greater knowledge of forecasting techniques. However, the typical uses to which long-term projections are put — long-range estimation of demographic trends, evaluation of program impact, commodity production planning — do not typically require the same accuracy needed for short-term forecasts, since other variables used in such analyses are also imprecise. Long-term forecasting issues are not covered explicitly in this version of the Cookbook, although the mathematical techniques are the same as those used for short-term forecasting. Future versions of this manual will address long-term forecasting issues in more detail.

B. DEFINITIONS: THE FORECASTING/VALIDATION/NEEDS ESTIMATION PROCESS

Logistics is defined as that branch of management which deals with ways to ensure that the resources needed by a working group or the products required by a group of consumers

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reach their destination in the required amount, in the least possible time and at the least possible cost. This objective is more completely described as the "six R's":

- The ***RIGHT QUANTITIES*** of
- the ***RIGHT COMMODITIES*** in
- the ***RIGHT CONDITION*** in
- the ***RIGHT PLACE*** at
- the ***RIGHT TIME*** for
- the ***RIGHT COST***.

To achieve this objective, it is essential, first of all, to know what products are wanted and in what amounts, and in what places they are to be consumed. This assumes that it is possible to know and quantify future consumer needs. The Webster's Ninth New Collegiate Dictionary definition of *forecasting* is:

> to calculate or predict some future event or condition, usually **as a result of rational study and analysis of available pertinent data.** (Emphasis added.)

Thus forecasting is an effort to determine ahead of time what is going to occur in the future and then quantify it, with the accuracy of such an effort being directly related to the predictability of the subject matter as well as to the completeness and the quality of the information available as to past and present activity. For the purposes of this manual, forecasting means estimating the *use* and *losses* that will occur for each contraceptive that will be used by a family planning or AIDS/STD prevention program over some future period of time.

These two terms require further explanation. The Dictionary definition of *demand* is:

> the quantity of a commodity or service wanted at a **specified price and time.** (Emphasis added.)

In the context of family planning or AIDS/STD prevention services, price includes not only the monetary cost and the program personnel cost, but also the cost in time and inconvenience for the client to obtain services. The implication is that while public sector programs might provide these services at no monetary cost, some clients will use private sector providers for convenience or other reasons. The goals of most public sector programs

include increasing the numbers of people who want family planning (or condoms for AIDS/STD prevention), but expecting others to provide services to some of them. Also, although most programs may want to meet the demand as defined above, they may be prevented from doing so by a variety of constraints.

Therefore, we not only must try to forecast true demand, but also must take into consideration the program's ability to deliver the commodities and services before deciding how many contraceptives are to be procured. In logistics terminology, managers are interested in the amount *dispensed to users*: the quantity actually given to clients at the clinic, dispensary, shop, or field level of the distribution system. This is carefully distinguished from quantities which are *issued* from one level to another within the distribution system (for example, from the central store to the regional stores). For reasons discussed below, it is very important that wherever possible dispensed to user data rather than issues data be used for forecasting purposes.

Use (or amounts *dispensed to users*, or *consumption*), then, are those quantities of product used for their intended purpose, and *loss* means the opposite. Losses are usually classified as either "system" losses or "client" losses. System losses are those that occur within the logistics system, such as expiration, damage, or theft. Client losses are those that occur after the client has taken possession of the product. Since these latter losses are extremely difficult to measure, and in any case largely beyond the control of a program's logistics system, the terms "use", "consumption", and "dispensed to users" are most often considered to be interchangeable terms for logistics purposes.

Consumption forecasts, no matter how they were made, should always be validated before use. Webster's definition of *validate* is:

> to support or corroborate **on a sound or authoritative basis.**
> (Emphasis added.)

For our purposes, validation means comparison of two or more forecasts made using different methodologies to determine whether the forecast results are consistent, and, where they are not, to identify strengths and weaknesses of each forecast used in the comparison, in order to arrive at a "best" forecast of anticipated consumption and losses.

Once the forecast of the amounts expected to be dispensed to users over a particular time period is finalized, program staff must take account of stocks which may already be on hand or on order before deciding how much to purchase or request from donors. This calculation process is known as *requirements estimation.*

With estimates of quantities needed in hand, program managers must acquire the necessary products in a timely fashion. The definition of *procure* is:

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> to get possession of; obtain by **particular care and effort**. (Emphasis added.)

For our purposes, procurement means acquiring the contraceptives (through purchase, donation, or other means) and scheduling the contraceptive shipments.

Finally, the definition of *monitor* is:

> to watch, observe, or check, especially for a special purpose.

Our "special purpose" in monitoring, as implied above, is to ensure that products are available at all times and in sufficient quantities so that the anticipated demand of the program's clients will be met and losses will be kept to a minimum.

C. STEPS IN THE PROCESS

The forecasting process in its entirety can be inferred from the above definitions. The tasks which the forecaster must accomplish are to:

1. **Forecast** not only the true demand for commodities but also amounts that the program will actually dispense to clients and the amounts which will be lost in the process;

2. **Validate** the estimates by comparing forecasts made by several methodologies;

3. **Estimate requirements** for obtaining commodities which are not available in sufficient quantities to meet anticipated needs;

4. **Procure** through purchase or donations the commodities required; and

5. **Monitor** commodity consumption over time to correct supply imbalances which will inevitably occur, and to gather data which will be needed for the next forecast.

The basic steps which should be followed in completing these tasks are to:

1. Prepare a written preliminary schedule of the work, including travel schedules, appointments with key officials, and a final report to the program director and other responsible officers. This schedule should be revised as the process proceeds and preserved for future reference;

2. Collect, review, and evaluate data sources and other documents;

3. Visit key locations — preferably following the supply chain down several distribution channels — to interview staff and collect data, and, more importantly, to determine data quality and identify gaps which must be filled before a forecast can be prepared;

4. Visit other programs and private sector outlets to determine the effect that their activities will have on future demand and service delivery;

5. Analyze the information collected, focusing on the relevance of the data to future contraceptive use, and take steps to fill in gaps, correct for errors or identified deficiencies, and in general clean the data sufficiently to allow the forecast(s) to be made;

6. Prepare one, two, three, or four forecasts as discussed in the following chapters, depending on the number of separate data sources available and the purpose and scope of the forecast;

7. Validate the primary forecast by comparison to at least one forecast made by another technique;

8. Discuss the forecast(s) with host country program managers and where appropriate USAID and other donor staff to obtain consensus on selection of a reasonable forecast;

9. Calculate procurement requirements by comparing stocks on hand or already on order to usage and loss forecasts;

10. Assist program staff in identifying source(s) of supply for quantities required;

11. Prepare proposed shipping schedules for quantities which must be procured, separately for each source of supply;

12. Assist program staff in preparing documentation which they or appropriate donor or procurement agencies may require for ordering commodities; and

13. Monitor procurements, shipments, and consumption during the period of the forecast, adjusting both forecasts and procurement/shipment schedules as appropriate based on actual quantities dispensed to users.

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In programs where forecasting is an on-going activity, the above elements could form the basis for the job description of the person responsible for forecasting.

For family planning programs, the forecast might focus on those contraceptive methods that require relatively large quantities for constant resupply to clients (sometimes called "major supply methods", usually oral contraceptives, condoms, IUD's, implants, injectables and/or vaginal foaming tablets). However, the other methods such as foams, jellies, diaphragms, voluntary surgical contraception (VSC), rhythm, traditional methods, etc., should not be ignored: changes in the use of these other methods will surely affect the demand for the major supply methods. The implication here is that other program data and information must be considered as a part of the forecasting exercise.

In any case, early and frequent meetings with program staff are vital to the forecasting effort. Much time can be wasted, and dissatisfaction can result, when the "rules of the game" are not understood by all the players. When everyone involved agrees on the procedures, the technical work of the forecast can begin.

D. FORECASTING METHODS AND DATA SOURCES

Most of this manual is devoted to quantitative methods for forecast preparation. Very important parts of the definitions of *forecasting* and *procurement* are those which say "as a result of rational study and analysis of available pertinent data" and "by particular care and effort." Without reliable data and careful analysis, forecasting and procurement become little better than guesswork.

Those conducting the forecast should collect relevant program and logistics information from their own data systems and, if possible, from suppliers, other programs, and other sources of family planning commodities and services in the geographical area served by the program. Among these documents should be:

- Records from the central contraceptive logistics data system;
- Previous forecasts and requirements estimates;
- Previous contraceptive procurement records;
- Program policy statements on service delivery;
- Relevant program planning documents;
- Demographic data;

- Contraceptive Prevalence Survey (CPS) reports and/or other survey reports that contain information on prevalence, method mix, target population, clients' sources of contraception, etc.;

- Other program documents that show past performance and the planned future directions of the program. Reports of program evaluations are particularly useful;

- Correspondence and other documents relative to procurement for contraceptives, shipments and scheduled shipments; and

- Lists of principal program and current supplier officials, and resident officials of other potential suppliers and donor agencies.

The primary requirement for accurate forecasts and procurement schedules is a reliable logistics database on contraceptive procurement, use, losses, and inventory levels over time and at all program locations. In addition to logistics data, the forecaster should analyze program performance data and program plans for the future, along with the service delivery capacity (existing or planned) of the program. Demographic data for the catchment area should also be examined. These data are generally available from surveys, program evaluations, program plans, service statistics, and the program's own Logistics Management Information System (LMIS).

The following chapters describe methods for forecasting contraceptive consumption (or for AIDS/STD prevention programs, condom consumption) based on four different data sources:

- Data on historical consumption of the product;

- Service statistics from the organization using the product;

- Population data; and

- Distribution system capacity of the organization.

Each of these sources has advantages and limitations, as discussed below, and many programs, especially new ones, will not have data from all four sources. The type of forecast(s) that are prepared will depend on the type of data available, and on a determination of which data are of the best quality and therefore most reliable. Other criteria for deciding which type(s) of forecast to use are the time period covered by the projection (short-, medium-, or long-term); the scope (for a town, a region, a country, or a group of countries); and the purpose of the projection (for purchasing, for budgeting, for planning, for evaluation

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of program impact). Figure 1 shows the forecasting methodologies FPLM typically uses for different types of forecasts.

When projections are prepared for an entire country or a major portion thereof, or when considerable volumes of product or large quantities of money are involved, it is advisable to use two, three, or ideally all four methods of projection, comparing the results to arrive at the "best" estimate. This strategy will considerably increase the probability of producing an

Figure 1

THE MOST COMMON FORECASTING SITUATIONS

SHORT- OR MEDIUM-TERM FORECASTING FOR EXISTING PROGRAMS

- Historical consumption (logistics) data
- Service statistics
- Population data

SHORT- OR MEDIUM-TERM FORECASTING FOR NEW PROGRAMS

- Service Statistics
- Population data
- Distribution system capacity

LONG-TERM FORECASTING FOR NEW OR EXISTING PROGRAMS

- Service statistics
- Population data
- Distribution system capacity

accurate forecast by allowing comparison of projections made by one method with those made by a different procedure, providing an opportunity to discover weaknesses in the basic data which it is necessary to correct, or strengths which can be used subsequently to validate the results of the calculations. The additional effort required to prepare several different types of projection is always more than compensated by gains in accuracy and reliability, and by reduction in the risk of projecting excessive or insufficient quantities, thus avoiding the losses which either error would generate.

Since good data are so important to the forecasting process, the quality and completeness of the data should be evaluated as the forecast is being prepared, and steps should be taken to correct any deficiencies. This will make the next forecasting cycle much easier. For all of these techniques, it cannot be stressed enough that the quality of the forecast is entirely dependent on the quality of the data used in making it. Since data are almost always incomplete or inaccurate to some extent, the ability to assess and compensate for data flaws is the **key** skill of the forecaster. Unless such adjustments are appropriately made, the forecasts will also be flawed, despite the mathematical precision of the calculations described in the following chapters. As you work through the procedures or use the tools described here, you must always remember the first rule of data processing:

Garbage in ..... **Garbage out**.

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II. PRELUDE (1): EXTRAPOLATION FROM HISTORICAL DATA

The first two types of projection for family planning or AIDS/STD prevention programs — from logistics data and from service statistics — use an identical mathematical technique called *extrapolation* to prepare the forecast. Indeed, any forecast which is based solely or primarily on historical data uses some form of this technique, which assumes that there is a discernable pattern of change in the historical data, and that this pattern will continue in the future. Using this procedure, a supposedly known continuum is established between the past and a future period of time (the time horizon of the projection).

This chapter describes several variations of the extrapolation technique. Although logistics data are used in the examples, the same techniques and formulas are used in making forecasts based on service statistics.

A. ORGANIZING DATA IN A TIME SERIES

The first step in preparing an extrapolation is always to organize historical data by means of a time series. A time series is simply a table containing two columns, the first of which has equal and successive divisions of time while the second contains values of a variable as a function of each time period. The quantity of condoms consumed in each of the twelve months of a year, for example, form a time series. Figure 2 presents four time series representing quantities of condoms consumed in four different clinic locations during calendar year 1993. These data will be used to illustrate the different extrapolation techniques for preparing a forecast for 1994.

The purpose of organizing data in this fashion is to observe the trend of the data items in the series, the variability of these values around an average or median value, and the existence of "patterns" or "models" of change that repeat themselves in a cyclical basis. The time series also serves to establish the starting point for the projection toward the future.

The data shown in Figure 2 are obviously not very helpful organized just as lists of numbers. The first step in extrapolating from any time series should always be to graph the historical data. It is customary to show time on the horizontal (X) axis of the graph and the variable being projected on the vertical (Y) axis, though this is not mandatory. It is essential, however, that for each axis, the divisions be of equal value, and, of course, that you extend each axis far enough to allow the future projection to be drawn in. The steps to be followed are simply:

Figure 2

CONDOM CONSUMPTION IN FOUR FACILITIES in CY1993

MONTH	CLINIC 1 (Series 1)	CLINIC 2 (Series 2)	CLINIC 3 (Series 3)	CLINIC 4 (Series 4)
January	10	10	18	10
February	11	11	16	13
March	12	12	20	17
April	13	13	22	22
May	14	14	19	30
June	15	15	23	27
July	16	16	24	29
August	17	17	20	19
September	18	18	27	21
October	19	19	28	14
November	20	20	30	11
December	21	32	26	12

1. Create a graph with time on one axis and the quantity to be projected on the other (the quantity axis should be as long as can conveniently be drawn, so that the projection can be read more accurately);

2. Aggregate, smooth, or adjust data if necessary, using the techniques described in this chapter and the following chapters;

3. Plot the available historical data for each time period;

4. Identify any observable trend in the data (stable, downward, upward, cyclical) along with the most probable trend line;

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5. Identify the magnitude and variability of deviations from the trend, and decide, based on careful examination of the data, which data points, if any, must be corrected or discarded;

6. Select the trend line which most closely represents the historical data;

7. Choose the starting value for the forecast;

8. Draw the line which represents the most probable extrapolation of the historical data to the future forecast period; and

9. Read the values of the projection from the graph.

The method used to make the extrapolation depends on what you see when you draw the graph. Among the possibly applicable techniques are the simple average, the linear trend, drawing a line "by eye", the procedure of semi-averages, linear regression, and more sophisticated "decomposition" techniques for non-linear trends.

B. EXTRAPOLATION USING SIMPLE AVERAGES

The easiest mathematical technique for extrapolation, and unfortunately the least useful, is the simple average: that is, the forecaster assumes that the future values of the variable being projected are just the average of the available historical data. Mathematically, the formula is expressed as:

$$\text{Estimated Use for Next Period} = \frac{\text{Total Quantity Consumed in Past } n \text{ Periods}}{n}$$

For the condom consumption data at Clinic 1 in Figure 2, for example, the calculation would be:

$$\text{Estimated Use for January 1994} = \frac{\text{Total Quantity Consumed in Past 12 Months}}{12}$$

$$= \frac{186}{12}$$

$$= 15.5$$

This same figure would be used for the remaining eleven months of 1994 as well. Thus, the condom consumption forecast for the whole of 1994 for Clinic 1 would be 15.5 x 12 = 186.

Figure 3 shows the graph of historical condom consumption for Clinic 1, along with several possible extrapolations. It is immediately clear from the graph that the simple averages technique does not provide an appropriate forecast: the line for the simple average forecast is nothing like the pattern of the historical data. This is of course because the historical data show a uniformly increasing trend in consumption of condoms at Clinic 1. In such situations, a different extrapolation technique is needed.

Had the consumption figures at Clinic 1 been stable instead of increasing, however, simple averages would provide an altogether adequate extrapolation.

C. EXTRAPOLATION USING LINEAR TRENDS

In cases like Clinic 1, where a reasonably consistent increase or decrease in the variable being projected is found, a technique called *linear trend* can be used for extrapolation. This technique uses historical data from the first and last period to calculate the slope of the historical trend, and projects a straight line based on this slope. This is most easily done with a ruler, by drawing a straight line through the first and last historical data points on the graph, with no need for any type of mathematical formulas or calculations. The line is then extended into the future for the period of the forecast. Mathematically, the formula for linear trend is:

$$\text{Estimated Use for Next Period} = \text{Use in the Most Recent Period} + \text{Average Change in Use Over Past } n \text{ Periods}$$

where

$$\text{Average Change in Use Over Past } n \text{ Periods} = \frac{\text{Use in Period } n - \text{Use in Period } 1}{n - 1}$$

So, in the example of Clinic 1,

$$\text{Average Change in Use Over Past 12 Months} = \frac{21 - 10}{12 - 1} = \frac{11}{11} = 1$$

that is, usage is going up at the rate of one condom per month,

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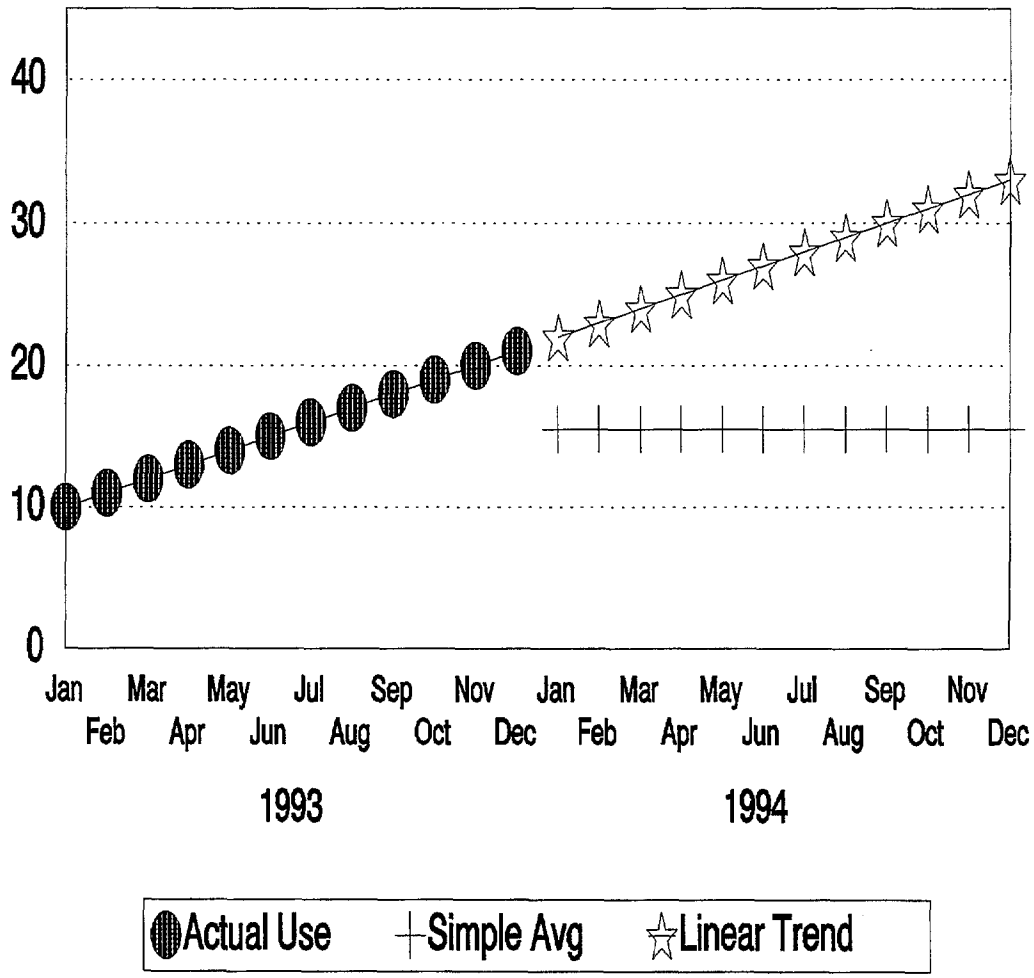
FIGURE 3

QUANTITY OF CONDOMS CONSUMED BY CLINIC 1 IN 1993 AND FORECASTS FOR 1994



and therefore

$$\text{Estimated Use for January 1994} = 21 + 1 = 22$$

Continuing this logic, the estimated use for February, 1994 would be 23, for March, 24, and so forth.

There is no doubt that this line best represents the projection for 1994, based on simple examination of the graph in Figure 3.

In real life, of course, historical data will rarely fall so nicely onto a straight line. The data for Clinic 2 in Figure 2 show performance identical to that of Clinic 1 except during the month of December. In this case, the linear trend calculation would be:

$$\text{Average Change in Use Over Past 12 Months} = \frac{32 - 10}{12 - 1} = \frac{22}{11} = 2$$

that is, usage is going up at the rate of two condoms per month,
so

$$\text{Estimated Use for January 1994} = 32 + 2 = 34$$

with a projection of 36 for February, 38 for March, and so on.

This projection, shown in Figure 4, seems very probably *incorrect*, demonstrating the limitations of the linear trend technique: The forecast is entirely dependent on the first and last historical data points; if these do not follow the pattern of the other data, the forecast may be wildly in error.

In the case of Clinic 2, the forecaster must examine why the data for December 1993 are so different from the clinic's experience earlier in the year, and decide whether or not to use different end points for the extrapolation. Was it simply a reporting error? If so, the error should be corrected, or the data should be omitted for purposes of extrapolation. Did the same thing happen in December 1992? If so, perhaps December data should not be used for preparing the extrapolation, but an allowance should be made for a similar jump in December 1994. Was the sudden increase due to a staffing change at the clinic, a new IEC program, or some other permanent change? If so, perhaps the linear trend extrapolation *is* realistic, or even low. These judgements must be made in collaboration with management

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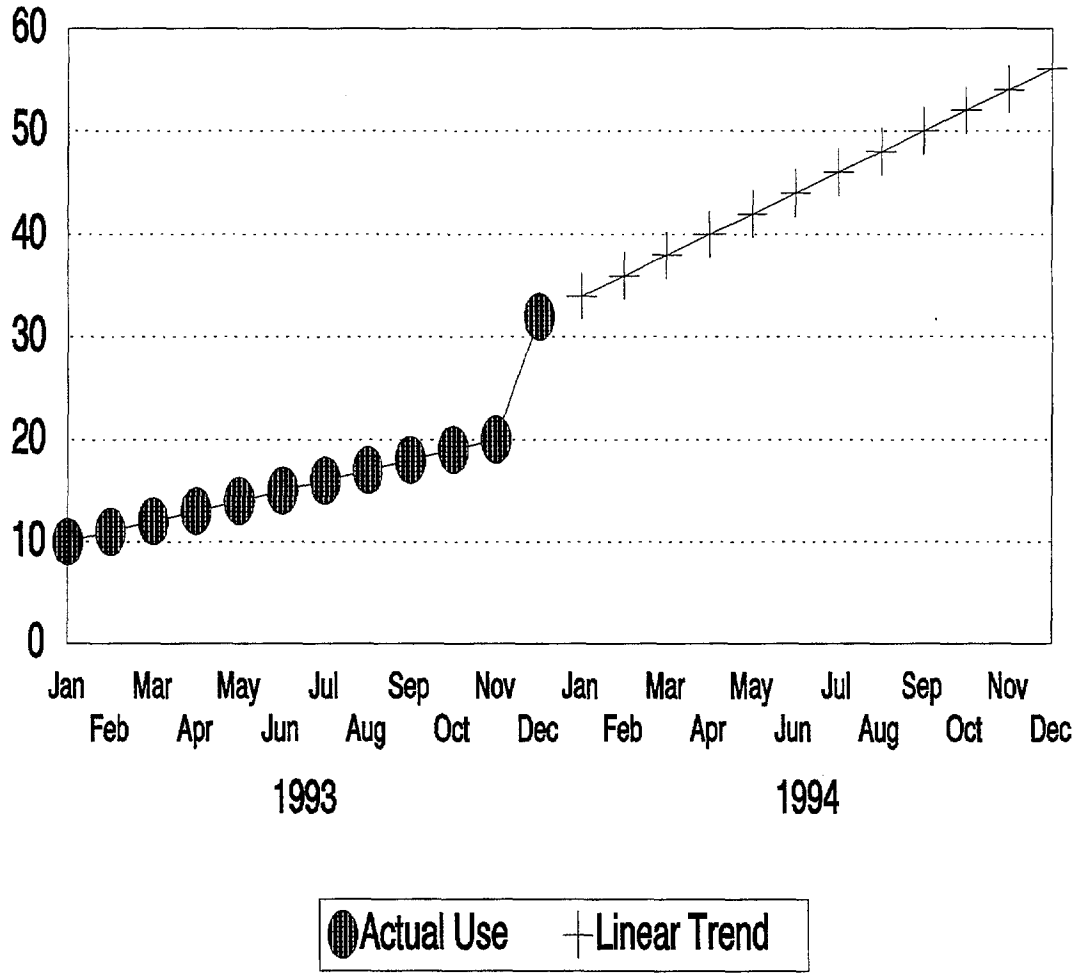
FIGURE 4

QUANTITY OF CONDOMS CONSUMED BY CLINIC 2 IN 1993 AND FORECASTS FOR 1994



staff of Clinic 2.

D. DRAWING A LINE "BY EYE"

Figure 5 plots the data and several projections for Clinic 3. Here the historical data are more realistic: there is some consistency and a perceptible (upward) trend, but the data do not fall neatly into line. In such cases, the simplest technique consists of drawing a straight line with a ruler through the historical data, attempting to leave the same number of data points on each side of the line, if possible, both at the beginning and the end of the line. The "by eye" line in Figure 5 satisfies the first of these criteria, but not the second, because there is no way to do both.

In this case, the results of the "by eye" extrapolation do not look bad. If program managers at Clinic 3 are comfortable with these results, then this extrapolation could be used as the projection. If not, one of the mathematically more precise techniques discussed below should be employed.

The major problem with the "by eye" technique is not its accuracy: certainly in the example shown here the projection appears reasonable. However, a "by eye" projection may be difficult for the forecaster to defend, and in any case it is not replicable; another forecaster's eye is likely to see a slightly different line. If these issues are of concern, a mathematical technique should be used instead.

E. EXTRAPOLATION USING THE PROCEDURE OF SEMI-AVERAGES

Another option is to calculate an average for the first half of the series and another for the second half, using the formula for simple averages shown above. These two values are plotted on the graph at the midpoint of the appropriate half of the series. A line is then drawn between the two dots and extended forward for the time period of the projection. This is called the procedure of "semi-averages".

Using the example of Clinic 3,

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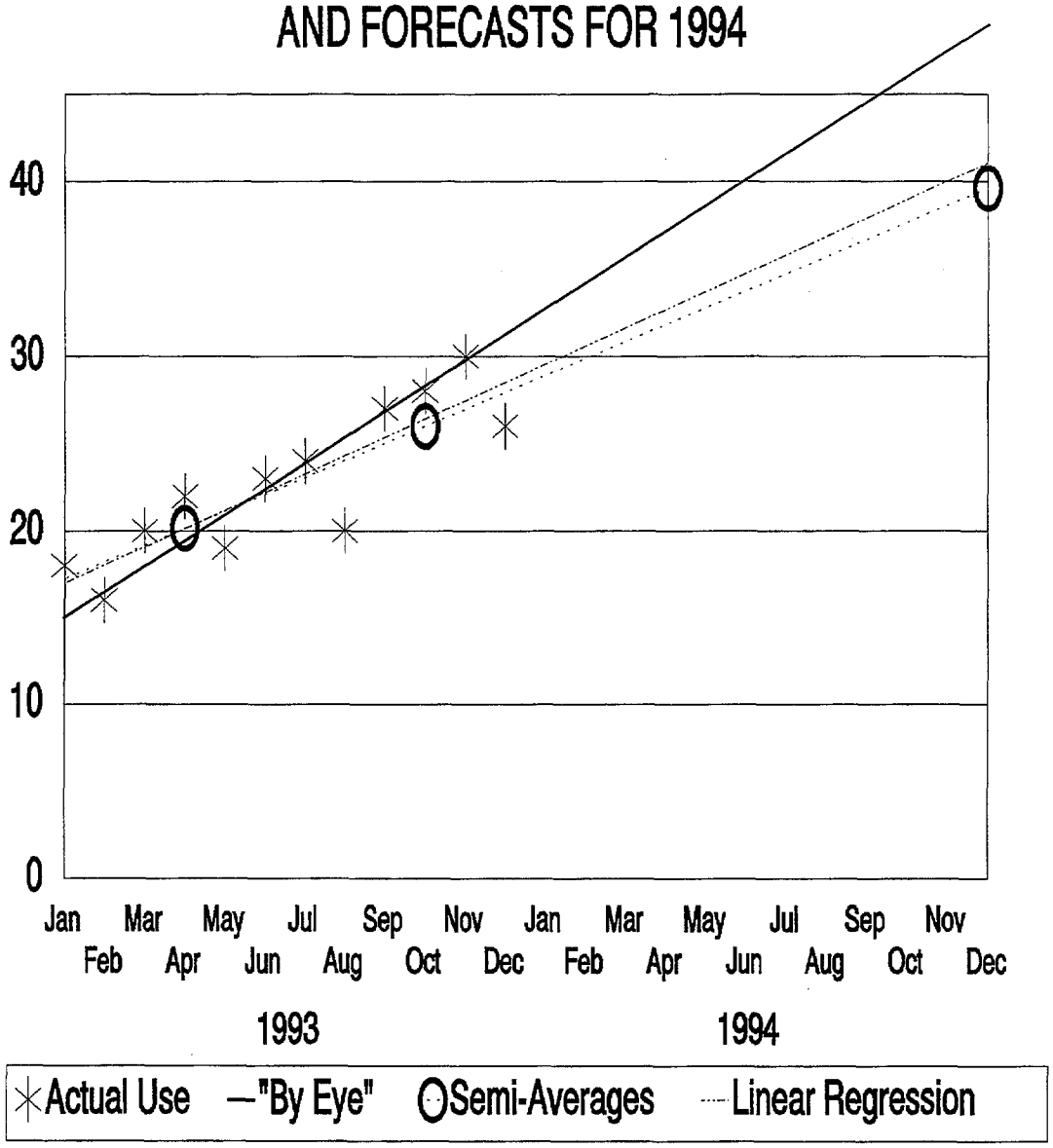
FIGURE 5

QUANTITY OF CONDOMS CONSUMED BY CLINIC 3 IN 1993 AND FORECASTS FOR 1994



$$\text{Estimated Use in First Half of Series} = \frac{\text{Total Quantity Consumed in January - June}}{6}$$

$$= \frac{(18 + 16 + 20 + 22 + 19 + 23)}{6}$$

$$= \frac{118}{6} = 19.7$$

and

$$\text{Estimated Use in Second Half of Series} = \frac{\text{Total Quantity Consumed in July - December}}{6}$$

$$= \frac{(24 + 20 + 27 + 28 + 30 + 26)}{6}$$

$$= \frac{155}{6} = 25.8$$

The first of these points is plotted at the midpoint of the January - June series (i.e., between March and April) and the second is plotted at the midpoint of the July - December series (i.e., between September and October). As Figure 5 shows, the extrapolation using semi-averages in this case gives a projection similar to the "by eye" technique, and one that appears reasonable. Results obtained with this procedure are generally acceptable, and usually better than the results of any of the techniques described above.

F. EXTRAPOLATION USING A STRAIGHT LINE OF REGRESSION

Another procedure, requiring more elaborate math and a larger number of historical data points, involves calculating a straight line of regression with the values of the series, using the technique of least squares or another equivalent method. Prior to the age of computers, this technique required much time and effort. Today, it is easily manageable with a personal computer and even with some simple calculators. While the mathematics are complicated to describe, regression is essentially an automated version of the "by eye" technique described above: that is, it attempts to draw a straight line through the data that minimizes the total of the differences between the actual data points and the values depicted by the regression line. The formulas can be found in any of the statistical references included in Appendix 1.

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Figure 5 also shows the results of a linear projection forecast for Clinic 3, made using the Harvard Graphics software package. A regression line can be considered to be the most reliable expression of the trend of any series of data which can be represented by a straight line, and an extension of the regression line through the forecast period could be accepted as the most probable projection. Thus when computer software or a calculator with regression capability is available, and when there are enough historical data points to support the statistical calculation, this technique should be used in preference to the mathematically simpler techniques discussed in the preceding examples.

G. EXTRAPOLATION WHEN THE DATA SHOW NON-LINEAR TRENDS

Time series do not always exhibit a straight line trend, and when this is the case, it is not appropriate to attempt a projection by *any* of the above procedures. Many phenomena are more accurately represented by curved lines, and must be analyzed using much more sophisticated statistical techniques. Due to the degree of complexity which this analysis may entail, this manual presents only a single simple procedure that may be of use if a case such as this is encountered. The reader requiring more sophisticated techniques is referred to the statistical texts listed in Appendix 1.

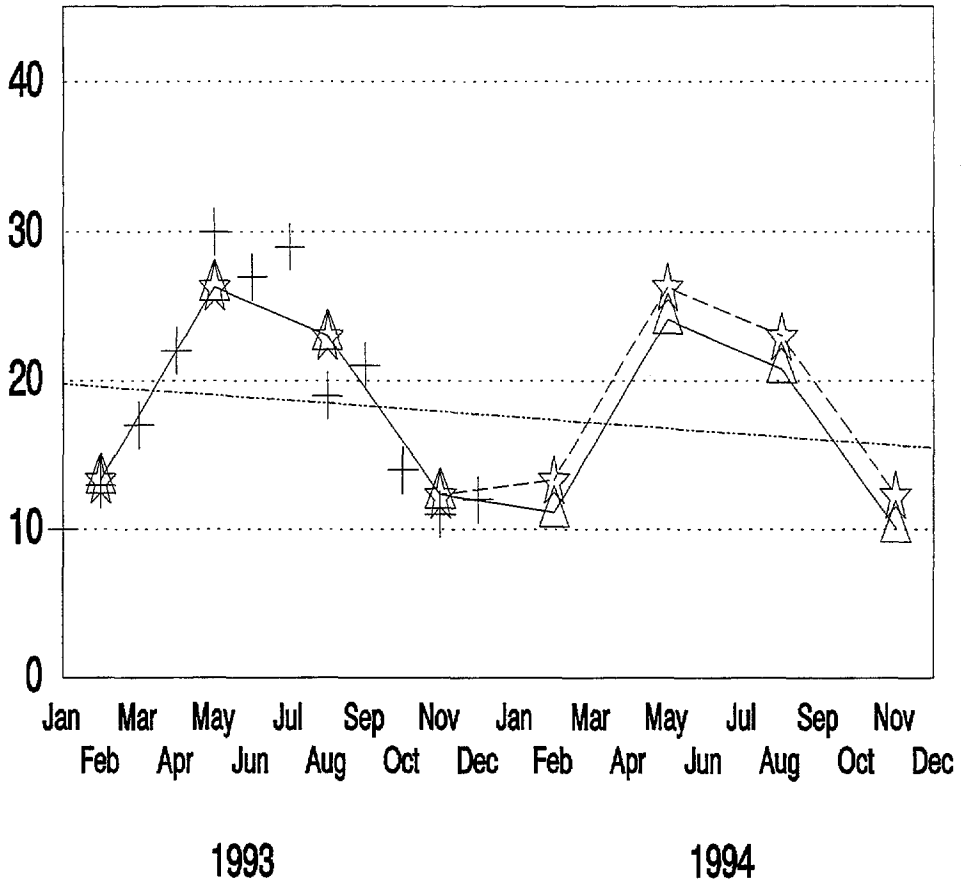
Figure 6 is a graph of the data from Figure 2 for the quantity of condoms consumed by Clinic 4. This time series presents a different problem from the cases discussed above. When the values of the series are represented on the graph in the same way as the previous examples, they trace a *curved* trajectory, with a peak in the center, toward the months of May and June, and with lower levels at the beginning and at the end of the year. If this curved line pattern is repeated over a period of several consecutive years, it would indicate that consumption of condoms in this location is affected by factors related to the different seasons of the year (known as seasonal variations). If this is the case, it is very probable that a similar, although not necessarily identical, curved line trajectory would occur in the following year, rather than any of the straight line patterns forecast above.

None of the above procedures will directly forecast this curved trajectory. In order to work with cases such as this one, there are techniques ranging from the very simple to the very complex that require the use of a computer and special programs. Lacking these, it may be possible to make a satisfactory estimate manually, using a variation of the procedure of semi-averages.

Taking the example of Clinic 4 in Figure 2 it is possible to calculate four quarterly averages using the simple average formula. For Clinic 4's 1993 data, these would be 13.3, 26.3, 23, and 12.3. These quarterly averages are then represented by dots placed on the central month of each quarter (February, May, August, and November). If we join these four dots with

FIGURE 6

QUANTITY OF CONDOMS CONSUMED BY CLINIC 4 IN 1993 AND FORECAST FOR 1994



Actual Use — Regression — Semi-Averages — Decomposition

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lines, we have a trajectory which represents the trend of the preceding year better than if we were to calculate a straight regression line, as can be seen in the graph.

At this point, one might simply use the quarterly averages as the projection for 1994. Note, however, that the trend indicated by the straight regression line tells us that consumption is decreasing, although relatively slowly. Actually, between the first and second semesters there was a decrease of about 10%. If the person preparing the projection would like to have a bit more accuracy in the forecast for the coming year, he or she could decrease the values of the four quarterly averages by 10%. Such a correction should definitely be made if the increase from one year to the next were greater.

Figure 6 also shows this projection. This is an elementary example of *decomposition*, by means of which different aspects of a time series are calculated separately. Here, the seasonal variations and the trend are calculated in this fashion. More complicated patterns can also sometimes be extrapolated using more sophisticated variations of this decomposition technique, but the assistance of a statistician is likely to be needed for such an effort.

Depending on the purpose and scope of the forecast, it may be possible to prepare a projection which ignores the non-linear data pattern but still gives a satisfactory result. Suppose, for example, that the purpose of the forecast is to estimate an aggregate *annual* consumption figure for procurement purposes. Rather than plotting monthly data and quarterly averages as shown in Figure 6, the forecaster might plot *annual* consumption totals for several years, and then see whether the annual trend can be projected using one of the linear methods. This strategy might produce a sufficiently accurate annual estimate for Clinic 4, though it would not allow the forecaster to estimate monthly or quarterly shipping schedules.

III. PRELUDE (2): CORRECTIONS FOR MISSING OR ERRONEOUS DATA

Reporting of logistics and service data is almost never complete. There might be missing reports, incomplete reports, consolidated groupings such as several brands of oral contraceptives being grouped together and reported as "pills", etc. In some cases, current reports may be missing, but previous reports may be available.

In these cases, the reported quantities must be adjusted to account for the missing and/or consolidated data. Making these adjustments requires good judgement on the part of the forecaster, and an understanding of the trend patterns shown by the data which *are* available. The adjustment techniques are equally applicable to logistics and service data based forecasts, or indeed to any extrapolation made from a historical time series.

A. ADJUSTMENT FOR INCOMPLETE REPORTING

When data are available and of good quality, but reports from some facilities are missing, the values can be estimated by increasing the reported quantities by the percentage of missing reports. If one accepts that quantities were dispensed from the non-reporting outlets at the same rate as from the reporting outlets, the quantities should be increased by using the formula:

$$\text{Estimated Use During Period} = \frac{\text{Quantity Reported Used}}{\text{Proportion of Outlets Reporting}}$$

For example, if 85% of outlets reported 850,000 Lo Femenal orals dispensed last year, then

$$\text{Estimated Use During Period} = \frac{850{,}000}{0.85} = 1{,}000{,}000$$

Since it is frequently, but not always, the low-producing outlets that do not report, and since program locations that miss a reporting period might make up for the missing quantities on the next report, the above formula may be too simplistic. Program managers may determine (or estimate) that the 85% reporting represents 90% of the contraceptives dispensed, for

example. In such cases, this proportion should be used instead of the proportion of outlets reporting, so:

$$\text{Estimated Use During Period} = \frac{850{,}000}{0.90}$$

$$= 944{,}000$$

B. ADJUSTMENT FOR MISSING TIME PERIODS

In some programs, data will be reasonably complete for some time periods but non-existent for others. This situation occurs when facilities report routinely but sometimes neglect to report, or when reports are occasionally lost in transit. It might also occur when there is no service activity to report, either because of stockouts or some other programmatic problem.

The first step in such cases is to identify the reason(s) that data are missing, and particularly to determine whether it is likely that service activity in the missing time period(s) differed greatly from activity during the periods for which data are available. If significant differences in service activity during the time periods for which data are missing is suspected, then it will be necessary to make corrections based on expert judgement, or to undertake further data collection efforts. If no great differences in service activity are suspected, mathematical adjustments to correct for missing periods can be made. The form of such adjustments depends on the trend pattern observed in the data which *do* exist.

Where the Trend is Reasonably Stable

The easiest mathematical correction for a missing time period is just the simple average of time periods for which data do exist, made in the same fashion used in the extrapolation example above. That is:

$$\text{Estimated Use for Each Missing Period} = \frac{\text{Total Quantity Used in Other } n \text{ Periods}}{n}$$

If the existing data show a reasonably stable pattern over time, then this technique will work well. Of course, if multiple time periods are missing, the accuracy of the estimate produced using these corrections will be less certain.

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Where the Trend is Upward or Downward

If existing data show an increasing or decreasing trend over time, it may be more accurate to correct for a missing period by using the average of the period before and the period after the one for which data are missing. That is:

$$\text{Estimated Use for Each Missing Period} = \frac{\text{Quantity Used in Previous Period} + \text{Quantity Used in Following Period}}{2}$$

Returning to the example of Clinic 3 shown in Figure 2, if the forecaster had found June's data to be missing, he or she could have estimated consumption as:

$$\text{Estimated Use for June} = \frac{\text{Quantity Used in May} + \text{Quantity Used in July}}{2}$$

$$= \frac{19 + 24}{2} = 21.5, \textit{ rounded} = 22$$

Note that the "actual" consumption for June shown in Figure 6 was 23; thus this technique produced a reasonable correction in this instance.

Where the Trend Shows a Seasonal Pattern

If the data which do exist show a seasonal pattern such as Clinic 4 (Figure 2 and Figure 6), then a mathematical correction can be made only if complete data are available for a previous cycle. Such a case is shown in Figure 7: Clinic 5 had exactly the same seasonal consumption pattern in 1992 as Clinic 4's pattern for 1993, and a similar seasonal pattern (but with higher consumption rates overall) in 1993. Unfortunately, Clinic 5's report for May 1993 is missing.

In this case, the forecaster can correct for the missing data point by assuming that the proportion of total consumption for 1993 represented by May 1993 is the same as the proportion of total consumption for *1992* represented by May *1992*. The proportion is calculated simply by dividing the figure for the time period in question by the total:

$$\text{Proportion of Use Represented by a Single Period} = \frac{\text{Use in Single Period}}{\text{Total Consumption}}$$

So,

Figure 7

CONDOM CONSUMPTION IN CLINIC 5 in CY1992 and CY1993

MONTH	CY1992	CY1993
January	10	12
February	13	16
March	17	20
April	22	26
May	30	?????
June	27	32
July	29	35
August	19	23
September	21	25
October	14	17
November	11	13
December	12	14
TOTAL	225	233 + ?????

$$\textit{Proportion of Use Represented by May 1992} = \frac{30}{225} = 0.133$$

Thus, it could be assumed that May 1993 will represent 0.133 of 1993's total consumption.

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Of course, 1993's total consumption is not known, since May 1993's data are missing. However, the 1993 total figure can be estimated using the process for incomplete reporting discussed above. In this case the formula would be:

$$\text{Estimated Total Use} = \frac{\text{Quantity Reported Used}}{\text{Proportion of Total Use Reported}}$$

The proportion of 1993's use which *was* reported is 0.866 (i.e., everything but the 0.133 assumed to represent May 1993), and the 1993 consumption excluding May's figure was 233, as shown in Figure 7. Thus,

$$\text{Estimated Total Use for 1993} = \frac{233}{0.866} = 269.05$$

Finally, it is necessary only to multiply this estimated total by May's estimated proportion to arrive at the correction for the missing data point. The formula is simply:

$$\text{Estimated Use for Missing Period} = \text{Estimated Total Use} \times \text{Proportion of Use Represented by Period in Previous Year}$$

So,

$$\text{Estimated Use for May 1993} = 269.05 \times 0.133 = 35.7, \textit{ rounded} = 36$$

Of course, it is quite possible that data for multiple time periods will be missing, so that there are no complete data sets to which these formulas can be applied. In such cases, the forecaster can go back to the graphical representation of the data and fill in the missing points by eye, or choose to make further field visits to try and collect the missing reports.

C. ADJUSTMENT FOR BOTH INCOMPLETE REPORTING AND MISSING TIME PERIODS

It is also possible that reporting will be incomplete *and* that data for some periods will be missing. The above formulas can be applied sequentially to make such corrections. When this is necessary, the correction for incomplete reporting should be made first, and then the appropriate formula for correcting for missing data should be applied.

IV. ESTIMATING CONSUMPTION USING TRENDS IN LOGISTICS DATA

All of the preceding examples are projections based on quantities of product dispensed to users (and assumed to be consumed). In programs where data from the logistics MIS are complete and of good quality, consumption can be determined directly from the output. It is only necessary to follow the above procedures, choosing the most appropriate technique for extrapolation and correcting for missing data, to prepare the consumption-based forecast. Because these procedures require very few assumptions on the part of the forecaster, consumption-based projections normally provide the best basis for short- and medium-term forecasting of future product use. Of course, brand new programs will not have historical data of any kind, and therefore cannot use this projection method at all.

A. DATA SOURCES AND LIMITATIONS

Historical consumption data are drawn from the program's LMIS, and may be variously referred to as "distribution," "sales," "dispensed to users," or "issues" data. As mentioned above, reports of **quantities dispensed to clients** at the lowest level in the distribution system should be used wherever possible, since future trends in these figures are precisely the phenomenon which you are trying to predict. When data from the lowest level are incomplete or otherwise problematic, the forecaster must use distribution data from the next level up in the system, or the lowest level at which the data can be considered to be reasonably complete and accurate; it is usually necessary to strike a balance between completeness of reporting and nearness to the lowest level. Great caution must be used, however, in substituting issues data from a higher level for dispensed to user data: if the lowest-level facilities are stockpiling commodities (or letting them expire or be lost), issues data may be completely unrelated to actual consumption.

Some of the strengths and weaknesses of logistics data for forecasting are summarized in Figure 8. In general, the data sources for consumption figures are:

- the reporting system, or LMIS, where contraceptives dispensed to users are reported directly from outlets on a monthly or quarterly basis;
- receiving records;
- records of contraceptives issued and/or dispensed;

Figure 8

FORECASTS USING LOGISTICS DATA

ADVANTAGES	DISADVANTAGES
Based on the quantity you are trying to predict: consumption	Assumes that the future will be similar to the past
Requires few assumptions	Assigns equal value to old and new experience
Automatically takes distribution/ service delivery constraints into account	Incorrect if there have been instances of over- or under-supply (or stockouts) in the past
Easy to understand and to prepare	Often ignores losses
Requires little knowledge of forecasting	May confuse distribution (issues) with consumption (dispensed to user) data
Easy to systematize and institutionalize	Does not take into account changing program plans

- records of stock accounting and/or monitoring, the principal one being inventory control records;
- financial records, including budgets, records of payment, and so forth;
- shipping records of supplier(s); or
- records of physical inventories.

B. EVALUATING THE QUALITY OF LOGISTICS DATA

Unhappily, many programs lack complete and accurate dispensed to user data. The initial activity in these cases becomes the evaluation of the data available.

The quality of any data source depends on three factors:

- The design of the data collection system;

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- The accuracy of the data; and
- The completeness of the data.

The *appropriateness* of the system design can be evaluated by:

- Determining if all the data required (in this case, consumption or dispensed to user data) are collected and reported by the system;
- Assessing the difficulty of data collection, entry and processing;
- Assessing the completeness and format of the output;
- Determining if the instructions for operating and maintaining the system are clear and complete;
- Determining if the system is overburdened by "nice to know" but unnecessary data; and
- If the system is automated, determining whether data are collected, entered and processed in a timely manner.

If consumption data are not gathered, or are gathered by a system so tortuous that its output is clearly unreliable, then the program's routine reporting system cannot be used to prepare the forecast.

By *accuracy* we mean that the data reported up through an information system are true representations of the parameters being measured. The accuracy of MIS or LMIS reports can be checked in a representative sample of entities reporting by comparing the reports from higher levels with local records. Such verification, even if done in only a small sample of sites, must be made before the forecaster can proceed with confidence in preparing a consumption-based forecast. This is sometimes impossible because no records are maintained by those reporting, or because the records are inaccurate. For example, losses and/or contraceptives borrowed from another outlet might not be recorded or reported. The verification effort will reveal any such problems.

If the MIS is automated, the accuracy of the data entered into the computer system must also be checked by comparing a number of reports with their corresponding entries in the database.

Completeness of the data can be checked by:

- Determining whether reporting is up to date;

- Counting the number of reports submitted and comparing this with the number required; and
- Determining if all data required are contained in each report.

Appendix 2 contains more complete guidelines for assessing a Logistics MIS. Common problems with LMIS data, along with possible solutions, are summarized in Figure 9.

C. CORRECTING FOR FLAWED LOGISTICS DATA

At the conclusion of these investigations, the forecaster must decide whether the quality of available data are sufficient to proceed with a logistics-based forecast. A number of techniques beyond those discussed above can be used to compensate for common flaws in these data, as follows.

When Consumption Data Do Not Exist

The scarcity of reliable stock balance and consumption data from the service delivery level of many programs, combined with the intractable nature of this constraint, has lead logisticians to seek substitutes or surrogates for consumption data. Unfortunately, adequate substitutes do not exist. However, the need for commodity planning to proceed and to proceed quickly, even in unfavorable circumstances, has lead to the common practice of substituting issues data as a proxy for consumption. Thus, for example, it is common to assume that everything which the central medical store has issued to the districts during a particular time period has been dispensed, and that this figure can be taken as the level of total consumption.

In a perfectly operating Maximum-Minimum (Max-Min) inventory control system[1], stock is issued on a replacement basis, and the quantities issued from any program level will be very close to consumption. However, a Max-Min system can operate perfectly only if its information system operates perfectly, since the control procedures are based on consumption data. Thus where consumption data are not available, it must be presumed that the inventory control procedures do not work well. In such cases, using issues data as a surrogate for consumption will only perpetuate current and past stock imbalances and forecasting errors. The higher the level in the distribution system from which issues data are used, the greater the possibility of grievous error.

This does not mean that it is impossible to prepare the projections at all, or that there is nothing to be done. In small countries, a quick review can be made of most or all higher

[1] For a full discussion of maximum/minimum inventory control systems, see, for example, WHO's Managing Condom Supplies, or CDC's Logistics Guidelines (references in Appendix 1).

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Figure 9

LOGISTICS DATA: PROBLEMS AND SOLUTIONS

PROBLEMS	TYPICAL SOLUTIONS
Issues Data vs. Dispensed to User Data	- Use data from lowest level available - Beware of double counting - Check inventory control and data collection processes
Incomplete Data	- Compensate through extrapolation and interpolation - Adjust for factors such as volume and seasonality
Timeliness	Same as for incomplete data

Data Quality/Reliability	- Are data recording and reporting procedures understood and followed?
	- Cross check:
	  - dispensed to user records with stock records
	  - stock records with actual stock levels
	  - records from different levels on movement of same stock
	- Validate with other forecasts

Right data not collected	- Collect correct data
	- In case where records/reports are kept by method, not brand:
	  - limit number of brands to one
	  - do a clinic survey to determine brand mix

Stockouts and Stock Imbalances	- Compensate through extrapolation or interpolation, if not severe - If severe or prolonged, don't use
Losses not distinguished from consumption	Reduce consumption by estimated losses

level facilities and a sample of service delivery points (which should include those involving the highest volume of contraceptive service production, or perhaps all of them). In larger countries, only a smaller sample of outlets can be visited, along with a larger proportion of higher-level facilities. In either case, the review should follow one or more distribution channels from top to bottom (or from bottom to top). At each level, physical counts of stocks on hand should be taken and compared to inventory records, receipts data should be cross-checked with issues data from the level above, and issues data should be cross-checked with receipts data from the level below. This review can be used to collect data geared toward preparing a reasonably good estimate of consumption and verifying the quality of distribution data from the vantage point of the upper organizational levels.

In some countries where information systems are quite inefficient, such a review is conducted annually, not only to collect information on service production and contraceptive supply but also for purposes of supervising, evaluating and gradually improving the information system[2]. This special effort is perfectly feasible in most situations, and is even more important when the quantities of contraceptives donated or distributed are large.

Inventories and service statistics can be complemented with small surveys taken of samples of clients, conducted with a view toward finding out how much those clients normally purchase (or consume) in a given period of time, for example, one month or a week. In this way, annual or quarterly consumption can be calculated both easily and accurately. If these mini-surveys are conducted each year, comparison can be made against the results obtained in prior years in order to establish trends in consumption.

All of these are very simple techniques, within the reach of any country or any organization, providing that there is an interest in good management, common sense and the responsibility for managing the program's resources. In all countries, even the least developed, there are firms specializing in marketing, advertising and survey-based market studies. It is generally cheaper and more efficient to contract one of these local agencies to conduct such surveys, rather than to train the staff of family planning organizations or to leave such studies to foreign experts.

When Consumption Data Are Not Reported

If consumption data are not gathered or reported but other logistics data are, stock records can be used to estimate historical consumption patterns. These records must include receipts, issues, and inventory levels for (at least) the most recent two years, preferably for the lowest level in the distribution system. Ideally these data would be available for all program locations over a longer period of time. Where these data exist, consumption can be

[2] Procedures for taking these *physical inventories* can also be found in CDC's Logistics Guidelines or in WHO's Managing Condom Supplies (See Appendix 1).

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estimated, or "forced out", by adding receipts during the year to the beginning inventory and subtracting the ending inventory. Mathematically:

$$\begin{array}{c}\textit{Estimated Use}\\ \textit{at Lowest Level}\\ \textit{During Period}\end{array} = \begin{array}{c}\textit{Beginning Inventory}\\ \textit{at Lowest Level}\end{array} + \begin{array}{c}\textit{Receipts}\\ \textit{at Lowest Level}\end{array} - \begin{array}{c}\textit{Ending Inventory}\\ \textit{at Lowest Level}\end{array}$$

If receipt data from the lowest level are not available, issues data from the next higher level could be used instead.

There are dangers in using this technique. First, the formula makes no allowance for losses or expiration; all product is assumed to have been dispensed to users. This problem is discussed further below. Substituting issues data from the next higher level corresponds to an assumption that no product is lost in transit, which may also be untrue.

In cases where field inventories are not available at all, it is common to apply this technique with data from the central store and, perhaps, the next level or two down. This is even more dangerous, since the above problems may exist at *every* level, thus compounding errors of estimation. Worse, inventory fluctuations at lower levels are ignored: applying the formula at, say, the district level corresponds to the assumption that district level issues equals service delivery level consumption, and further assumes that lower level inventory control systems are completely functional. These assumptions are questionable at best, and should be verified by site visits to selected outlets. It may well be true that commodities are simply piling up at the lowest level unused, or worse, that the outlets have used *everything* and run out of stock. It is much preferable in such cases to take an inventory at least at a sample of outlets, as described above. In any event, field inventories collected should be recorded and preserved, because they will be needed when estimates of quantities to be procured are prepared.

When Consumption and Losses Are Not Distinguished

Even where consumption data are reported from the lowest to the highest level, there may be no data that indicate the quantities of a product that were used and the quantities that were lost, so that it is necessary to assume that everything not still in storage was consumed. This assumption overestimates use by the amount of losses that actually occurred, with the result that the next forecast overestimates consumption and may well lead to oversupply and additional losses in the future. An essential task for the forecaster is thus to investigate whether this is happening, and, if so, to reduce reported consumption figures by the estimated amount of losses. Chapter XI of this manual discusses procedures for estimating losses.

When There Were Stockouts (or Changes in Demand)

It is important to understand that even where logistics records accurately reflect true consumption, they might not reflect true demand. Some instances where this might be true are when certain contraceptives are out of stock for extended periods and/or when staff have not been properly trained in prescribing contraceptives.

If stockouts were a problem during the period covered by the historical data, it may be possible to adjust the consumption data to reflect true demand using a formula similar to the one used for missing reports. That is:

$$\text{Estimated Consumption During Period} = \frac{\text{Quantity Reported Consumed}}{\text{Proportion of Time Stocks Were Available}}$$

For example, if outlets reported 850,000 Lo Femenal orals dispensed last year, and it is known that they were stocked out on average 25% of the time, then

$$\text{Estimated Consumption During Period} = \frac{850{,}000}{0.75} = 1{,}133{,}333$$

This calculation assumes a more or less even distribution of stockouts during the period. In adjusting actual consumption data in a time series as discussed above, it is important to verify this assumption. If, for example, all the outlets were stocked out during the last quarter (due, say, to a missed shipment), and if consumption had until then been rapidly rising, the above formula would *under*adjust the consumption figures.

It is also important to note that facilities may be effectively stocked out even though inventory records do not show zero stock balances. It is common for staff to hoard small (or large) quantities in under-supply situations, for emergency use or other reasons. The forecaster must be alert to this possibility, looking for situations in which stock is not moving in addition to actual stockouts.

Stockouts are not the only reason that consumption may under-estimate (or over-estimate) true demand. Other constraints at the service delivery points, as well as the program's service delivery policies, may significantly influence quantities dispensed to users.

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D. COMPLETING AND ADJUSTING THE LOGISTICS DATA BASED FORECAST

When the necessary corrections to historical consumption figures have been made, the forecaster can complete an initial logistics data based forecast by direct extrapolation, as described in Chapter II. An example of such a forecast for the fictitious country of Anyland is shown in Appendix 6.

Remember, however, that extrapolation by definition assumes that the future will repeat the patterns of the past. This assumption may be entirely false: future program plans, such as opening a new clinic or beginning an intensive education and distribution program, may mean that future consumption patterns can be expected to be quite different than the past.

The forecaster, working with program managers, must take these differences into account in adjusting the logistics data based forecast. If new clinics are opening, it may be possible to gain some understanding of their likely growth patterns by examining historical consumption data from old clinics with similar catchment areas. Similarly, consumption patterns around the time of past IEC programs may give an indication of the likely result of new IEC programs. Where such data exist, they should be used to quantify the anticipated effect of new program plans on the consumption forecast. Perhaps the most difficult adjustments are those required when a new contraceptive method is introduced: such changes may well cause *decreases* in consumption for other methods, rather than increases.

In any case, the forecaster *should not* simply add a percentage to account for program growth to the estimate for every commodity. This "last year plus ten percent" method of projection is perhaps the most common and least accurate of forecasting methods; almost no programs show such a historical pattern of growth.

Other forecasting methods that more readily reflect such changes in program plans and operating environments are discussed in the following chapters.

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V. ESTIMATING CONSUMPTION BASED ON SERVICE STATISTICS

Consumption projections based on service statistics are made using the extrapolation techniques described in Chapter II. An additional step, however, is needed to convert the resulting service variable projections into consumption estimates. This conversion requires additional assumptions which may reduce the accuracy of the service based forecast.

A. DATA SOURCES AND LIMITATIONS

Service data are taken from regular management reports at service delivery sites. In some programs, no such data are available; others may keep a variety of measures of services provided. The most commonly counted service statistics are:

- *New Acceptors* or *New Clients*: the number of persons visiting a program and accepting a method for the first time[3];
- *Revisits*: the number of repeat visits made by all clients during a particular time period;
- *Users* or *Current Users*: the number of individuals who are users of a particular method at a particular point in time, whether or not they have actually made a visit during the reporting period.

Note that these data items measure quite different things. New Acceptors/New Clients counts the number of unique individuals new to the program, method, or modern contraception (depending on the definition being used) during this reporting period. The sum of New Acceptors plus Revisits equals the total number of visits made during the time period: if a single individual made three visits, he or she would be counted three times. Users or Current Users, on the other hand, would count this individual only once. User/Current User figures are very difficult to collect from service statistics data except in

[3] There are several slightly different variations of this data item in common use: USAID's EVALUATION Project, in the Handbook of Indicators for Family Planning Program Evaluation for example, lists three different possibilities: *Number of Acceptors New to Modern Contraception* (i.e., clients accepting for the first time in their lives); *Number of Acceptors New to the Institution* (i.e., clients accepting for the first time from a particular service system); and *Number of New Segment Acceptors* (i.e., clients new to a particular contraceptive method).

programs which have sophisticated computer systems to track individual clients, and the general trend today is to discourage programs from attempting to gather such data routinely.

If New Acceptor/New Client and Revisit data are available, they can be used to forecast commodity requirements. Some advantages and disadvantages of service statistics for forecasting purposes are shown in Figure 10. The most important limitation of these data for commodity forecasting is that a specific assumption must be made regarding the amounts dispensed at each client visit.

Figure 10

FORECASTS USING SERVICE STATISTICS

ADVANTAGES	DISADVANTAGES
Automatically takes distribution/ service delivery constraints into account	Requires critical assumption regarding dispensing protocols
Easy to modify forecast to account for program service targets	May assume that the future will be similar to the past
Focuses discussion on client services	Assigns equal value to old and new experience
Easy to understand and not difficult to prepare	Incorrect if services have been interrupted for any reason
Requires little knowledge of forecasting	Definitions of critical data items (e.g., "new client", "revisit", "new user", "user", "continuing user") likely to be unclear or inconsistently applied
Easy to systematize and institutionalize	Brand-specific data (or even method-specific data) may not be gathered
	Will produce unrealistic forecast if service targets are unrealistic

Basic service statistics data should be available from an organization's MIS, and dispensing policies should be found in the organization's policies and procedures or training materials. Unfortunately service statistics reporting systems are frequently very weak, and dispensing practices may not be standardized, or standards may not be enforced.

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B. EVALUATING THE QUALITY OF SERVICE DATA

This data source, like logistics data, might suffer from inaccuracy because of poor reporting system design, non-reporting, and/or inaccurate reporting. Comments in the previous chapter regarding appropriateness, accuracy, and completeness of logistics data apply equally to service statistics, and the same processes of information system evaluation and field verification of data should be applied before a decision to prepare a service-based forecast is taken. This evaluation can of course be completed simultaneously with the logistics information system analysis.

In addition to the above questions, there may be problems with service statistics definitions. Different programs, sometimes within the same country, will use different definitions for "new acceptor", "continuing user", "active user", and so on; these definitions may be so imprecise that reporting is not uniform within the program, so that the data are virtually useless for logistics purposes. Some service statistics systems only report the numbers of "first visits" and "subsequent visits" for family planning services. These systems might not specify the method being used, and many of those which do will not specify brands.[4] Figure 11 summarizes common problems with service statistics data sources, along with common solutions.

Any of these difficulties may preclude preparation of a service-based forecast, and it is the task of the forecaster and the program planners to decide whether or not to proceed. It is important that this decision be made pragmatically. Great amounts of intellectual energy have been spent, for example, in efforts to arrive at the "correct" definition of a new client. Should a client be counted as "new" at the first visit to a particular clinic, or at the first visit anywhere in the program? Unless the client population is extremely mobile, the difference in service totals produced by these two definitions will be small, and for most routine management purposes can be ignored. This conclusion is especially true where there are also other problems with the data (like a 20% rate of non-reporting) for which large adjustments must be made, or for longer-range planning decisions, where other variables are even more imprecise.

It is suggested that service-based forecasts be prepared only in cases where the following conditions are met:

- The service statistics reporting system reports data on *Visits* (either in total or broken down by *New Acceptors/New Clients* and *Revisits*);

[4] For a more detailed discussion of appropriate definitions of service statistics indicators, see the EVALUATION Project's Handbook of Indicators for Family Planning Program Evaluation.

Figure 11

SERVICE STATISTICS DATA: PROBLEMS AND SOLUTIONS

PROBLEMS	TYPICAL SOLUTIONS
Definitions: - unclear - reporting and recording procedures not understood or followed	If not clearly defined or correctly collected, don't use - Clearly define each statistic - Ensure that service statistics recording and reporting procedures are understood and followed
Visits - Do clinic personnel know and follow guidelines for number of units to dispense to clients?	- If no guidelines or not uniformly followed, don't use - If guidelines are known and followed, multiply number of visits by standard quantity dispensed to convert to quantities of contraceptives
Users	Don't use for commodity forecasting
Timeliness / Incomplete Data	- Compensate through extrapolation and interpolation - Adjust for factors such as volume and seasonality
Lack of Brand-Specific Data	- Use method-specific data as upper boundary for aggregate brand estimates made by another method (e.g., logistics-based) - Do a field-based study of brand mix

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- *Method Mix* can be determined, either because Visit data are reported by method or brand, or because other data exist that allow the forecaster to reasonably estimate a Method Mix breakdown to apply to total visits; and

- *Prescribing protocols* are reasonably standardized throughout the program, so that commodity use can be calculated from the service forecast as described below.

C. COMPLETING AND ADJUSTING THE SERVICE DATA BASED FORECAST

If the decision is made to proceed with a service-based forecast, then graphs of historical data should be prepared as described in Chapter II, and the appropriate extrapolation technique should be used to make the forecast. If reporting of service data are incomplete, the formulas shown in Chapter III can be used to adjust for missing data. Depending on the prescribing protocols of the program, it may be necessary to make different consumption calculations for different types of visits, or at least for New Acceptors and for Revisits, for the reasons discussed below.

Adjusting the Projection Based on Program Plans

It is common for service delivery programs to phrase both short- and long-term plans in terms of service delivery targets, i.e., anticipated numbers of New Acceptors and Revisits, either in total or broken down by method. These plans must of course be accommodated in the forecasting process, through discussions with program managers and planners. Indeed, the primary advantage of a service-based forecast is that it can readily be adjusted to reflect changing program plans and priorities, since the forecast is prepared using the same variables as the plan. The formulas for estimating consumption presented below can be applied equally well to service targets or to estimated service levels extrapolated from historical data.

A major service that the forecaster can provide in this process is precisely the comparison of service targets to extrapolations based solely on historical data. Since planning targets are frequently *very* optimistic, a compromise between such plans and historical reality is usually required. Another frequent error is the planning assumption that use of all methods will increase uniformly over time — the "last year plus ten percent" method of forecasting again. As stated previously, this assumption is almost always wrong. While a new program may initially experience growth in every method, more mature programs will usually experience a gradual shift from less effective traditional methods to more effective modern methods, and from temporary modern methods to permanent. As this transition occurs, consumption for

some methods may actually *decrease*. These trends can also be identified through service-based forecasts made using actual historical data.

Calculating Commodity Consumption from Visit Projections

Once the forecasts of the service data are prepared and agreed upon, commodity consumption for the projected service levels can be estimated. Figure 12 and Figure 13 show sample service statistics data for 1993 and an extrapolation for 1994 which will be used to illustrate these calculations.

Figure 12

CY1993 SERVICE ACTIVITY AT CLINIC 5 AND PROJECTIONS FOR CY1994
Oral Contraceptives

MONTH	1993 (Actual)		1994 (Projected)	
	NEW ACCEPTORS	REVISITS	NEW ACCEPTORS	REVISITS
January	2	10	2	16
February	3	10	2	16
March	2	11	2	17
April	1	11	2	17
May	2	12	2	18
June	3	12	2	18
July	2	13	2	19
August	1	13	2	19
September	2	14	2	20
October	3	14	2	20
November	2	15	2	21
December	1	15	2	21

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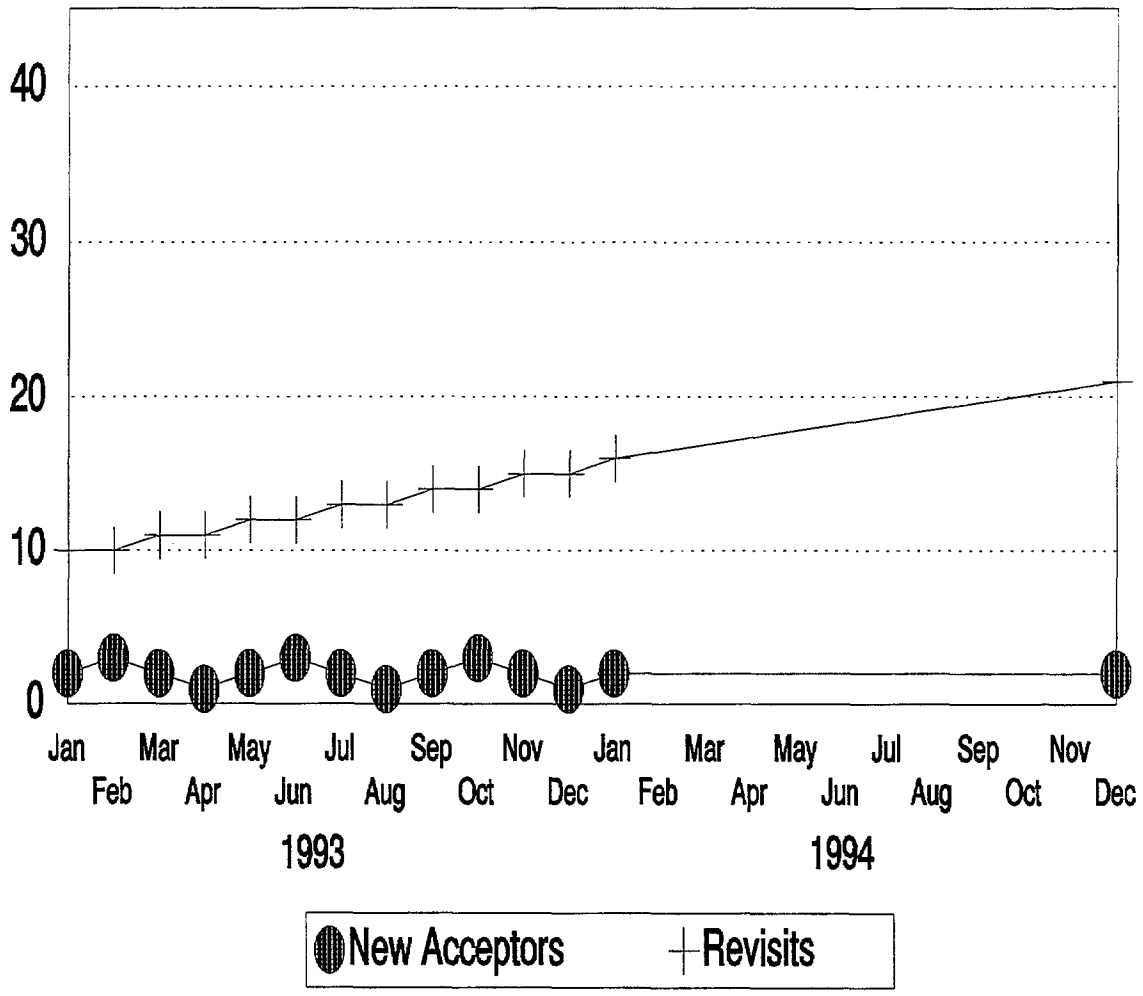
FIGURE 13

CY 1993 SERVICE ACTIVITY AT CLINIC 5 AND FORECAST FOR 1994: ORALS



Most programs have stated policies on the quantities of contraceptives to be dispensed when clients visit an outlet. For example, the policy might be, "Clients who accept oral contraceptives for the first time are to be given one monthly cycle (mc) at the first visit and three mc on subsequent visits, providing there are no contraindications". If all outlets followed this policy and there were never any contraindications, pill use could be estimated by adding the number of first (or initial) visits by pill clients to three times the number of subsequent visits (or revisits). That is, for each type of visit and method:

$$\begin{array}{c}\textit{Estimated Use}\\ \textit{for Next}\\ \textit{Period}\end{array} = \begin{array}{c}\textit{Estimated}\\ \textit{Total Visits}\\ \textit{of this Type}\end{array} \times \begin{array}{c}\textit{Quantity of Product}\\ \textit{Given at Each Visit}\\ \textit{of this Type}\end{array}$$

Using the above dispensing policy and the data for Clinic 5 from Figure 12,

$$\begin{array}{c}\textit{Estimated Use}\\ \textit{for}\\ \textit{1994}\end{array} = \left(\begin{array}{c}\textit{Estimated}\\ \textit{New Visits}\\ \textit{for 1994}\end{array} \times 1\ \textit{mc}\right) + \left(\begin{array}{c}\textit{Estimated}\\ \textit{Revisits}\\ \textit{for 1994}\end{array} \times 3\ \textit{mc}\right)$$

$$= (24\ \textit{New Visits} \times 1\ \textit{mc}) + (222\ \textit{Revisits} \times 3\ \textit{mc})$$

$$= 690\ \textit{monthly cycles}$$

In this example, commodity usage for initial visits and revisits must be calculated separately, because the program policy for contraceptive distribution differs by visit type. Where the program policy does not distinguish among visit types ("All condom clients are given twelve condoms at each visit."), only one calculation would be required.

This type of calculation is relatively accurate when the policy regarding quantities dispensed in each visit is followed faithfully in all or almost all service outlets. But this rarely occurs because the quantity purchased differs from one client to another (when contraceptives are sold) and even where they are provided free of charge, the norm may vary from time to time, or from one site to another. When there are shortages, the amounts given may be reduced; when large amounts of stock are about to expire, it may be advisable to increase the amount dispensed. Increases may also occur when service delivery points are being pressured by their supervisors to produce a high level of distribution.

Where such difficulties exist, the forecaster and program managers must agree on necessary adjustments to the computation of commodity needs. Of course, the degree of confidence in the final forecast depends on the accuracy of these adjustments. At minimum, dispensing practices should be explicitly investigated at a sample of service delivery points before these decisions are made.

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A complete example of a service data based forecast for the fictitious country of Anyland is included in Appendix 6.

VI. ESTIMATING CONSUMPTION USING POPULATION DATA

Both of the preceding forecast methodologies use the trends shown by historical data to predict future patterns of contraceptive consumption. A different forecasting technique uses demographic data from the Demographic Health Surveys (DHS's) and other sources of population and family planning data to estimate future contraceptive demand. Because such surveys are usually taken at infrequent intervals, often with changes in the questions asked from one survey to the next, there are rarely enough comparable historical data points to apply the extrapolation methodologies discussed above.

It is still possible, however, to prepare a forecast using such survey data, based on worldwide historical experience and country- or program-specific targets. This methodology requires estimating the Contraceptive Prevalence Rate (CPR) at the beginning year of the forecast, setting a target level for CPR in the ending year, and interpolating an estimated CPR for each interim year. The number of full-time contraceptive users required to achieve these estimated levels of prevalence are then calculated. Finally, user figures are converted into contraceptive quantities using the Couple Year of Protection (CYP) conversion factors, which are simply the estimated quantities of contraceptives required to protect a couple from unwanted pregnancies for one year.

A major consideration in making a demographic data based forecast is that its accuracy depends upon the accuracy of the estimated, or target, CPR. Setting an appropriate target CPR requires familiarity with the program and country in question, as well as an understanding of the historical precedents regarding rates of CPR change in developing countries. Target setting is further complicated because many family planning programs have set five or ten year CPR targets which are overly optimistic.

On the other hand, this methodology has a significant advantage over logistics and service statistics based forecasts in that it does not require historical program data. Consequently, demographic data based forecasts are particularly appropriate when historical service or logistics data are unavailable or inaccurate, as well as for new programs which lack historical data altogether.

By the same token, population based forecasts do not automatically take into account limitations of the service delivery or logistics systems, precisely because they are not based on historical performance data. Further, even if a population based forecast accurately reflects demand in the population at large, important assumptions must be made regarding the portion of that demand which will be fulfilled by a particular program. While population based forecasts may give an accurate estimate of need, such estimates may not be reflective of quantities clients will actually demand, nor of quantities that they will finally consume.

These issues mandate additional assumptions which may further reduce the accuracy of the forecast.

For these reasons, population based projections are more often used for longer-range forecasting, or for validation of short-term forecasts made by other methods. Figure 14 summarizes some of the strengths and weaknesses of population-based forecasts.

A. DATA REQUIREMENTS AND SOURCES

Population/family planning data are the results of survey, census, or operations research studies for a geographical area or specific population group. The key demographic data for contraceptive forecasting are:

- *Number of Women of Reproductive Age (WRA)*: the number of women in their reproductive years (15 - 49);

- *Percentage of WRA Married (MWRA), or in Union*: used as an estimate of the percentage of WRA who are potentially at risk of pregnancy;

- *Population Growth Rate*: the annual rate of population growth, measured as births minus deaths plus migration, or more commonly, the *Rate of Natural Increase*, which is just births minus deaths. It is important to note that these rates measure the growth of the entire population, not a sub-population such as MWRA;

- *Total Fertility Rate (TFR)*: The average number of live births a woman would have if she survived to the end of her child-bearing years, and had births at the prevailing age-specific rates.

- *Contraceptive Prevalence Rate (CPR)*: the percentage of the base population (WRA or MWRA) using a contraceptive method, frequently disaggregated by modern vs. traditional methods and by individual contraceptive methods;

- *Method Mix*: the mix of contraceptive methods used by the population, expressed as the percentage that each method constitutes of all contraceptives used;

- *Source of contraceptives*: the source of supply for contraceptives as reported in the DHS. This is important because most prevalence

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Figure 14

FORECASTS USING POPULATION DATA

ADVANTAGES	DISADVANTAGES
Independent of existing service delivery system(s)	Does not automatically take account of service delivery or logistics system limitations
Does not suffer data limitations of other methods (missing reports, incomplete data, low quality of recording/reporting)	Requires critical assumption for client usage rates of each method (CYP factor)
Where survey design is sound and data processing rigorous, may provide more accurate estimates of consumption	Since contraceptive source data usually inadequate, requires critical assumption regarding portion of total demand to be met by program
Provides estimate of maximum need or demand	Often requires critical assumptions regarding trends in Total Fertility Rate, Contraceptive Prevalence Rate, method mix, which may be overly optimistic
Usable in new programs with no historical data	Subject to sampling and non-sampling errors (particularly for methods with very low prevalence)
	Data rarely broken down by brand
	Survey data on condom use as backup method or for AIDS/STD prevention usually inadequate
	Survey data frequently very old
	Losses cannot be estimated from survey data alone

surveys report on all national use whereas most forecasts are directed toward a specific program (e.g., the MOH public sector program).

These population data are typically available from one of several sources:

- *Demographic and Health Surveys (DHS's):* a regular world-wide series of surveys, including such indicators as Total Fertility Rate (TFR), percent of women in union, Contraceptive Prevalence Rate (CPR), source of family planning services, and Method Mix, published by Macro International, Inc., under contract to the U.S. Agency for International Development (USAID).

- *Reproductive Health and Family Planning Surveys:* a series of national surveys, similar to the DHS, conducted primarily in Latin America and the Caribbean. These surveys are coordinated and published by the U.S. Centers for Disease Control and Prevention (CDC), Division of Reproductive Health.

- *National censuses:* complete population counts taken at a particular point in time, typically every ten years. These detail the age and sex structure of a national population and of various sub-populations, providing figures for Women of Reproductive Age (WRA) as well as percent Married (MWRA) or in union;

- *Intercensal surveys:* sample surveys conducted between national censuses, which also provide data on WRA or MWRA.

- *Other local or national population or family planning surveys:* additional surveys made for a variety of reasons by national or local governments, foreign donors, or others which report population, family planning, or AIDS data in some form.

- *World Population Prospects:* population projections published every other year by the United Nations Department of International Economic and Social Affairs Statistical Office. These provide estimates of future levels of demographic variables, including TFR and WRA.

- *Levels and Trends of Contraceptive Use as Assessed in 1988*: historical contraceptive prevalence information by country, published by the United Nations Department of International Economic and Social Affairs Statistical Office. This is the essential data source for setting CPR targets; an updated version is expected shortly.

- *World Contraceptive Use 1994 (Wall Chart)*: a summary of CPR trends and other data from Levels and Trends of Contraceptive Use, published by the United Nations Department for Economic and Social Information and Policy Analysis, Population Division.

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- *The International Data Base*: population projections to the year 2005, by age and sex, for all developing countries, published by the Center for International Research of the U.S. Census Bureau. This data base is particularly useful for obtaining yearly estimates of WRA.

- *PRB World Population Data Sheet:* current worldwide estimates of family planning and demographic data, including total population, TFR, CPR, and annual rate of natural increase, published by the Population Reference Bureau (PRB).

B. EVALUATING THE QUALITY OF POPULATION DATA

Of the above sources, the DHS's are considered the most useful for making a demographic data based forecast. However, even where recent DHS's are available it will be necessary to look at other sources for numbers of WRA and for guidance in setting CPR targets. And while it is desirable to use local survey data when preparing contraceptive estimates, it is essential that the forecaster assess such local surveys for methodological flaws which may cause the data to be unusable.

There are countries which lack any of these surveys, or for which the most recent survey is so old or so flawed that it cannot be used with any degree of confidence. In such cases, a population data based forecast cannot be made. Where population data appear serviceable, it is sometimes necessary to adjust data from older surveys to obtain current estimates. In any case, one must be careful to use the same population in the forecast as that from which the survey sample was drawn.

Figure 15 summarizes common problems encountered in using population data for forecasting, along with possible solutions.

Figure 15

POPULATION DATA: PROBLEMS AND SOLUTIONS

PROBLEMS	TYPICAL SOLUTIONS
Old Data	- If it's more than five or six years old, don't use it
Unreliable Data due to Sampling or Non-sampling Errors	Don't use it

PROBLEMS	TYPICAL SOLUTIONS
Lack of Program-specific Data	- Get program-specific data - Estimate proportion from national data, if possible - Use national data as upper boundary for forecast
Biases in survey data	- Be aware of them - % WRA married often underestimates % WRA at risk - may need to adjust up
Lack of Brand-specific Data	- Use method data as upper boundary for aggregate brand estimates made by another method (e.g., logistics-based) - Do a field based study of Brand Mix
CYP Conversion Factors	- Use country specific CYP factors whenever possible - If none, use global recommendations
Data do not Account for Multiple Method Use (e.g., condoms as Backup)	Adjust CYP factor to compensate, or, preferably, prepare separate projection for condom use for AIDS/STD prevention
If Target-based Projection: Overoptimistic Targets	Use established guidelines regarding program growth, etc.
Partial Data e.g., regional operations research data	Decide how representative it is of country as a whole; if it is, can extrapolate
Survey Data Does Not Account for Losses	Estimate separately and adjust requirements estimate

C. STEPS IN PREPARING THE POPULATION DATA BASED FORECAST

Preparation of a population based forecast requires conversion of population data into estimates of commodities needed for the various time periods covered by the forecast. In particular, the forecaster must:

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1. Gather the necessary demographic data (WRA, percent in union, Method Mix, CPR) for the beginning year of the forecast from the various sources listed above, adjusting if necessary for data which are out of date.

2. Forecast changes in WRA, CPR, and Method Mix (and in other variables if necessary) over the time period of the forecast.

3. Prepare estimates of commodity consumption for meeting the demand implied by these population parameters.

Each of these steps is discussed in turn below.

D. GATHERING AND ADJUSTING DATA FOR THE BEGINNING YEAR OF THE FORECAST

Appendix 3 contains FPLM's guidelines for preparing projections using the Futures Group's Target-Cost model. It includes an annotated example of the data needed for a population based forecast, taken from actual source data for Kenya and showing the format in which population data are typically available. Similar data, for the fictitious country of Anyland, are summarized in Figure 16.

Two common difficulties with population data based forecasting are immediately apparent from Figure 16: no single source will contain all the necessary data for the forecast, and the data from different sources are likely to be from different time periods. In this example it was necessary to use five different sources — the country DHS, the International Data Base of the U.S. Census Bureau, the PRB World Population Data Sheet, local logistics data, and the U.N.'s Levels and Trends in Contraceptive Use. While the DHS and PRB data are both from 1993, the U.S. Census WRA figure is from 1990, three years out of date.

Choosing the Base Year for the Projection

Adjusting old data to obtain current estimates of population parameters is time consuming and problematic, potentially requiring the forecaster to make assumptions about trends in many of the variables shown in Figure 16, and possibly introducing significant error in the forecast. In order to minimize the number of such adjustments, it is recommended that the date of the survey which is used as the major data source for the projection be chosen as the base or starting year of the forecast. In the example of Figure 16, the 1993 DHS is the source of most of the data items, so 1993 should be selected as the first year of the projection, even if 1994 is the first year for which a forecast is actually desired.

Figure 16

POPULATION DATA FOR ANYLAND
For 1993 Base Year Forecast

DATA ITEM	SOURCE	VALUE
Beginning (Base) Year: 1993 Ending Year: 1996		
Women of Reproductive Age (WRA)	U.S. Census Bureau International Data Base (1990)	4,940,447
Annual Rate of Population Increase	PRB World Population Data Sheet (1993)	3%
WRA in Union	DHS (1993)	100% (See page 60)
Contraceptive Prevalence Rate (CPR) -- all methods	DHS (1993)	16%
Annual CPR Increase (in percentage points)	UN Levels and Trends of Contraceptive Use (1988)	1.0
Method Mix: Condoms Orals Other	DHS (1993)	 9.0% 45.4% 45.6%
Brand Mix (orals): Lo-Femenal Other	Anyland Logistics MIS	 50% 50%
Source Mix (all methods): Public Sector Other	DHS (1993)	 65% 35%
CYP Conversion Factors: Condoms Orals	 USAID Defaults	 150 15

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Estimating Women of Reproductive Age for the Base Year

Both the U.S. Census Bureau and the United Nations have invested substantial effort in preparing demographically sound estimates of population growth. The U.S. Census Bureau Center for International Research's International Data Base provides estimates of WRA for all developing countries for each year between 1990 and 2000, as well as the year 2005. The U.N. World Population Prospects also publishes estimates of WRA, broken down by country. If at all possible, one of these two sources should be consulted to obtain a current estimate of WRA.

In some situations, however, the forecaster will not have access to these data sources. In such cases it is possible to adjust older census enumerations of WRA, using an annual population growth rate, to obtain an estimate for the beginning year of the projection. It should be noted that sub-populations (such as WRA) do not in fact demonstrate the same growth rate as national populations. However, given the inherent imprecision introduced by other assumptions that must be made in preparing the forecast, and the relatively short time frame of projections made for procurement purposes, it is acceptable to use this approximation when the forecaster cannot obtain U.S. Census Bureau or U.N. estimates. The formula is:

$$\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } \underline{n+1}\end{array} = \begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } n\end{array} + \left(\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } n\end{array} \times \begin{array}{c}\textit{Annual Rate}\\ \textit{of Population}\\ \textit{Increase}\end{array}\right)$$

Population growth rates are reported in one of two ways: the Annual Rate of Population Increase, which takes into account estimated births, deaths, and the effects of migration; or the Annual Rate of Natural Increase, which takes into account only births and deaths. The former figure is more appropriate, and should be used when it is available. If it is not, then the Annual Rate of Natural Increase can be substituted in the above formula. In the example of Figure 16, for instance, the 1990 WRA figure is 4,940,447 and the Annual Population Growth Rate is 3%. If it is impossible to obtain either U.S. Census Bureau or U.N. projections, then the 1993 base year WRA figure would be calculated by using this formula repeatedly:

$$\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ 1991\end{array} = 4{,}940{,}447 + (4{,}940{,}447 \times 0.03)$$

$$= 4{,}940{,}447 + 148{,}214 = 5{,}088{,}661$$

Similarly,

$$\text{Estimated WRA for 1992} = 5{,}088{,}661 + (5{,}088{,}661 \times 0.03)$$

$$= 5{,}088{,}661 + 152{,}660 = 5{,}241{,}321$$

And finally,

$$\text{Estimated WRA for 1993} = 5{,}241{,}321 + (5{,}241{,}321 \times 0.03)$$

$$= 5{,}241{,}321 + 157{,}240 = 5{,}398{,}561$$

Estimating the Actual Population at Risk of Pregnancy

The data sources discussed above will yield estimates of the Percent of WRA Currently Married and/or the Percent WRA in Union. However, neither of these figures necessarily provides a good estimate of the number of women at risk of pregnancy. In many societies, substantial numbers of women and men are sexually active without being married or "in union"; active teenage women in particular are often underreported, though more recent surveys in some countries have targeted teenagers specifically.

Accordingly, it is frequently necessary to adjust reported figures to give a more accurate estimate of the population actually at risk. Adding the percent of WRA reported in the DHS as living together to the percent of WRA Currently Married yields an estimate of WRA in Union; this figure should always be used instead of WRA Currently Married when data are available.

Although WRA in Union gives a more accurate picture of the population at risk, it may still seriously underestimate the target population in certain countries. Where the forecaster has reason to believe that the WRA in Union or WRA Currently Married figures do underestimate the actual population at risk of pregnancy, a different strategy can be used to prepare the projection: *all* Women of Reproductive Age can be considered at risk, and the CPR for *all* women, as opposed to *Currently Married* women, should be used. Since it is never true that all women are actually at risk of pregnancy, this assumption is obviously illogical. Mathematically, however, using the CPR for all women (which is of course lower than the CPR for WRA Currently Married) compensates for the assumption that 100% of women are at risk, allowing the forecaster to complete the projection without making a potentially incorrect guess about the number actually at risk.

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Choosing the Appropriate Contraceptive Prevalence Rate for the Base Year

The initial CPR estimate is best obtained from the most recent DHS, from the table "Current Use of Contraception by Age". This table provides CPR figures for both WRA Currently Married and All Women. If the projection is to be made using WRA in Union or WRA Currently Married, the former CPR figure should be used; if the projection is to be based on total WRA, then the latter CPR figure should be used.

If a survey other than the DHS is used, the same principle should apply. It is essential that the forecaster be certain that the base population for WRA and the base population for CPR are the same.

Calculating the Method Mix

Most surveys provide figures for contraceptive users by method, and in most cases the overall Method Mix can be taken from the survey report. If the DHS is being used, for example, the desired figures are contained in the table "Current Use of Contraception, by Method". This table provides data both for All Women, and for WRA Currently Married. As with CPR, the choice of which figure to use depends on which WRA figure has been selected as the basis of the projection.

The DHS and most similar surveys present data for each method as a percentage of All Women or WRA Currently Married, including women who are not contracepting. For projection purposes, the forecaster needs the Method Mix expressed as percentages relative to All Women or WRA Currently Married *who are using any method of contraception*. This percentage can be obtained by dividing the DHS figure for women using each method by the percentage of women using any method:

$$\text{Method Mix for a Method} = \frac{\text{Percentage Using Method}}{\text{Percentage Using any Method}}$$

So, for example, if All Women are being used for the projection, and the survey reveals that 8% use the pill, and that 30% use any method, then:

$$\text{Method Mix for Orals} = \frac{8}{30} = 26.6\ \%$$

In other words, orals represent 26.6 % of overall contraceptive use. This calculation is then repeated for all other methods. Where surveys other than the DHS are used, it is likely that this same calculation will be needed.

Estimating the Brand Mix

If the forecast is being made for procurement purposes, it is usually not sufficient just to know the number of users of each method. Unless the program provides only a single brand of each method, the forecaster will need a further breakdown into individual brands in order to complete the projection.

Very few surveys tabulate data by brand. The most obvious source of information on Brand Mix within a method is the program's LMIS. If consumption data or even low level issues data are available, a Brand Mix can be calculated and used to disaggregate method figures into brands. If there is no functioning LMIS, then a representative sample of service sites must be visited, and service providers and program managers must be interviewed in order to determine the brand split. As with the overall Method Mix, the desired figure is the percentage that each brand represents of the total use *of that method.*

Of course, for new programs, no such data will be available. In such cases, program targets or historical experience of other established programs should be used to make the brand estimates.

Estimating the Proportion of National Contraceptive Use Attributable to the Program

Most surveys on which population data forecasts are based are national in scope. These data can be used directly to prepare national level consumption estimates. However, consumption estimates are usually needed for individual service delivery programs.

In order to prepare program-specific estimates, the forecaster must of course estimate the proportion of national contraceptive use that is attributable to the particular program for which the forecast is being prepared. This proportion may be very different for different methods (for example, an AIDS/STD prevention program may contribute a significant portion of the national condom CPR, but will likely not have anything to do with other contraceptive methods). Thus it is likely that the Program Proportion of Each Method will have to be estimated separately.

As shown in Appendix 3, DHS's provide a table entitled "Source of Supply for Modern Contraceptive Methods". In many cases this table can be used to estimate the Program Proportion of Each Method. Where the DHS breakdowns are too general, or where no recent DHS is available, the forecaster and program managers should estimate these figures based on local data or program managers' experience. Errors in these estimates will yield proportional errors in the consumption forecast; if data are lacking and managers are unsure of the estimates, confidence in the final consumption forecast must be correspondingly reduced.

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In the Anyland example of Figure 16, the DHS showed that the "Public Sector" accounts for 65% of contraceptive use for every method. To prepare a projection for the MOH, then, the forecaster should use a Program Proportion of 0.65 for each method, assuming the MOH is the only public sector program which provides contraceptives.

E. ESTIMATING WRA, METHOD MIX, CPR, AND PROGRAM PROPORTION FOR THE FINAL FORECAST PERIOD

The above formulas and procedures provide the necessary population parameters for a single year, the base year of the projection. Before the consumption estimates can be made, it is necessary to project how these parameters will change over the forecast period. The three population parameters which are most likely to change, and which will consequently require estimates for the future years of the forecast, are WRA, Method Mix and CPR. The most common technique is to estimate values for these data items for the last year of the projection, and then to calculate intermediate values using the formulas for linear trend projections shown in Chapter II.

In a mature and relatively stable program, it may be reasonable to assume that both Method Mix and CPR will remain constant for a period of up to four years, so that the linear trend calculation would be needed only for WRA. In a less stable environment, the CPR and Method Mix must be adjusted as well, and the Brand Mix may also differ. A similar judgement must be made regarding the Program Proportion of Each Method. In such situations, and in the case of longer-range forecasts covering more than four years, manual calculations may be excessively tedious. Fortunately there are several software tools available which can be used to make the forecast.

Regardless of whether a manual or automated projection is made, the forecaster will need to prepare a set of parameters similar to that shown in Figure 17, and to ensure that program managers and other concerned individuals (e.g., donors) agree that the figures are reasonable.

Estimating WRA for the Final Forecast Year

The WRA figure for the final year of the forecast should be taken from the source that was used for the base year, again preferably either the U.S. Census Bureau's International Data Base, or the U.N.'s World Population Prospects. If neither of these sources are available, the formula given above for adjusting older WRA data for the base year can be used repeatedly to calculate WRA figures for the forecast years, though this methodology is much less desirable.

Figure 17

POPULATION DATA FOR ANYLAND
For Final Forecast Year (1996)

DATA ITEM	VALUE
Women of Reproductive Age (WRA)	5,899,153
Annual Rate of Natural Increase	3%
WRA in Union	100%
Annual CPR Increase (in percentage points)	1%
Target Contraceptive Prevalence Rate (CPR) -- all methods	19%
Method Mix:	
Condoms	9.0%
Orals	45.4%
Other	45.6%
Brand Mix (orals):	
Lo-Femenal	50%
Other	50%
Source Mix (all methods):	
Public Sector	65%
Other	35%
CYP Conversion Factors:	
Condoms	150
Orals	15

Estimating CPR for the Final Forecast Year

The CPR estimate for the final forecast year is *the* crucial assumption in demographic data based forecasting. A special danger derives from the fact that many programs and governments set national targets for increases in CPR and these "official" targets are often very optimistic. Furthermore, the forecaster is likely to come under pressure to use them in the population data forecast. With the exception of the U.N.'s World Contraceptive Use and Levels and Trends of Contraceptive Use there are few generally recognized data sources demonstrating historical rates of change in CPR which can be used to confirm or refute national or program targets.

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Given the relatively short time period of forecasts made for immediate procurement purposes, it is unlikely that major CPR increases or decreases will occur during the forecast period. For reference, Appendix 4 contains the most recent data from Levels and Trends of Contraceptive Use. Changes in CPR are summarized and categorized in Figure 18.[5]

It is immediately apparent from these figures that the most successful family planning programs in the world have increased contraceptive prevalence by only one to two percentage points per year. In countries with lower levels of prevalence and less commitment to family planning, the change is closer to one half of one percentage point growth per year, ranging all the way down to negative growth. One rational way to set the target CPR for the country or program in question is to check the rates of change in countries with similar programmatic and cultural settings, using the data from Figure 18 and Appendix 4.

Another strategy is to prepare the demographic data forecast based on estimates of the trends in Total Fertility Rate (TFR) rather than the CPR, using the automated Target-Cost Model to calculate CPR changes. A great deal of effort *has* been invested in the study of TFR trends throughout the world. For example, there are country-specific and average figures for TFR decline by strength of program effort and level of development of the country as shown in Figure 19,[6] as well as U.N. and World Bank estimates of future levels of TFR, as shown in Appendix 3.

In any case, it is essential that forecasts be prepared using multiple data sources, as discussed in Chapter I. This strategy will highlight excessively optimistic (or excessively pessimistic) assumptions not only for CPR but also for other data items.

Estimating Method and Brand Mix for the Final Forecast Year

Unfortunately, few comprehensive studies on trends in Method Mix have been completed, and most of the rules of thumb on Method Mix changes are applicable to long-term changes as a program moves from a "launch" to a more "mature" stage. Thus the empirical record, which demonstrates clearly the shift over time from traditional to resupply to more permanent methods, gives little guidance in estimating short-term Method Mix changes.

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[5] Contraceptive Prevalence Rate increases are based on data from the U.N. Department for Economic and Social Information and Policy Analysis, Population Division, World Contraceptive Use 1994 and the U.N. Department of International Economic and Social Affairs Statistical Office, Levels and Trends of Contraceptive Use as Assessed in 1988. Most data are taken from surveys completed between 1973 and 1993. The format of Figure 18 and the categorization of countries is taken from John Bongaarts, W. Parker Mauldin, and James F. Phillips, "The Demographic Impact of Family Planning Programs", Studies in Family Planning 21, 6 (1990): 299-310.

[6] Source: John Bongaarts, W. Parker Mauldin, and James F. Phillips, "The Demographic Impact of Family Planning Programs", Studies in Family Planning 21, 6 (1990): 299-310.

Figure 18
AVERAGE ANNUAL CONTRACEPTIVE PREVALENCE INCREASES

DEVELOPMENT INDEX	PROGRAM EFFORT			
	STRONG	MODERATE	WEAK	VERY WEAK
HIGH	Colombia (66%) 1.8 Hong Kong (81%) 0.9 Korea Rep (79%) 2.0 Mauritius (75%) -0.5 Mexico (53%) 2.1 Singapore (74%) 1.6 AVERAGE 1.3	Jamaica (67%) 1.4 Malaysia (48%) 1.1 Panama (58%) 0.7 Trinidad and Tobago (53%) 0.1 AVERAGE 0.8	Costa Rica (75%) 0.8 AVERAGE 0.8	Iraq (14%) -0.1 Jordan (35%) 0.7 AVERAGE 0.3
UPPER MIDDLE	China (83%) 1.3 Sri Lanka (62%) 2.4 AVERAGE 1.9	Dom. Republic (56%) 1.2 Ecuador (53%) 1.9 El Salvador (53%) 0.6 Philippines (40%) 1.0 Thailand (66%) 1.7 Tunisia (50%) 1.8 AVERAGE 1.4	Algeria (47%) 2.0 Botswana (33%) 1.2 Peru (59%) 1.8 Turkey (63%) 1.2 AVERAGE 1.6	Bolivia (30%) 1.0 Nicaragua (49%) 1.9 Paraguay (48%) 1.1 AVERAGE 1.3
LOWER MIDDLE	Indonesia (50%) 1.5 AVERAGE 1.5		Egypt (46%) 1.7 Guatemala (23%) 0.6 Honduras (47%) 1.8 Kenya (33%) 1.8 Morocco (42%) 1.8 Zimbabwe (43%) 1.1 AVERAGE 1.5	Ghana (13%) 0.4 Lesotho (23%) 1.3 Nigeria (6%) 0.1 AVERAGE 0.6
LOW	India (43%) 1.3 AVERAGE 1.3	Bangladesh (40%) 2.1 AVERAGE 2.1	Haiti (10%) -0.4 Pakistan (12%) 0.8 Rwanda (21%) 1.3 Senegal (7%) -0.6 AVERAGE 0.4	Malawi (13%) 0.7 Sudan (9%) 0.4 AVERAGE 0.6

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Figure 19
TFR DECLINE BY FAMILY PLANNING PROGRAM EFFORT AND LEVEL OF DEVELOPMENT (1960/65 - 1980/85)

DEVELOPMENT INDEX	PROGRAM EFFORT							
	STRONG		MODERATE		WEAK		VERY WEAK	
HIGH	Colombia	2.8	Fiji	2.5	Brazil	2.3	Iraq	0.5
	Hong Kong	3.5	Jamaica	2.1	Chile	2.5	Jordan	0.7
	Korea Rep	3.0	Malaysia	2.8	Costa Rica	3.4	Kuwait	2.2
	Mauritius	3.3	Panama	2.5	Cyprus	1.1	Saudi Arabia	0.0
	Mexico	2.6	Trinidad and		Guyana	2.8		
	Singapore	3.2	Tobago	2.1	Venezuela	2.4		
	AVERAGE	3.1	AVERAGE	2.4	AVERAGE	2.4	AVERAGE	0.8
UPPER MIDDLE	China	3.6	Dominican		Algeria	0.7	Bolivia	0.4
	Sri Lanka	1.9	Republic	3.1	Botswana	0.4	Congo	-0.1
			El Salvador	1.6	Peru	1.9	Paraguay	2.0
			Philippines	1.9	Turkey	2.2	Syria	0.3
			Thailand	2.9				
			Tunisia	2.3				
	AVERAGE	2.7	AVERAGE	2.4	AVERAGE	1.4	AVERAGE	0.8
LOWER MIDDLE	Indonesia	1.3			Egypt	1.8	Burma	1.3
					Guatemala	0.7	Ghana	0.4
					Honduras	1.2	Cote d'Ivoire	-0.1
					Kenya	0.0	Lesotho	0.0
					Liberia	-0.2	Nigeria	-0.2
					Morocco	1.7	Togo	0.1
					P.N.G.	0.6	Zaire	-0.1
					Tanzania	-0.2	Zambia	-0.6
					Zimbabwe	1.3		
	AVERAGE	1.3			AVERAGE	0.8	AVERAGE	0.1
LOW	India	1.1	Bangladesh	0.5	Gambia	0.0	Benin	-0.2
					Haiti	1.1	Burkina Faso	0.2
					Pakistan	0.0	Burundi	-0.8
					Rwanda	-0.8	C.A.R.	-0.2
					Senegal	0.2	Ethiopia	0.7
							Guinea	0.2
							Madagascar	0.0
							Malawi	-0.1
							Mozambique	-0.1
							Niger	0.0
							Sierra Leone	-0.2
							Sudan	0.1
							Uganda	0.0
							Yemen N.	-0.1
							Yemen PDR	0.2
	AVERAGE	1.1	AVERAGE	0.5	AVERAGE	0.1	AVERAGE	0.0

The best strategy for estimating change in Method Mix over a three or four year period is to be conservative. Without an aggressive program to introduce or expand the use of specific methods (backed by training for service providers and an IEC campaign to orient clients) it is unlikely that there will be significant changes in the Method Mix. Attempts to affect even the Brand Mix for a particular method have been unsuccessful in programs where the proper launch activities were not undertaken. On the other hand, it is also important to keep in mind that demand for certain methods can increase rapidly with only word of mouth promotion among clients. Such has been the case for injectables and NORPLANT® in countries as different as Tanzania and Haiti.

If historical logistics or service statistics data (or multiple population surveys) are available, these should be compared in an effort to discern trends in Method Mix. In the absence of quantitative data, knowledgeable service providers should be interviewed, and their best estimates of trends should be evaluated for reasonableness. If neither of these approaches yields a satisfactory result, it may be best to assume *no* change in Method Mix over the short-term forecast period.

These same comments apply to estimation of the Brand Mix. Where these decisions must be made without hard data, the program's information systems should be quickly strengthened.

Estimating the Program Proportion of Each Method for the Final Forecast Year

In the rare cases where two or more successive DHS's are available and the DHS table "Source of Supply for Modern Contraceptive Methods" is sufficiently detailed, the extrapolation techniques shown in Chapter II can be used to estimate changes in the Program Proportion of Each Method. Frequently, however, there will be no hard data available, and the forecaster and program managers will have to use their best judgement in estimating changes in the Program Proportion of Each Method. As with the other variables discussed above, it is best to be conservative. Unless specific program interventions aimed at changing the market share of individual programs are planned, these percentages are likely to remain relatively constant over the time period of a short-term forecast.

F. ESTIMATING CHANGES IN WRA, METHOD MIX, CPR, AND THE PROGRAM PROPORTION OF EACH METHOD OVER THE FORECAST PERIOD

Once agreement has been reached on the population parameters for the base year and the final forecast year, it is necessary to compute their values for each intermediate forecast

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year. For a base year of 1993 and a final forecast year of 1996, for example, values would also be needed for 1994 and 1995.

Estimating Intermediate Values for WRA

The U.S. Bureau of the Census's International Data Base and the U.N.'s World Population Prospects provide annual WRA estimates; as discussed above, these should be used where possible. If it is impossible to obtain access to either of these sources, the formula for adjusting WRA data given above can be used. The formula was:

$$\text{Estimated WRA for Year } n+1 = \text{Estimated WRA for Year } n + \left(\text{Estimated WRA for Year } n \times \text{Annual Rate of Population Increase}\right)$$

Returning to the Anyland example, WRA for 1993 had been estimated to be 5,398,561 and the Annual Rate of Population Increase is 3%. The estimate for 1994 would be:

$$\text{Estimated WRA for 1994} = 5{,}398{,}561 + (5{,}398{,}561 \times 0.03)$$

$$= 5{,}560{,}518$$

1995 and 1996 estimates would be calculated in the same way.

Estimating Intermediate Values for CPR, Method Mix, and the Program Proportion of Each Method

Unless there is good reason to think otherwise, the forecaster should assume that the change from year to year for each of these parameters is linear, and simply interpolate a line between the first and last values for each parameter. Interpolation is really the same procedure as the extrapolation technique using linear trends described in Chapter II, except that the points being estimated are *between* the first and last point, rather than *beyond* the last point (hence "interpolation" instead of "extrapolation"). The formulas are just:

$$\text{Average Change Over Forecast Period} = \frac{\text{Target Value in Final Period} - \text{Value in Base Year}}{\text{Number of Years in Forecast}}$$

and:

$$\text{Estimate for Period } n+1 = \text{Estimate for Period } n + \text{Average Change Over Forecast Period}$$

In the Anyland example, the CPR in 1993 was 16% and the target CPR for 1996 is 19%. So,

$$\text{Average Change Over Forecast Period} = \frac{19\% - 16\%}{3} = 1.0\%$$

and

$$\text{Estimate for 1994} = 16\% + 1.0\% = 17\%$$

Applying the formula again would of course give a CPR estimate of 18% for 1995.

Method Mix changes for the interim time periods would be calculated similarly. If changes in the Brand Mix within one or more methods are expected during the time period of the forecast, the same procedure can be used to calculate Brand Mix values for each period. Note that the sum of the Method Mix percentages for each time period must equal 100%, as must the Brand Mix percentages for each method. It may be necessary to round individual interpolated figures to reach 100%.

Finally, if significant changes in the Program Proportion of Each Method are foreseen during the forecast period, this same interpolation technique should be applied to estimate intermediate values.

G. CALCULATING COMMODITY CONSUMPTION FOR FUTURE TIME PERIODS

Once the forecaster and program planners have come to agreement on the above data items and projections, the consumption forecast for each method and brand can be completed.

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General Calculation for Population Data Forecasts

The general formula for this calculation is:

$$\text{Estimated Consumption of a Brand of a Method in Year } n = \text{Estimated WRA for Year } n \times \text{CPR for Year } n \times \text{Method Mix for this Method for Year } n \times \text{Brand Mix for this Brand for Year } n \times \text{Program Proportion of this Method} \times \text{CYP Conversion Factor}$$

Although at first glance this formula appears complex, in fact it is straightforward: Multiplying Estimated WRA times the CPR, the first two factors, simply gives the total number of women at risk of pregnancy who are estimated to be contracepting. (Again, remember to be consistent in using All Women or WRA in Union for these factors.) Multiplying this result by the Method Mix and Brand Mix percentages, the third and fourth factors, gives the number of users being protected by a particular commodity. Multiplying further by the Program Proportion of this Method, the fifth factor, gives the number of those users being protected by the program.

With this latter figure in hand, it is necessary to estimate the quantity of commodities necessary to protect those women throughout each time period. This is done using the last factor in the equation, the CYP Conversion Factor.

Using Couple-Year of Protection Conversion Factors to Estimate Consumption for Short-Term Contraceptive Methods

The quantity of each commodity required to protect each user is normally estimated for a one-year period, and is called the *Couple-Year of Protection (CYP) conversion factor*, that is, the amount of a particular contraceptive needed to provide one couple with protection for one year. Figure 20 shows the CYP standards used by USAID and those commonly used by a number of other family planning organizations. These differ primarily because the USAID factors include an estimate for client losses. It should be noted that the USAID standards are presently under review, and are likely to be modified in the near future.

Although both the CYP concept and CYP conversion factors have been used for several decades for purposes of program evaluation, there is still controversy regarding application of the factors for specific purposes. In particular, setting the exact quantity of a given contraceptive required to protect one couple for one year from an unwanted pregnancy is problematic for many contraceptive methods.

Figure 20

COUPLE-YEAR OF PROTECTION CONVERSION FACTORS

METHOD	USAID STANDARDS	INTERNATIONAL STANDARDS
Oral Contraceptives	15 cycles/CYP	13 cycles/CYP
Condoms	150 pieces/CYP	100 pieces/CYP
CuT 380A IUD's	3.5 CYP/insertion	2.5 - 3.5 CYP/insertion
Injectables Depo-Provera® Noristerat®	 4 doses (1 ml)/CYP 6 doses/CYP	 4 doses (1 ml)/CYP 6 doses/CYP
Vaginal Foaming Tablets	150 tablets/CYP	100 tablets/CYP
NORPLANT®	3.5 CYP/implant	3.5 CYP/implant

Use of the standard factors from Figure 20 is likely to be acceptable for orals and injectables, because the CYP factor is very closely associated with the menstrual cycle, and there is little variation from woman to woman or country to country.

For the barrier methods, however, there is great variability from person to person and place to place, and little hard data on which to base conversion factors. The international standard of 100 for condoms and foaming tablets assumes 100 acts of (vaginal, protected) intercourse per year, and that the two methods are not used together. The USAID standard of 150 further assumes significant client wastage. These are questionable assumptions. It is known that the frequency of sexual relations varies from culture to culture and from individual to individual. Moreover, many users combine condoms or spermicides with the rhythm method or withdrawal, or with sexual techniques other than vaginal coitus. Condoms used for the prevention of AIDS or other sexually-transmitted diseases are also often considered separately. Moreover, more than one method may be used simultaneously, either for backup, or in the case of condoms, for disease prevention. The standard CYP factors do not automatically account for these variations.

For these reasons, the authors of the CYP methodology indicated explicitly the need to conduct country-specific user surveys in order to establish CYP factors. Use of such local data for conversion factors greatly improves the quality of the forecast for barrier methods.

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Unfortunately, such data are rarely available, and it will usually be necessary for the forecaster to use the standard factors from Figure 20 for all short-term contraceptive methods in the general formula for Estimated Consumption. In the Anyland example of Figure 16, for example, the calculation for condoms for the 1993 base year, presuming there is only one brand of condoms in the program, would be:

$$\begin{aligned} \textit{Estimated Consumption of Condoms in } 1993 &= 5{,}398{,}561 \times 0.16 \times 0.09 \times 1 \times 0.65 \\ &\times 150 \\ &= 7{,}579{,}580 \end{aligned}$$

Note that this calculation uses the adjusted WRA estimate for *1993*, not the 1990 survey figure shown in Figure 16.

Estimating Consumption for Long-Term Contraceptive Methods

CYP conversion factors are even more problematic in forecasting for longer-acting methods (IUD's, implants), because these methods provide protection that extends beyond the time period of the forecast. This means that not all of the women being protected by these methods in a particular year will need a device that year: many of them will be protected by IUD's or implants received in previous time periods. The CYP factors for IUD's and implants take into account the extended use life of these methods, with an allowance for discontinuation.

Mathematically, the *inverse* of the CYP factor for these methods gives the portion of the program's users who will need devices in a given year. If no local data are available, the forecaster can just use the inverse of the factors for IUD's and NORPLANT® from Figure 20 in the general formula for Estimated Consumption to obtain quantity estimates for these methods. If NORPLANT® represented 2.0% of Anyland's Method Mix, for example, the required quantity would be:

$$\begin{array}{l} \textit{Estimated Consumption of NORPLANT® in 1993} \\ \\ \end{array} = 5{,}398{,}561 \times 0.16 \times 0.02 \times 1 \times 0.65$$

$$\times \frac{1}{3.5}$$

$$= 3{,}208$$

For IUD's, a more refined estimate is sometimes possible. It is generally true that women either continue using the first device for many years, or discontinue relatively quickly and switch to another method or cease contracepting. For commodity forecasting purposes, then, the simplest and most accurate assumption for IUD's is that a single device will be required for each New User. If program estimates of New Users can be obtained or calculated for the forecast period using the extrapolation techniques described in Chapter II, IUD quantities for each time period of the forecast should be estimated by the following formula, rather than the general formula for Estimated Consumption:

$$\textit{Estimated Consumption of a Brand of IUD in Year } \underline{n} = \textit{Estimated Number of New Users of the Brand in Year } \underline{n}$$

A completed population data based forcast for the fictitious country of Anyland is included in Appendix 6.

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VII. ESTIMATING CONSUMPTION BASED ON DISTRIBUTION SYSTEM CAPACITY

New family planning or AIDS/STD prevention programs (and less well managed older programs) will not have historical data on trends in either contraceptive consumption or services provided, and so will not be able to use historical consumption data or service statistics for making projections. Population data forecasts may or may not be feasible. Even in well managed programs which do have such data, longer-range forecasts are prepared which do not assume that the future will follow the same patterns as the past. Most program plans are based, realistically or not, on continued growth, but few quantify the implications of such growth either for contraceptive commodities or for other program resources. Finally, all programs, well managed or not, face special situations, such as introduction of a new product (e.g., NORPLANT®), for which there will be no historical use data. In all these situations, a forecast based on service delivery capacity should be prepared.

Ideally, such a forecast would take into account three types of programmatic constraints:

- The realistic level of demand for services which exists in the program's target population;
- The quantity of services that can realistically be provided by existing staff and facilities; and
- The quantity of contraceptive commodities that can be stored and moved through the distribution system.

This manual deals only with the third type of constraint, the capacity of the in-country distribution system itself.

Even where projections using other data sources are feasible, a distribution system capacity forecast may be needed: Forecasts based on historical data (either logistics or service statistics) automatically take into account the capacity limitations of a program's storage and distribution systems, since they reflect rates of growth (or decline) that the program has proven its ability to achieve. Population based forecasts do not. Similarly, logistics or service based forecasts which have been adjusted to reflect future program plans, or any other target-based forecast, may or may not be consistent with the program's ability to actually deliver the required commodities.

In these cases, an explicit review of the program's storage and transport capacity is in order. This analysis might take one of two forms: First, the forecaster might simply calculate the maximum throughput of the program's *existing* storage and transport systems, and use this constraint to set a ceiling for forecasts prepared by one of the above methods. This approach is appropriate for forecasting in situations where constraints of time, funding, or human resources make it difficult or impossible for the program to increase its logistics capacity. Second, the forecaster might take one or more forecasts prepared by the other methods, and calculate the storage and transport capacity which would be required to achieve the projected levels of commodity distribution. This approach is appropriate for longer-term forecasts, where the program's ability to increase its logistics capacity is greater, and where such a projection can quantify the program implications of targets set by one of the other forecasting methods.

A. DATA SOURCES AND LIMITATIONS

There are several determinants of distribution system capacity; these include:

- *Contraceptive requirements*: the quantity of each product needed to achieve a particular level of service;
- *Method mix*: the actual (or desired) percentage represented by each method in a facility's service output;
- *Staff time*: the amount of time available of *properly trained* procurement, warehouse, and transportation staff;
- *Storage capacity*: the amount of space available (or required) to store and manage products at each warehouse or storage facility;
- *Transport capacity*: the amount of space available (or needed) on public or private transport for shipping the required commodities down through the distribution system; and
- *Cost* or *budget*: anticipated costs or maximum budget levels available for all of the above.

Many family planning programs, and almost all AIDS/STD prevention programs, are in a process of rapid expansion, particularly in countries classified as "emerging" or "established". For these programs, the level of all the above inputs may be changing quite rapidly, and it is important to try to quantify and understand the implications of such change. In the case of family planning, even in "mature" programs where contraceptive prevalence is

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no longer growing at a rapid rate, the method mix continues its evolution following patterns and trends seen worldwide for the majority of methods currently in use. Less desirable methods (abortion and traditional methods) are gradually replaced by modern contraceptives, and reversible contraceptive users gradually switch to permanent methods. These changes have profound implications for the quantities of commodities which must be procured, stored, transported, and dispensed.

In theory, the above types of data are available from a program's administrative management and budgeting systems. In practice, large programs (and less well managed small programs) may not know, for example, the dimensions of every storeroom in the country, or whether all the district trucks are functioning. In such cases, simplifying assumptions may be possible, as discussed below, or site visits or surveys may be used to obtain the required infrastructure data. It is important to note that the calculations for service capacity based forecasts are predicated on the assumption that the program has or can create a properly functioning distribution system, with appropriate Maximum and Minimum inventory control policies that are followed at every facility. If this assumption is false, a valid service capacity based forecast cannot be prepared.

Some of the advantages and disadvantages of forecasting based on distribution system capacity are summarized in Figure 21.

B. COMPLETING THE DISTRIBUTION SYSTEM CAPACITY BASED FORECAST

In preparing the distribution system capacity based projection, the forecaster must first reach an understanding with program managers regarding the possibilities of changing the program's capacity during the time period covered by the forecast. If such changes are possible, then the forecaster's task is to quantify the capacity changes required to meet program targets prepared by one of the other forecasting methods. If changes are not possible, then the task is calculating the maximum throughput of commodities that can be achieved with existing capacity. In either case, the space and volume requirements calculations use the procedures shown below.

Calculating Storage Capacity Requirements for a Single Facility

To calculate the storage space required at a single facility, the forecaster must know the maximum quantity of each commodity that is to be stored, and the unit volume which each commodity occupies in storage. Storage volumes per carton for commonly supplied contraceptives are given in Appendix 5.

Figure 21

FORECASTS USING DISTRIBUTION SYSTEM CAPACITY

ADVANTAGES	DISADVANTAGES
Closely associated with the idea of a service delivery plan	Requires large quantities of local data from all levels of the service delivery system
Based on very concrete assumptions understandable to program managers	Requires properly functioning Max-Min inventory control system
Essential for determining physical infrastructure and budgetary implications of service or demographic targets	Requires tedious and extensive mathematical calculations
Usable in new programs with no historical data	May require drastic simplifying assumptions

In a properly functioning distribution system, the maximum quantities for each product are set by program policy, in terms of Months of Supply to be maintained in the storeroom. It should be noted that the maximum quantity to be stored is *not* the same as the quantities to be consumed that are projected by the forecasting methods described above. This is because storage facilities must also maintain safety stocks as a buffer against uncertainty of demand (or inconsistency of supply) as well as quantities sufficient to cover offtake during the time between ordering and receiving new supplies. If Max-Min policies do not exist, they will have to be created before the capacity based forecast can be prepared.[7]

The Maximum Stock Level for each facility (in Months of Supply) can be converted to actual *quantities* to store using the formula:

[7] For a full discussion of maximum/minimum inventory control systems, see CDC's Logistics Guidelines or WHO's Managing Condom Supplies.

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$$\text{Maximum Quantity to Store (in Units)} = \text{Maximum Stock Level (in Months)} \times \text{Average Quantity Dispensed to Users per Month}$$

where the Average Quantity Dispensed may be based either on historical logistics data, or on projections made by one of the methods described in previous chapters. Once the Maximum Quantity to Store has been set, the conversion from quantities to be stored to volume to be stored for any product is simply:

$$\text{Cubic Meters of Storage Space} = \left(\frac{\text{Maximum Quantity to Store}}{\text{Quantity per Carton}}\right) \times \text{Cubic Meters per Carton}$$

Few storekeepers or program managers think of their storerooms in terms of cubic meters of usable storage. *Cubic* meters of *storage* space can be converted to *square* meters of *actual floor* space, by using two common assumptions:

- The maximum height that commodities should be stacked (to prevent both damage to the product and injury to the storekeepers) is 2.5 meters (8 feet).

- In a properly organized storeroom, the floor space needed for aisles, packing and handling areas, ventilation, and so forth is equal to at least 100% of the floor space actually devoted to product storage.

If these assumptions are accepted, then the floor space needed for commodity storage is:

$$\text{Square Meters of Storage Space} = \frac{\text{Cubic Meters of Storage Space}}{2.5 \text{ meters}}$$

and the total area needed for the commodity is:

$$\text{Square Meters of Storage and Handling Space} = \text{Square Meters of Storage Space} \times 2$$

Smaller storerooms at lower level facilities may require less handling space, since volumes to be handled are smaller. It may be decided that 50% extra space for handling is sufficient at the clinic level, for example. In this case, the forecaster would multiply by 1.5 instead of 2 in the above equation. On the other hand, large facilities at the central level may require more than 100% handling space, particularly if mechanical handling equipment such as forklifts are employed. In such cases, a larger multiplier should be used.

As an example, suppose that an AIDS/STD prevention program intends to rent a new central warehouse for condoms, and that program policy specifies that a Maximum of 9 Months of Supply should be maintained at the central level. Assume further that a forecast has been prepared which suggests that the Average Quantity Dispensed to Users over the time period of the forecast is one million condoms per month. The product is supplied by USAID, which supplies condoms in cartons of 6,000, each of which has a volume of 0.12 cubic meters, as indicated in Appendix 5. The required storage space would then be:

$$\text{Maximum Quantity to Store (in Units)} = 9 \times 1{,}000{,}000 = 9{,}000{,}000 \text{ units}$$

$$\text{Cubic Meters of Storage Space} = \left(\frac{9{,}000{,}000}{6{,}000}\right) \times 0.12 = 180\ m^3$$

$$\text{Square Meters of Storage Space} = \frac{180\ m^3}{2.5 \text{ meters}} = 72\ m^2$$

And, finally:

$$\text{Square Meters of Storage and Handling Space} = 72\ m^2 \times 2 = 144\ m^2$$

These calculations should be repeated for each product to be stored, and the answers summed to obtain the total required size of the warehouse or storeroom.

If this grand total is greater than the storage space actually available, several options can be explored:

- Alternatives for increasing storage capacity can be examined. In many places it is possible to rent additional space on a temporary or permanent basis rather than actually building new stores. In most programs, additional storage capacity can be gained by simply reorganizing existing space and disposing of unusable commodities.

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- The Maximum Quantity to Store can be lowered if the delivery schedule both into and out of the facility can be changed. The more frequently deliveries are made, the lower the stock levels can be. It may also be possible to reduce safety stock levels by changing the type of Max-Min inventory control procedures used.[8]

- The projected quantities to be distributed can be lowered by reducing the projection for one or more products, repeating the above calculations until the overall forecasted amounts fit within the storage constraints.

A decision to reduce projected distribution because of storage capacity constraints must of course be made in close cooperation with program managers. From a logistics viewpoint, the easiest way to reduce storage (or transportation) volumes in a family planning program is to reduce projected quantities of condoms, because these are the bulkiest of the contraceptive commodities. In a country with a serious AIDS/STD problem, such a strategy may be most inappropriate.

Calculating Transport Capacity for a Single Transportation Link

In distribution systems which have policies for Maximum and Minimum Stock Levels at each facility or each type of facility, stock balances will vary between the Max and the Min, and each facility will generally need to be resupplied with the amount of product issued or dispensed in the previous period. To ensure that the system stays in balance, however, resupply decisions *should not* be made on the basis of quantities issued from higher level storage facilities to lower level facilities, but rather on the basis of Quantities Dispensed to Users at the *service* level of the system. Thus for any higher level storage facility, the monthly quantity which will need to be issued is calculated as:

$$\text{Average Quantity to Issue per Month} = \text{Average Quantity Dispensed to Users per Month at an SDP} \times \text{Number of SDPs Served}$$

Thus a Regional Medical Store which serves 30 SDPs which dispense on average 6,000 condoms per month should expect to issue:

[8] See CDC's Logistics Guidelines or WHO's Managing Condom Supplies for details.

$$\text{Average Quantity to Issue per Month} = 6{,}000 \times 30 = 180{,}000 \textit{ pieces}$$

The volume which this amount of product will occupy is calculated using the same formula as above. If the 180,000 condoms are USAID product, for example,

$$\text{Cubic Meters of Storage Space} = \left(\frac{180{,}000}{6{,}000}\right) \times 0.12 = 3.6\ m^3$$

This is the amount of space in the vehicle which will be needed for condoms for a regular replenishment trip if all 30 SDPs are to be restocked in a single monthly trip from the Regional Medical Store.

Of course, the calculation illustrated here is based on *Average* Quantity Dispensed. In actual practice, amounts above or below the average will be needed by individual SDPs, and there are likely to be significant differences in service volumes between SDPs. In such cases, it may be necessary to calculate quantity requirements for each SDP individually rather than using a global average.

The above example assumes that delivery is made by the higher level storage facility to the SDPs in a single monthly trip. If multiple trips are made (or if the lower level facilities are given responsibility for coming to the higher level facility to pick up supplies), the volume which must be transported on a single trip would be correspondingly reduced. Also, the calculation shown is for *monthly* distribution; if the delivery schedule were, say, quarterly, the volume estimate must be multiplied by 3.

As with the storage capacity calculation, this procedure must be repeated for each commodity to be transported, with the results summed to obtain the total shipping volume for a single trip.

It should be noted that the above calculation computes the regular *replenishment* quantity for a facility. For new programs or facilities, initial stocks equal to the Max Supply Quantity must be provided, since the facilities will have no stock on hand at the outset. That is,

$$\text{Initial Quantity} = \text{Max Stock Quantity}$$

If the stock policy at the SDP specifies a Max Stock Level of 3 months and a Min Stock Level of 2 months, for example, then a new clinic would initially have to be provided a three month supply, or 18,000 condoms in the above example.

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Analogous calculations can be made to determine the *weight* of commodities which must be transported. Appendix 5 provides product weights needed to make the computation. Contraceptives are light relative to their volume, and it is rare that weight will be the limiting factor, except where products must be carried by porters or animals. In cases where transport will be by air, both weight and volume may need to be considered, for reasons of cost.

If these calculations show that existing transport capacity is insufficient, three options are available:

- Alternatives for increasing transport capacity can be examined. These include use of commercial transport, which may well be less expensive than program-owned transport, as well as procurement of additional program-owned vehicles.

- The projected quantities to be distributed can be lowered by reducing the projection for one or more products. As with storage space constraints, such decisions must be made in close cooperation with program managers.

- Consideration can be given to increasing the frequency of deliveries.

Obviously, if it is possible to deliver monthly instead of quarterly, three times as much product can be transported. But a more frequent delivery schedule is feasible only if vehicles and drivers are available, and if fuel, per diem, and other added expenses can be covered.

It should be noted that Max and Min levels and delivery schedules are inter-related. Specifically, deliveries must be made at least as frequently as the difference between Max and Min. That is,

$$\textit{Resupply Interval} \leq \textit{Max Stock Level} - \textit{Min Stock Level}$$

where the Max Stock Level and Min Stock Level are expressed in months.

In the above example, the SDPs *must* be resupplied on a monthly basis, (since 3 - 2 = 1). Thus, decisions to change delivery schedules may also require changes to Max and Min levels, affecting the amounts which the facilities themselves must store.[9]

[9] The reader who wishes to understand the reasons for this inter-relationship is referred to WHO's Managing Condom Supplies.

Preparing the Aggregate Delivery Capacity Forecast

The above calculations give the capacity requirements (or limitations) for a single facility or a single transportation link. Ideally, this analysis should be performed for each facility and transportation link in the distribution system, to identify individual bottlenecks in the various supply chains.

The total capacity of the existing distribution system can be computed as the sum of the maximum quantities which can be moved through all of the individual supply chains. Of course, each supply chain is only as strong as its weakest link: lower level facilities cannot move more product than higher level facilities in the supply chain can provide, even if the lower level capacity is greater. If the forecasting exercise is undertaken with the assumption that the program's logistics capacity can be increased during the forecast period, then this constraint would not apply.

Obviously these calculations are simple enough to complete manually only in a very small distribution system which manages a small number of products and a few facilities. In larger systems it may be possible to perform the analysis for each *type* of facility rather than for each individual facility, using standard Max and Min Levels, and averages for transport capacity, storage space, and consumption. This approach is dangerous in programs where facilities of each type vary greatly in size, since a distribution system may have enough capacity to serve the average facility but not enough to serve the largest facilities. In such cases, automated techniques for calculating service capacity must be used to produce a more refined projection.

This analysis may produce several alternative strategies for meeting the program's commodity throughput requirements. For example, capacity can be increased by obtaining additional storage space and more vehicles; changing Max-Min policies and increasing the frequency of resupply with existing vehicles might accomplish the same increase. Obviously these two strategies have very different cost implications, and very different staffing and management implications. The forecaster should be prepared to assist program managers in quantifying these implications.

A complete example of a service delivery capacity based forecast for the fictitious country of Anyland is included in Appendix 6.

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VIII. ESTIMATING CONSUMPTION FOR NEW PROGRAMS

Since new programs have no historical data, the logistics data method cannot be directly used to produce a forecast. However, it should be possible, depending on the external data available and the planning process employed in establishing the program, to prepare forecasts using some or all of the other methods. In any event, the basis for a new program forecast must be the program's development plan.

A. CHARACTERISTICS OF AN ACCEPTABLE PROGRAM PLAN

When new programs are established, particularly where they receive major government support, they tend to set targets such as "We will provide family planning services to XX % of fertile couples in the first year, YY % in the second year, etc." These are population based estimates to which a method mix can be attached in order to prepare the forecast. Other programs might state their targets in numbers of acceptors, sometimes from a well-defined population sub-group such as factory workers, or the general population of a limited area of the country. These are service estimates which can be used directly according to the procedures specified in Chapter V to obtain commodity consumption estimates.

A complete discussion of program planning is beyond the scope of this manual. For logistics management purposes, however, a new program plan must include at least the following elements:

- Estimates of the target population to be served, preferably based on an analysis of unmet need.
- A realistic, phased schedule for increased acceptance in the target population (which does *not* assume that the entire population will be served in the first year of the program);
- Where and when the service delivery outlets will be established;
- Numbers of trained staff now available;
- Projections of when and how many staff will be trained to provide services in the future;
- Details of the distribution system to be established, including numbers and capacities of warehouses and storerooms, types and capacities of

transportation links between facilities, and inventory management policies and procedures;

- Details of the number and types of personnel available for logistics management activities, and the training they already have or will require;

- An explanation of how well equipped the program is and/or when needed equipment will be available, as well as details of other resources available for logistics management; and

- A detailed plan for instituting the data collection and reporting mechanisms required for obtaining logistics and service statistics data for future use in commodity forecasting and other areas of program management.

B. EVALUATING THE VALIDITY OF THE PROGRAM PLAN

As mentioned above, one of the problems with new programs is that they tend to be overly optimistic. Though the new program will have no historical data of its own, it is possible to compare program plans and targets with the experience of similar programs operating in similar environments. The very abundant literature on the evaluation of family planning programs is filled with information on what can be expected from a given level of program effort. Figure 18 and Figure 19 provide just two examples of the data available on rates of program growth. Though AIDS/STD prevention programs are far younger than family planning programs, research efforts are underway to gather similar data on program expansion.

Figure 22 summarizes some additional points to consider when evaluating a program's development plan. A common approach in setting or evaluating a program's targets is to gather a group of experts who have experience in the field, and simply ask them — in either a structured or unstructured format — to assess the program's prospects in the light of likely evolution of the external environment, political events or economic changes, and so forth. This "qualitative" method of forecasting is very commonly used in many fields, and may be a useful adjunct to the more quantitative methods described here, particularly for new programs.

Where a new program plans to offer all methods with no particular emphasis on any one, the mix of services that it plans to deliver should be compared with the mix of other programs serving the same or similar target populations and, if possible, with the method mix and prevalence provided by the private sector. Where it is available, historical trend data from

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Figure 22

NEW PROGRAM PLANNING: ISSUES TO CONSIDER

The most successful national family planning programs have increased contraceptive prevalence from one to two percentage points per year between 0% and 20% percent prevalence, and from two to three percentage points per year between 20% and 50% prevalence. Since these are national averages, annual growth rates that are twice as high may be found in urban areas. Very successful clinics may experience even swifter growth for a period of time.
A good estimate of potential demand for contraception can be made from rates of *unmet need*, if a recent Contraceptive Prevalence Survey is available.
Major concentrations of actual or potential clients will likely be located in areas with the *lowest* fertility rates. It is here that the highest rates of knowledge, positive attitude, and current use will almost certainly be found.
Sectors of the population or regions of the country with high rates of prevalence of traditional family planning methods or high abortion rates are more likely to be ready to adopt family planning on a large scale.
Programs with strong private sector components tend to grow faster than programs based purely in the public sector.
Single-purpose family planning programs tend to grow faster than integrated programs, especially if the single-purpose program is market-oriented.
Programs which concentrate a smaller number of service points in areas of high demand tend to grow faster than comprehensive programs which have many diverse or dispersed facilities.
An effective CBD distributor should produce a minimum of 1.5 CYP per month at the beginning of the program, and between 3 and 10 CYP per month when the program is mature.
A successful, mature, social marketing project which distributes only condoms should generate 1/2 percentage point of additional prevalence per year. If multiple contraceptives are distributed, one percentage point is not unrealistic.
It is doubtful that STD/AIDS prevention programs can develop new markets for condoms faster than the most successful social marketing projects, at least in the general population.

such programs should also be examined, as a basis for further quantifying the new program's likely pattern of growth.

C. COMPLETING THE FORECAST(S)

In short, estimated demand must be considered along with the program's capacity to deliver family planning services and the anticipated performance of other programs serving all or part of the same population group. Ideally, all these issues will be reflected in the program plan.

If the plan has been properly prepared, projected service levels should be stated either in population coverage terms, or more specifically in terms of new acceptors and revisits. If the appropriate population data are available, a population based forecast should be prepared, using exactly the methodology described above. In addition to production of consumption estimates, such a forecast can be used to assess the reasonableness of population coverage targets included in the plan (or to generate them if they do not exist).

If the planning process has produced new acceptor and revisit targets, these can be used instead of actual historical data to produce a service statistics based forecast, again using exactly the methodology described above. Since such a forecast will not be based on any historical reality, it is very important to compare it to forecasts made by the other methods.

A service capacity based forecast should always be completed for new programs, using either actual or planned facility and transport information, if only to force quantification of the program's logistics management capabilities. If program planners are unable to produce the necessary data for completing a service capacity forecast, then it is very likely that the program has not been designed well enough to be successfully implemented.

Although the forecaster's mandate is to look at the situation realistically, care must be taken to avoid discouraging those who are establishing the new program. When in doubt, the forecaster should err on the high side, to ensure that the forecast itself does not become the limiting factor in the program's expansion.

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IX. ESTIMATING CONSUMPTION FOR AIDS/STD PREVENTION PROGRAMS

Many AIDS/STD prevention programs are new, and all are far younger than most family planning programs. The wealth of historical data on program growth and commodity consumption that family planning programs enjoy is unavailable for AIDS/STD programs. Of the data which *are* available from family planning program sources or program-independent surveys, condom consumption figures are usually the least reliable, because survey questions frequently are not comprehensive. However, the severity of the epidemic requires an urgent response, whether or not historical data for program planning are available.

In spite of these constraints, all of the forecasting methods discussed above, with some modifications, are applicable to AIDS/STD prevention efforts. Given the relative youth of most programs, the forecasting strategies for new programs outlined in the previous chapter are likely to be applicable. In any event, the forecaster should prepare projections using as many data sources as possible, for the same reasons that multiple data sources should be used for family planning program forecasts.

A. ESTIMATING CONSUMPTION USING LOGISTICS DATA

AIDS/STD prevention programs which are fortunate enough to have historical data on quantities dispensed to clients should prepare a logistics data based forecast using exactly the same methods described in Chapter IV.

For most AIDS/STD prevention programs, it is even more important that logistics data from the lowest possible level of the distribution system be used for the projection, because distribution system malfunctions are more likely in newer programs. It is essential to avoid basing forecasts and subsequent shipments simply on previous shipment histories, since many national and local AIDS/STD prevention programs are originally stocked on an emergency basis, with little or no analysis of actual consumption patterns. Such an emergency strategy is initially reasonable, to get distribution systems up and running so that usage patterns can be determined. In subsequent resupply periods, however, program managers must ensure that shortages due to underestimation of demand do not occur, and also that condoms do not sit and expire unused at service delivery points or remain in intermediate storage facilities until they deteriorate, lest the program's credibility be destroyed by increasing condom breakage rates.

To prevent such supply imbalances, AIDS/STD prevention programs that do not have LMIS's which gather lowest-level consumption data should move expeditiously to put such systems in place. Many AIDS/STD programs dispense condoms in non-clinical settings, in which data gathering on individual clients is neither desirable nor feasible. Nonetheless, it should always be possible to gather data on quantities dispensed in aggregate from service delivery points, by comparing stock balances at the beginning and end of each resupply period.

B. ESTIMATING CONSUMPTION BASED ON SERVICE STATISTICS

The service statistics based forecasting method is likely to be most applicable to clinic-based AIDS/STD prevention programs, though the technique can be applied in any setting in which clients are counted and dispensing protocols are standardized.

As with family planning programs, separate estimates must be prepared for each different dispensing protocol that the program uses. In the family planning example of Chapter V, commodities for new visits and revisits were computed separately, because quantities dispensed to a new client differed from quantities dispensed to old clients.

AIDS/STD prevention programs might or might not have different protocols for new and old clients, but in any case there are likely to be separate protocols for different target population segments. A program which dispenses to commercial sex workers, military recruits, and sexually-transmitted disease clinics, for example, may well need to prepare separate projections for each group, as each group's usage pattern is likely to be quite different.

C. ESTIMATING CONSUMPTION USING POPULATION DATA

All AIDS/STD prevention programs, new or old, should be able to prepare forecasts based on data regarding the population(s) to be served or targeted. It is essential that population based estimates *not* be made using overall population size or sero-prevalence in the general population, as some forecasting methods recommend. These measures determine the severity of the epidemic and the total potential *need* for condom protection. Need, however, does not equal the *demand* for condoms, even where the scope of the epidemic is well known in the population at large: demand is usually substantially less than the actual need. This is seen in family planning programs which, for decades, have documented the gap between knowledge and attitudes, and between attitudes and practice, regarding all sorts of contraceptives, including condoms. Though the consequences of becoming infected with HIV far outweigh the consequences of pregnancy, experience with other sexually transmitted diseases indicates that fear of adverse consequences is a weak motivator of sustained behavior change among

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members of high risk groups. Though individuals may know that they are at risk of HIV or other STD infection, they may not use condoms consistently or at all to prevent infection.

Figure 23 shows condom-specific prevalence rates found in selected developed and developing countries. These figures are taken from DHS's, Reproductive Health and Family Planning Surveys, or the U.N.'s World Contraceptive Use 1994 wall chart. These sources have traditionally interviewed only women. Where couples have been interviewed, the partners' reports of condom use are frequently different from one another. For these reasons, condom prevalence figures must be interpreted with caution. Nonetheless, in these surveys very few countries — developing or developed — have reached a condom prevalence rate of 10% or higher, and the majority have rates of under 5%. Thus forecasts based on an assumption of 20% prevalence of condom use in the general population — or even on 10% or 5% — may vastly overstate condom consumption.

Forecasts should be prepared for specific high-risk groups to be served, rather than assuming that the entire general population will be reached. Population data based forecasts for these programs will require separate estimates for different segments of the target population, since condom use rates vary drastically between, for example, semi-monogamous married couples and commercial sex workers. Segments that are quite different in sexual behavior, including frequency of sexual relations, coital frequency, sexual practices, and the prevalence of condom use must be differentiated and quantified separately.

The first step in preparing a population based estimate for such programs should be definition of the target segments, and estimation of the size of each segment. For example, the target population might be commercial sex workers. One segment might be female, illiterate brothel workers who are in the lower income group, working in the hotel district of a capital city. Another might be women between the ages of 15 and 20 who work for escort services which cater to clientele staying in higher priced hotels in the tourist area of the capital.

Once the target population has been segmented into appropriate risk/practice groups, it is necessary to establish quantities of condoms which would be required to protect a member of each group over a specific time period. It would usually be a dangerous simplification to apply the standard CYP factors of Figure 20 to an AIDS/STD prevention program, because AIDS/STD programs are rarely designed to serve the same general population as family planning programs. Accordingly, it is necessary to define separate consumption factors, here called "Segment Member Year of Protection" or SYP factors, for each different target population segment. The definition of SYP is the functional equivalent of CYP: the number of condoms required to protect a *full time user of condoms* for one year.

There are little data at present upon which to base SYP factors for particular target segments. Programs may initially have to choose SYP's on the basis of local experts' estimates, or on interviews with small samples of clients from each segment. For some segments, one of the standard CYP factors may be sufficient. In any case, the factors should not be based simply

Figure 23
CONDOM SPECIFIC PREVALENCE RATES

COUNTRY	RATE	COUNTRY	RATE	COUNTRY	RATE
WORLD	5	Portugal	6	Viet Nam	1.2
AFRICA	1	St. Lucia	6	Zimbabwe	1.2
ASIA/OCEANIA	3	India	5	Dominican Republic	1.2
EASTERN ASIA	2	Venezuela	5	Thailand	1.1
OTHER COUNTRIES	4	Belgium	5	Swaziland	1
LATIN AMERICA	2	Puerto Rico	5	Philippines	1
MORE DEVELOPED	14	Martinique	5	South Africa	1
		Germany	4	Oman	1
Japan	48	Australia	4	Syria	1
Finland	32	Hungary	4	Iraq	1
Hong Kong	26	Austria	4	Lesotho	1
Sweden	25	France	4	Cameroon	0.9
Singapore	24	Romania	3.9	Morocco	0.9
Denmark	22	Guyana	3	Burkina Faso	0.8
Grenada	22	Bangladesh	3	Indonesia	0.8
Slovakia	21	Montserrat	3	Kenya	0.8
Jamaica	16.9	Reunion	3	Jordan	0.8
Czech Republic	16.6	Honduras	2.9	Tanzania	0.7
United Kingdom	16	Colombia	2.9	Algeria	0.5
Costa Rica	15.7	Peru	2.8	Haiti	0.5
Poland	14	Pakistan	2.7	Madagascar	0.5
Norway	14	Paraguay	2.6	Zaire	0.5
Mauritius	13.3	Nicaragua	2.6	Nepal	0.5
Italy	13	Ecuador	2.6	Gambia	0.4
Spain	12	Egypt	2.4	Nigeria	0.4
Trinidad & Tobago	11.8	El Salvador	2.4	Senegal	0.4
USA	11	Bahamas	2	Togo	0.4
Republic of Korea	10	Panama	2	Ghana	0.3
Bahrain	8	Cuba	2	Bolivia	0.3
Switzerland	8	Yugoslavia SFR	2	Namibia	0.3
New Zealand	8	Kuwait	2	Rwanda	0.2
Netherlands	8	Qatar	2	Mauritania	0.1
Canada	8	Bulgaria	2	Burundi	0.1
Barbados	7	Malawi	2	Ethiopia	0.1
St. Vincent	7	Mexico	1.9	Sudan	0.1
Turkey	6.6	Sri Lanka	1.9	Yemen	0.1
St. Kitts & Nevis	6	Belize	1.9	Benin	0.1
Guadeloupe	6	Zambia	1.8	Mali	0
Iran	6	Brazil	1.4	Cote D'Ivoire	0
Antigua	6	Botswana	1.3	Liberia	0
Malaysia	6	Tunisia	1.3	Uganda	0
Dominica	6	Guatemala	1.2	Niger	0

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on estimates of frequency of sexual encounters: in addition to the inaccuracies inherent in such figures, not every sexual encounter requires use of a condom for protection. Whatever factors are chosen initially, the program should move swiftly to design and implement small operations research-type client surveys to establish more accurate figures.

Once SYP factors have been selected, the *Total Need* for condoms for a segment for any year of the forecast can be calculated simply as:

$$\text{Total Need} = \text{Population Segment Size} \times \text{SYP}$$

For example, assume that the population of commercial sex workers is estimated to be 10,000, and 2,000 are found to be in the first segment of brothel workers. From surveys, it is estimated that each of these brothel workers has, on average, sexual encounters in which a condom should be used 6 times a night, 5 nights a week, for 50 weeks of the year. This gives a total of 1,500 sexual encounters which require a condom. Thus the SYP, the number of condoms to protect a user in this segment, is 1,500.

The Total Need is then simply:

$$\begin{aligned}\text{Total Need} &= 2{,}000 \times 1{,}500 \\ &= 3{,}000{,}000\end{aligned}$$

As mentioned above, however, need does not equal either demand or consumption. The Total Need is the maximum number of condoms that would be used if every member of the segment used a condom with every sexual encounter. However, not all members of a population segment will do so. *Total Current Need*, defined as the quantity needed to fully protect those members of the segment who are actually using condoms, can be calculated as:

$$\text{Total Current Need} = \text{Total Need} \times \text{Percent of Segment Using Condoms}$$

For example, if 40% of the population segment members report, when surveyed, that they are current users of condoms, then

$$\begin{aligned} \textit{Total Current Need} &= 3{,}000{,}000 \times 0.40 \\ &= 1{,}200{,}000 \end{aligned}$$

This figure and example represents the quantity of condoms required to protect the members of the segment *if members of the segment who report using condoms use condoms consistently in all sexual encounters*. No country boasts a 100% usage rate of condoms, even among current users. Therefore, the consumption estimate for each population segment should be further adjusted by the condom consistency of use rate reported by current users:

$$\textit{Total Current Demand} = \textit{Total Current Need} \times \textit{Consistency of Use Rate}$$

So, if on average, self-reported current users of condoms state that they use condoms about 50% of the time, then:

$$\begin{aligned} \textit{Total Current Demand} &= 1{,}200{,}000 \times 0.50 \\ &= 600{,}000 \end{aligned}$$

Most countries lack data on Consistency of Use Rates for specific target segments. In the short-term, the best guesses of local experts can be used to make the projections, but operations research studies should be instituted quickly to obtain more objective data.

It may be necessary or appropriate to simply use this Total Current Demand as the estimate of condom consumption. However, not all condoms dispensed to users are used for disease or pregnancy prevention. Some may be lost, given to friends, used to practice or familiarize oneself with condoms or simply not used. If the forecaster believes that these quantities are significant, the estimate should be adjusted upward accordingly, using the following formula:

$$\textit{Total Current Consumption} = \textit{Total Current Demand} + \left(\textit{Total Current Demand} \times \textit{User Wastage Rate}\right)$$

For example, if current users report that they only use about 8 out of every 10 condoms that they are given, corresponding to a User Wastage Rate of 20%, then

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$$\text{Total Current Consumption} = 600{,}000 + (600{,}000 \times 0.20)$$

$$= 720{,}000$$

An AIDS/STD prevention program which serves the general population can use this same methodology for estimating consumption. In this case, the population segment to be targeted would be *all* males of reproductive age, and the SYP factor would just be the CYP estimate for the general population. The formula for Total Need would then be:

$$\text{Total Need} = \text{Males of Reproductive Age} \times \text{CYP}$$

using the CYP factors of Figure 20, or, preferably, local data. The other formulas would be the same as shown above.

D. ESTIMATING CONSUMPTION BASED ON DISTRIBUTION SYSTEM CAPACITY

All AIDS/STD prevention programs should be able to prepare estimates of consumption based on distribution system capacity, using the methods described in Chapter VII. As with other new programs, any AIDS/STD prevention program which lacks the data necessary to make a capacity based forecast has not been sufficiently well planned.

E. MAXIMUM RATES OF GROWTH FOR AIDS/STD PREVENTION PROGRAMS

Because AIDS/STD prevention programs are relatively new, worldwide data are insufficient to establish rules of thumb for rates of program growth. However, there are many parallels between the AIDS/STD prevention effort and family planning: Pregnancy (always) and AIDS/STD (usually) originate in sexual activity. The prevention of both requires voluntary and sustained cooperation of both male and female members of the couple, and changes in their most intimate behaviors. From a programmatic viewpoint, AIDS/STD prevention and family planning require both preventive and curative interventions, sustained in both public and private sectors.

In many cases, collaboration between AIDS/STD and family planning programs is already a reality. Moreover, family planning programs in general, and contraceptive social marketing and community-based distribution programs in particular, have had condom distribution as a

major component of their services for many years. This distribution has taken many forms, including both public and private networks, and using many types of commercial distributors and local people.

It is reasonable to presume, then, that the experience of family planning programs, their limitations, their achievements, and the speed with which they have developed can be taken at least as a rough guide to the likely potential for expansion of AIDS/STD prevention programs. In particular, it seems unlikely that AIDS/STD prevention programs will see increases in consumption which are more rapid than the best social marketing programs have achieved. Whether even these rates will be fast enough to contain the epidemic remains to be seen.

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X. VALIDATING AND RECONCILING THE FORECAST(S)

At this point the forecaster will have prepared (or will have been given) forecasts based on as many data sources as are available; the next step is to validate and reconcile the forecast(s), working in collaboration with program managers to complete a "best" forecast of commodity consumption. This process involves:

- examining the different individual projections to identify the weaknesses of the various data sources and assumptions used;
- comparing and contrasting the acceptable forecasts; and
- using good judgement to select a final answer.

A. THE NEED FOR FORECAST VALIDATION

A perfect forecast is one based on complete, accurate and relevant data, projecting a phenomenon for which the future can be reliably predicted from the patterns of the past. In such circumstances, the forecaster's projection should be exactly correct, as proven by data gathered as the future unfolds.

Unfortunately, family planning and AIDS/STD prevention programs do not operate in such a perfect world: Data are almost never complete nor completely accurate. Future consumption patterns may be only loosely related to the past. The assumptions which must be made to convert population and service data to consumption estimates are questionable, and frequently must be made on the basis of managers' best judgements rather than hard data. And data gathered subsequently to judge forecast accuracy are also likely to be incomplete, making it more difficult for the forecaster to learn from his/her mistakes.

Yet forecasts must be made, and commodities must be purchased, at substantial and ever-increasing cost. Where donors are involved, the local organization may not even be aware of the purchase price, though the expenditure is great: USAID alone, for example, spends some US$ 60,000,000 annually on contraceptives. Even more important than these cash outlays are the program costs in credibility and wasted time when supply imbalances occur, and the cost to clients — measured in pregnancies, illness, or death — when there are stockouts.

For both human and financial reasons, then, the forecaster should spare no effort to produce the most accurate possible forecast. However, it is important to understand that in the

environment in which family planning and AIDS/STD prevention programs operate the forecast will *always* be wrong; the forecaster at most can hope to reduce the forecast error to a level that will not have severe programmatic or cost implications for the organization or its clients.

It is for these reasons that this manual recommends preparation and comparison of multiple forecasts from independent data sources. This strategy serves to highlight the strengths and weaknesses of each data source and mathematical assumption, and demonstrates the consistency (or inconsistency) of the resulting forecasts, allowing program managers to make an informed judgement in selection of the "best" projection. Increased accuracy — and defensibility — of the final forecast will always justify the extra labor. Even when data limitations prevent preparation of multiple forecasts, the quality of the single forecast should be explicitly judged.

B. EVALUATION OF INDIVIDUAL FORECAST QUALITY

Evaluating the quality of an individual forecast involves at least the following:

- *Assessment of source data strengths and weaknesses*: Completeness, accuracy, and timeliness of the data at least in part determine the accuracy of the forecast. A logistics data forecast made using an LMIS which has 90% reporting through the most recent quarter is likely to be much better than one made using an LMIS that is nine months behind in data processing and which has only 50% reporting.

- *Assessment of the reliability of forecast assumptions*: Because of the mathematics, a small error in assumptions used for calculating estimated consumption (e.g., CYP, prescribing protocols) may make a very large difference in total quantities projected. The reliability of these conversion factors must be carefully judged.

- *Assessment of external or programmatic events which may affect either the historical data or the forecast*: Local political and economic events such as strikes, civil unrest, or famine may have reduced past demand for services (or may affect future demand). Similarly, programmatic events, including stockouts or introduction of a new method, may mean that future consumption cannot be modelled by previous patterns.

- *Assessment of the methodologies used in completing the forecast calculations*: The forecasting methodologies presented in previous chapters of this manual are theoretically simple and mathematically

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sound. However, the total number of calculations required for any but the smallest programs is very large. Especially where the forecasts are prepared manually, the math should be reverified, preferably by someone other than the original forecaster. Where forecasts have been prepared by different methodologies than those suggested here, both theoretical and mathematical soundness should be checked.

All of these assessments except (perhaps) the last can best be made by program managers themselves, and it is essential that they be involved in the forecasting and validation process from the outset, particularly if the forecaster is an external consultant.

Figure 24 through Figure 27 present the minimum list of questions which should be asked and answered in evaluating forecasts based on logistics data, service statistics, population data, and service delivery capacity. Once the forecaster and program managers have completed this analysis for all the available projections, the final forecast of consumption can be prepared.

C. FORECAST RECONCILIATION

The above analysis will reveal whether the individual forecasts are technically and methodologically sound. Any which are not should be discarded. The remaining forecasts should then be compared and reconciled to produce the "best" consumption estimate.

This comparison is the essence of the validation process; as with the basic projection techniques described in previous chapters, the comparison is most easily accomplished by graphing all the projections for a product on a single graph. If forecasts prepared from several separate data sources have produced substantially congruent results (say, within 10% of each other), the forecaster can be confident that all the data and assumptions used in the process are at least consistent; it will probably not be possible to produce a "better" forecast.

If the forecasts differ substantially, which is more common, then some or all data and assumptions are incorrect. It is at this point that the forecasting process becomes more art than science, and that program knowledge becomes more important than mathematics. The forecaster and program managers in essence have three choices:

1. *Average the acceptable forecasts*: If all forecasts are judged equally good (or equally bad), a simple average might be used as the final forecast.

Figure 24

EVALUATING LOGISTICS DATA BASED FORECASTS

QUESTION	ASSESSMENT
1. Were Dispensed to User data used to make the forecast? If not, what level issues data were used?	Dispensed to User data provide by far the best estimate. The higher the level from which issues data are used, the less reliable the projection; service delivery site visits should have been made to determine whether issues data are an adequate substitute for Dispensed to User data. Except in the smallest distribution systems, projections based solely on central level issues data are unacceptable.
2. What percentage of reports from SDP's or warehouses were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	The higher the percentage of facilities not reporting, the less reliable the projection. The greater the variability in data which *were* available, the more uncertainty the adjustments for missing data introduce.
3. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	The more historical data used for the extrapolation, the more reliable the forecast. For an annual projection, a minimum of 2 to 3 years' of quarterly data (i.e., 8 to 12 data points) should be used. The higher the number of missing reporting periods, the less reliable the projection. The greater the variability in data among time periods which *were* available, the more uncertainty the adjustments for missing time periods introduce.
4. Were losses reported separately from consumption or issues data? If not, what adjustments were made to account for system losses?	All logistics systems have product loss in storage and transit, and any LMIS which reports zero losses is immediately suspect. Adjustments for losses should be made based at least on surveys of a sample of storage facilities at all levels, but in practice this is very difficult to accomplish.
5. Were there stockouts during the time period covered by the data? If so, what adjustments were made to estimate true demand?	The greater the percentage of time during which one or more products were stocked out, the less reliable the forecast. The greater the variability in data among time periods in which stocks *were* available, the more uncertainty the adjustments introduce.

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QUESTION	ASSESSMENT
6. Were there special circumstances affecting past demand which no longer affect the program? If so, what adjustments were made to consumption estimates?	Political, economic, or other external circumstances may have affected historical consumption trends either positively or negatively, and may similarly affect future consumption. If the projection has been adjusted to account for changes in such external circumstances, a rational justification for both direction and size of the adjustments should be given.
7. What was the basis for projection of future consumption? What adjustments, if any, were made to the extrapolation of historical data?	*Simple extrapolation* of historical data may not be appropriate, depending on the answer to the above questions. If based on *program plans*, significant differences from the historical pattern must be satisfactorily explained. If based on *government or donor targets or policies*, projections which differ from historical patterns are very suspect. If based on *funding or other resource constraints*, justification for anticipated consumption levels should be given, along with an explanation of plans to cover demand which will not be met by currently available resources.

Figure 25

EVALUATING SERVICE STATISTICS BASED FORECASTS

QUESTION	ASSESSMENT
1. Were Visit data (either in total or broken down by visit or client type) used to make the forecast? If not, what service statistics were used? Are service data definitions written down? Do service delivery staff understand them?	If any data other than Visits/Revisits were used (e.g., New/Continuing Users), the conversion from service statistics to consumption estimates will be very difficult, and the conversion process must be documented completely. In any case, data definitions must be absolutely clear to staff who record and report services data. If definitions are not well documented and understood, recording inconsistencies should be suspected which will make the forecast less reliable.
2. Are prescribing protocols documented and understood by service delivery staff? What evidence is there that such protocols are routinely followed?	The assumption regarding quantities of each product dispensed at each visit critically affects forecast accuracy. If the protocol specifies that 10 condoms should be dispensed to each client but staff in fact give 12, the forecast will be off by 20%. If protocols are not written and disseminated to staff, the basis for the conversion factor should be carefully investigated. If there has been a history of shortages or over-supply in the program, the likelihood that prescribing protocols are not strictly followed is higher.
3. What percentage of reports from SDP's were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	The higher the percentage of facilities not reporting, the less reliable the projection. The greater the variability in data which *were* available, the more uncertainty the adjustments for missing data introduce.
4. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	The more historical data used for the extrapolation, the more reliable the forecast. For an annual projection, a minimum of 2 to 3 years' of quarterly data (i.e., 8 to 12 data points) should be used. The higher the number of missing reporting periods, the less reliable the projection. The greater the variability in data among time periods which *were* available, the more uncertainty the adjustments for missing time periods introduce.

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QUESTION	ASSESSMENT
5. Were there special circumstances affecting past service levels which no longer affect the program? If so, what adjustments were made to service activity estimates?	Political, economic, or other external circumstances may have affected historical service levels either positively or negatively, and may similarly affect future service levels. If the projection has been adjusted to account for changes in such external circumstances, a rational justification for both direction and size of the adjustments should be given.
6. What was the basis for projection of future service levels? What adjustments, if any, were made to the extrapolation of historical data?	*Simple extrapolation* of historical data may not be appropriate, depending on the answer to the above questions. If based on *program plans*, significant differences from the historical pattern must be satisfactorily explained. If based on *government or donor targets or policies*, projections which differ from historical patterns are very suspect. If based on *funding or other resource constraints*, justification for anticipated service levels should be given.

Figure 26

EVALUATING POPULATION DATA BASED FORECASTS

QUESTION	ASSESSMENT
1. What source(s) were used for Total Population, WRA, Percent in Union/Sexually Active, Total Fertility Rate (if used in the projection), CPR, Method Mix, Brand Mix, Source Mix? Are there known problems with or biases in these surveys?	DHS's and Reproductive Health and Family Planning Surveys are the most carefully designed and executed demographic surveys, though local surveys may also contain data appropriate for local program forecasts. Local surveys may be especially useful for programs which do not provide nationwide coverage. Where local surveys are used, survey instruments, sampling plans, and data processing protocols should be examined for appropriateness, with the help of demographers or survey researchers as needed. Condom prevalence figures are likely to be problematic, as most surveys target female rather than male respondents, and concentrate on family planning activity, in some cases missing or underestimating non-family planning use of condoms. Survey figures for other contraceptive methods are likely to be more accurate.
2. How old were these demographic data? If adjustments were made to older data to obtain base year estimates for the forecasts, what methodologies were used?	The older the data, the less reliable the forecast. Ideally, the date of the primary survey source will have been used as the base year for the survey. If adjustments to survey data were required to obtain base year figures, WRA estimates should preferably be taken from the U.S. Census Bureau's International Database or from the U.N.'s World Population Prospects. CPR adjustments should preferably be taken from the U.N.'s Levels and Trends of Contraceptive Use, or computed from TFR estimates using the Target-Cost Model. Other methodologies and assumptions should be fully explained.
3. What was the basis for the estimate of Program Proportion of Each Method?	Population data surveys rarely cover exactly the same target population as a service program. Few surveys other than the DHS's provide source breakdowns, and the DHS source breakdowns may not relate directly to particular service programs. This assumption is critical, and its basis should be carefully examined; the forecast will be in error by the same percentage that this figure is in error.

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QUESTION	ASSESSMENT
4. What CYP/SYP factors were used to calculate commodity requirements?	Most programs will have no choice other than the worldwide average estimates. These are reasonably reliable for orals, IUD's, injectables, and NORPLANT®, but more problematic for condoms and VFT's. Accordingly, forecasts for these latter methods will be less reliable. SYP assumptions should be examined closely for forecasts of AIDS prevention programs which serve specific target populations; there are at present few hard data on which to base SYP estimates.
5. If brand-specific projections were made, what was the basis for disaggregating method-specific data into individual brands?	Brand-specific projections are always needed for forecasts made for procurement purposes. If logistics data on brand-specific distribution are available, they should be used as the basis for disaggregating by brands (and they should also be used to prepare a logistics data based forecast). If such data are not available, brand-specific estimates will be less reliable, though method-specific aggregates may still be acceptable.
6. How were population data changes over the forecast period estimated?	WRA estimates should preferably be taken from the U.S. Census Bureau's International Database or the U.N.'s World Population Prospects. If these sources were not available, the methodology used to estimate WRA should be fully explained. CPR should preferably be taken from the U.N.'s Levels and Trends of Contraceptive Use, or computed from TFR estimates using the Target-Cost Model. Projected changes in nationwide CPR of more than one percentage point per year (for CPR $\leq$ 20%), or of more than two percentage points per year (for CPR between 20% and 50%) should be reviewed carefully, and compared to the appropriate estimates in Levels and Trends of Contraceptive Use. These ranges may not apply to AIDS prevention programs serving particular target populations, but strong justification for higher estimates should be given. Projections based on *government or donor targets or policies* which differ from historical patterns are very suspect.

Figure 27

EVALUATING DISTRIBUTION SYSTEM CAPACITY BASED FORECASTS

QUESTION	ASSESSMENT
1. Does the program have a properly designed and functioning Max-Min inventory control system at every program level and facility?	If Max-Min policies are not set and followed, a distribution system capacity based forecast will not be valid.
2. What simplifying assumptions were made about stock level policies in preparing the projection?	Max and Min policies may be different at different levels or at individual facilities in the distribution system. If averages or other simplifying assumptions were used in preparing the forecast, these should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
3. What simplifying assumptions were made about storage capacity?	Storage capacity is likely to be different for different facilities, and averages or other simplifying assumptions will likely be necessary to reduce required calculations to a manageable level. These should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
4. What simplifying assumptions were made about transportation capacity?	Transport capacity is likely to be different for individual links in the distribution pipeline, and averages or other simplifying assumptions will likely be necessary to reduce required calculations to a manageable level. These should be examined to determine their likely effect on forecast accuracy. The more variability from place to place, the more uncertain the forecast.
5. What simplifying assumptions were made about Quantities Dispensed to Users at the service level of the distribution system?	Quantities to be transported are calculated based on the average Quantity Dispensed to Users for resupply, or on the Maximum Stock Quantity for initial supply to a new service delivery point. If these consumption data are estimates, or averages used for simplicity of calculation, the forecast will be more uncertain.

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2. *Weight the acceptable forecasts according to their perceived accuracy*: If one or two forecasts are judged superior to the others, a weighted average could be used as the final forecast.

3. *Choose the strongest forecast and discard the rest*: If one forecast seems clearly superior to all the others, it could just be accepted as final. If two forecasts seem clearly superior, they could be averaged and the weaker forecasts discarded.

In making these choices, it is necessary to consider whether the data sources from which the various projections were made are truly independent. For example, logistics data and service statistics often come from the same MIS, and might therefore suffer from similar data errors and biases. In such cases, a comparison of forecasts from these two sources may not be reassuring. A distribution system capacity forecast might or might not be more independent of suspected MIS flaws.

Since population data forecasts are completely independent of program data, and since demographic data are frequently available, a comparison between a population data based forecast and forecasts made by any of the other methods should be made whenever possible. If consumption estimates have been prepared for all projections, a direct comparison can be made. Alternatively, CYP factors can be used to convert consumption forecasts to an estimate of Contraceptive Prevalence Rate (CPR) for comparison to demographic projections.

Appendix 6 contains a completed example forecast for one brand of orals — Lo Femenal — for the fictitious country of Anyland, made using all four data sources discussed in previous chapters. In order to reconcile these forecasts, it may be desirable to display alternate projections in tabular form for discussion with program managers, particularly when forecasts for several products are being prepared simultaneously. Figure 28 shows an example of such a table for the 1994 forecast, with the Lo Femenal figures completed; subsequent years' forecasts would be displayed in the same format. Figure 29 displays the projections for a single method — again for Lo Femenal — for *all* forecast years in graphical form, which is likely to be easier to understand. Of course, separate graphs would be required for each method and brand.

As explained in Appendix 6, the forecaster and program managers in this case chose to use the logistics data based forecast as the "best" estimate of future consumption. Their reasoning was as follows:

1. The logistics data for 1992 and 1993 were more complete than the service statistics data. For this reason, the forecaster had more confidence in the logistics data based forecast, even though adjustments both for under-reporting and missing data were required in each case.

Figure 28

ALTERNATE FORECASTS OF CONTRACEPTIVE NEEDS
1994

METHOD	LOGISTICS DATA FORECAST	SERVICE STATISTICS FORECAST	POP DATA FORECAST	SERVICE CAPACITY FORECAST	FINAL FORECAST
Family Planning Condoms					
AIDS Prevention Condoms					
Lo Femenal	1,646,000	1,560,000	2,092,159	Feasible	1,646,000
Microgynon					
Depo-Provera®					
NORPLANT®					

2. The trend in consumption shown by the demographic data based forecast parallels the estimates made from logistics data. This fact further strengthened program managers' confidence in both the forecasts. The absolute values of the demographic data forecast are higher than those included in the logistics data forecast. However, the demographic data based consumption figures are calculated based on both Source Mix and CYP Conversion Factors, which are not known with certainty. Since the logistics data based forecast does not require such assumptions, it seemed more reasonable to use the logistics figures than, for example, to average logistics and demographic estimates.

3. The distribution system capacity forecast indicated that the current distribution system can adequately handle the volume of commodities implied by the other forecasts with a few exceptions, which program managers felt can be remedied with available resources. Thus it was not necessary to adjust the forecast downward based on distribution capacity.

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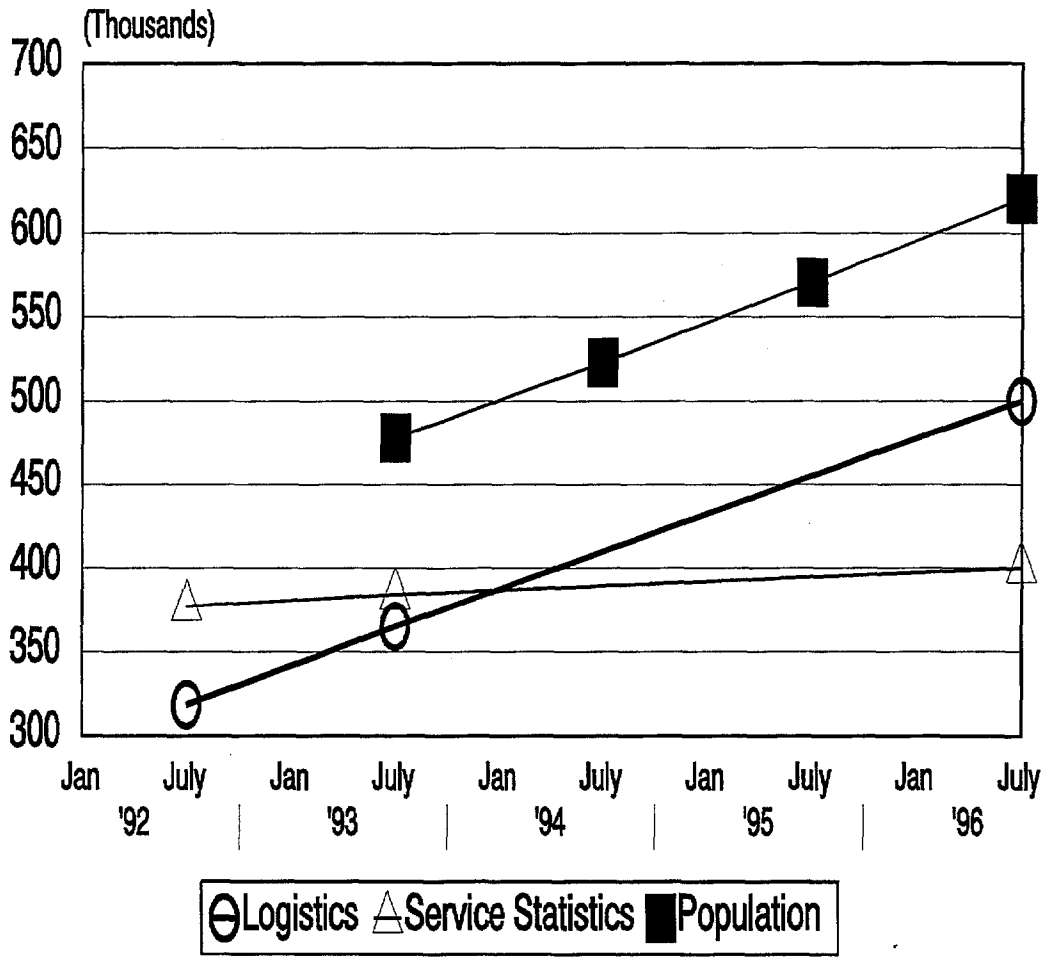
Figure 29

COMPARISON OF THREE ALTERNATIVE PROJECTIONS FOR ANYLAND



Again, it is essential that these deliberations be undertaken in collaboration with program managers. The number of judgements that had to be made even in this simplified, hypothetical example are large, and it should be clear just from the above list that the forecaster cannot make them alone.

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XI. REQUIREMENTS ESTIMATION

After the quantities of contraceptives or AIDS/STD prevention condoms which will be dispensed to users have been estimated, the next step is to determine the quantities that must be procured or requested from donors to maintain continuing availability. Note that the amounts to be procured are *not* the same as the amounts projected to be dispensed to clients; quantities already in the distribution system and desired stock levels must be considered as well.

A. THE BASIC CALCULATION FOR REQUIREMENTS ESTIMATION

Four data items are needed for estimating the quantity of any commodity which should be procured or requested from donors:

- *Stock on Hand*: The quantity of stock on hand *at all levels of the distribution system* at the beginning of the time period of the forecast. For an annual requirements estimation, this is called *"Beginning of Year Stock"*.

- *Shipments Received/On Order*: Shipments which have arrived and are available for distribution since the date of the Stock on Hand/Beginning of Year Stock figures, plus any quantities already on order but not yet received.

- *Estimated Consumption*: The quantity expected to be dispensed or sold to users, preferably projected by the forecasting methods described in this manual.

- *Adjustments*: Actual or projected quantities lost or disposed of due to damage, expiry, or some other reason, and quantities transferred into or out of the distribution system for any reason other than being dispensed to users.

In a well functioning distribution system, these data would be routinely recorded and reported in the program's LMIS; in practice, of course, this is not always the case.

In addition to these data, one further figure is required, which should be a part of the program's logistics management policies:

- *Desired Stock at End of Period*: The desired stock balance at the end of the period, including safety stocks and lead time stocks at *all* levels in the distribution system, and working stocks as appropriate.[10] For an annual requirements estimation, this is called *"Desired End of Year Stock"*.

Once these figures are obtained or estimated, the quantity which should be procured or requested from donors can be calculated simply as:

Net Supply Requirement = *Stock on Hand* + *Shipments Already Ordered/Received* − *Estimated Consumption* − *Losses/Adjustments* − *Desired Stock at End of Period*

That is, the Net Supply Requirement is just the sum of the quantities already available or known to be entering the distribution system (Stock on Hand and Shipments Already Ordered/Received) less the quantities which are expected to leave the system during the time period in question (Estimated Consumption and Losses/Adjustments) less the quantity which program managers wish to have left at the end of the period (Desired Stock at End of Period).

If the Net Supply Requirement resulting from this calculation is a negative number, then the program needs to procure or obtain from donors the calculated amount in order to meet estimated demand and still maintain Desired Stock at End of Period. A positive Net Supply Requirement indicates an oversupply situation; in such cases no procurement is needed for the period.

In programs which use multiple products it may be helpful to present these requirements data in tabular form. Figure 30 shows such a display for a 1994 forecast, with the figures for Lo Femenal for the fictitious country of Anyland that were estimated in the example of Appendix 6 filled in. Subsequent years' forecasts could be displayed in the same format.

Estimated Consumption figures should of course be produced using the forecasting methodologies described in previous chapters of this manual. Issues and considerations in obtaining the rest of these data are discussed below. Data sources, problems, and possible solutions are summarized in Figure 31.

[10] Safety stock, lead time stock, and working stock requirements are described in CDC's Logistics Guidelines and in WHO's Managing Condom Supplies (references in Appendix 1).

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Figure 30

NET SUPPLY REQUIREMENTS FOR CY1994
(1,000's)

METHOD	BEGINNING OF YEAR STOCK CY1994	(+) SHIPMENTS RECEIVED/ ON ORDER	(-) EST'D CONSUMP-TION 1994	(-) LOSSES/ ADJUST-MENTS	(-) DESIRED END OF YEAR STOCK	(=) NET SUPPLY REQUIRE-MENT
Family Planning Condoms						
AIDS Prevention Condoms						
Lo Femenal	1,283.4	562.8	1,646.0	12.0	2,149.7	-1,961.5
Microgynon						
Depo-Provera®						
NORPLANT®						

B. DETERMINING CURRENT STOCK ON HAND

As stated above, the Stock on Hand figure that should be used for requirements estimation for each product should include stocks *at all levels of the distribution system* as of the *beginning of the time period of the forecast*. Either of these requirements can be problematic.

Estimating Stock on Hand At All Program Locations

If the LMIS is fully functional, Stock on Hand figures should be available for all program locations. A physical inventory conducted at all levels of the distribution system would also provide correct figures[11]. In other situations, stock balances will have to be estimated.

[11] Procedures for conducting physical inventories are described in CDC's Logistics Guidelines and in WHO's Managing Condom Supplies (references in Appendix 1).

Figure 31

DATA SOURCES, PROBLEMS, AND SOLUTIONS

BEGINNING OF YEAR STOCK

Sources	Problems	Solutions
-stock cards -LMIS -physical inventory	-underreporting -incomplete records -out of date records -inconsistent records -no records	-do physical inventory -estimate based on data from a higher level -average data from multiple sources

ADJUSTMENTS

Sources	Problems	Solutions
-stock cards -LMIS -destruction reports -physical inventory -shipping or receiving records	-underreporting -lack of reporting -lack of facility for recording or reporting adjustments -lack of policies for dealing with losses, destruction, etc.	-check inventory records and stocks at clinics and warehouses -check available shipping and receiving reports

SHIPMENTS

Sources	Problems	Solutions
-stock cards -LMIS -donor records -customs or port records -bills of lading or receiving reports	-lack of records or improper recording -lack of information from donors	-seek records of next level up -seek donor records

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Where LMIS reporting is inadequate, the only data available might be the inventory in the central warehouse and, perhaps, the next level down in the system. It is tempting to base Stock on Hand estimates on these data. However, this strategy is equivalent to assuming that there are *no* stocks available at lower levels of the distribution system, and the resulting requirements estimate would cause program managers to overorder by whatever amounts are in fact in inventory at these facilities. Overordering leads to overstocking and perhaps to wastage through product expiry, and in the worst case can so clog the pipeline that products of all sorts cannot be moved.

Thus lower level stocks should never just be ignored. In programs which have some LMIS data available for these levels, adjustments for incomplete reporting or missing time periods (or both) can be made using the procedures described in Chapter III. This approach will have the same pitfalls as estimating consumption on this basis, as described in Chapters III and X.

Where such information is not centrally available, it is essential that an effort be made to gather hard data on which to base estimates of lower level balances. At minimum, field visits to all levels of the distribution system must be made to count commodities at selected facilities of each type. If such field visits were needed in preparation for making a logistics data based forecast, data on stock balances should of course be collected simultaneously. If possible, a more formal mini-physical inventory should be undertaken, including a representative sample of facilities and service delivery points at lower levels, and all significant warehouses at higher levels. In either case, Stock on Hand counts should be disaggregated by product expiry or manufacture date, to facilitate estimation of current and future product losses.

If the program has established Max-Min inventory control procedures[12], the field review should determine whether service delivery points and warehouses are operating within their prescribed Maximum and Minimum levels. If the locations are found to be in compliance, field Stock on Hand can be assumed to be at a level half way between Max and Min.

In large programs with multi-level distribution systems, significant quantities of product may be in transit in the country between one level and the next at any point in time. When field visits, mini-physical inventories, or complete physical inventories are taken, information on stocks in transit should be gathered; if appropriate, a percentage should be added to stock balance data gathered from warehouses and SDP's to account for these products.

[12] Max-Min inventory control procedures are described in CDC's Logistics Guidelines and in WHO's Managing Condom Supplies (references in Appendix 1).

Estimating Stock on Hand at the Beginning of the Forecast Period

It is rare that a requirements estimate is prepared exactly at the beginning of the forecast period. For a calendar year estimate beginning in January, for example, the forecast might be prepared in November or December, or maybe the following February. Even if the forecast is prepared in January, it is likely that LMIS reporting will be current only through the previous month or quarter, so that January 1st data will in any case not be available at the time the requirements estimate is made.

In the case of a requirements estimate prepared *after* the beginning of the forecast period, it is more likely that stock balance data as of the beginning of the forecast period will be available. If so, balances on the first day of the forecast period should be used for the requirements calculation, even though more current information may already have been reported.

If the requirements estimate is being prepared *before* the beginning of the forecast period (or if LMIS reporting and processing is delayed), it will be necessary to project the Stock on Hand balance as of the beginning of the forecast period. This is done by adding any shipments expected to be received before the forecast period begins to the present inventory level, and subtracting estimated use and anticipated losses for this period. That is,

Stock on Hand at Beginning of Forecast Period = *Current Stock on Hand* + *Anticipated Shipments* − *Estimated Consumption* − *Losses/ Adjustments*

In any case, Stock on Hand data and assumptions used for the requirements estimate should be documented completely. One easy way to display such information is shown in Figure 32, which shows estimated stock balances by distribution system level, along with details of assumptions which were made in arriving at the balances, again with the hypothetical figures for Lo Femenal from the Anyland example of Appendix 6 filled in.

C. DETERMINING SHIPMENTS ALREADY RECEIVED/ON ORDER

It is essential that the requirements estimation calculation account for shipments already in process, and the forecaster must ensure that such shipments are neither omitted from consideration nor double counted.

Once the beginning date of the requirements estimate is set and the Stock on Hand is calculated, *any* shipments which are not included in the Stock on Hand figures but are known to be in process should be counted as Shipments Already Ordered/Received. These include:

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Figure 32

ESTIMATED STOCK ON HAND AT ALL LEVELS AS OF JANUARY 1, 1994

METHOD	CENTRAL MEDICAL STORE	REGIONAL STORES	DISTRICT STORES	SERVICE DELIVERY POINTS	TOTAL STOCK ON HAND
Family Planning Condoms					
AIDS Prevention Condoms					
Lo Femenal	746,600*	417,950	N/A	118,889	1,283,439
Microgynon					
Depo-Provera®					
NORPLANT®					

* Includes 12,000 cycles expiring April, 1994.

Central and regional balances are actual figures reported by each store, based on 1993 year-end physical inventory.

SDP balances are based on LMIS reports, adjusted for missing data. Region 2 year-end figures were unavailable; SDP figures for Region 2 were calculated on the assumption that all facilities had an average of 1.5 Months of Supply on Hand, using the nationwide Average Quantity Dispensed to Users per Month.

- Commodities already procured by the program or committed to by donors which have not yet been received in country.
- Product which has been received but not yet cleared through customs, and is therefore not included in the central warehouse stock balance.
- For requirements estimates prepared after the beginning of the forecast period, shipments received, cleared, and possibly distributed that were omitted from the Stock on Hand balance because they occurred between

the beginning of the forecast period and the time the requirements estimate was prepared.

Where promises of donated commodities have been made but the commodities have not actually been shipped, program managers must evaluate the strength of each commitment and decide whether to include the promised quantities as Shipments Already Ordered/Received. If commitments have not been made in writing, or if past history suggests the likelihood of significant schedule slippage, a more conservative approach is to omit such quantities from the calculation.

D. ESTIMATING CURRENT AND FUTURE LOSSES

In making allowance for existing stocks, the requirements estimate should consider only currently usable stocks, and those which are likely to remain usable throughout the forecast period.

Commodities which have expired, or which are unusable due to damage in transit or storage should be removed from the distribution system promptly and destroyed in accordance with local laws and any applicable donor guidelines for disposal. Unfortunately, many programs find disposal procedures difficult to implement; in the worst cases, storekeepers may be financially liable for damaged product. In such situations, unusable commodities are likely to remain in the distribution system, and to be included in stock balances reported by the program's LMIS. If the LMIS routinely reports zero losses, or does not report losses at all, this problem should be suspected.

In these cases, a physical inventory is the only way to obtain information on current usables and future losses. Field visits should be made or a mini-physical inventory taken as described above, and stocks should be counted by age of the product, i.e., by manufacturing or expiration dates which are usually found on shipping cartons.

Once these investigations are complete, the forecaster and program managers should agree on the percentage of stocks for each product which are currently estimated to be unusable. In addition, they should determine how much, if any, will expire before it can be used, and estimate other losses which might occur during the time period of the requirements estimate. These quantities should be included in the Losses/Adjustments figure.

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E. IDENTIFYING OTHER ADJUSTMENTS TO INVENTORY

Besides actual and anticipated losses, other types of adjustments to inventory levels may be needed. There are normally two types of adjustments:

- *transfers of product* into or out of the system; and
- *adjustments for data errors* such as a difference between stock balances found through a physical inventory and balances reported by the LMIS.

The most common reason for transfers are loans of product (or repayment of loans) to another program in the country, or in rare cases to another country. It is important that such transfers not just be included with consumption data. Such a strategy would overestimate program consumption by the amount of the transfer, perhaps introducing significant additional error into future forecasts and causing program managers to overorder and overstock.

Note that adjustments might be either positive (product entering the distribution system) or negative (product leaving). However, because Losses/Adjustments are *subtracted* in the requirements estimation formula, the signs are reversed: Transfers out of the program, negative adjustments to inventory, and losses should be recorded as *positive* numbers; transfers into the program and positive adjustments to inventory should be recorded as *negative* numbers.

F. DETERMINING DESIRED INVENTORY LEVELS

The Desired Stock at End of Period should be set high enough to ensure continuous availability of products at all program levels, but not so high that they routinely expire. In setting this policy, program managers should take into account the length of the pipeline to and within the country, storage capacity at all levels of the distribution system, normal and maximum lead times for ordering and receiving supplies, and the volatility of consumption.

Most contraceptive and AIDS/STD prevention program logistics systems operate on variations of the Max-Min inventory control system, in which each storage facility is supposed to maintain stock balances between preset Minimum and Maximum levels, expressed in terms of number of Months of Supply on Hand. The Minimum Stock Levels include not only quantities sufficient to cover demand during the time it takes to replenish supplies, but also a safety stock. The purpose of safety stock is to avoid stockouts when shipments are late, when consumption or losses are higher than anticipated, or when breakdowns occur in the distribution system. In setting these levels, managers must judge the reliability of:

- the distribution system;
- the forecast of consumption and losses; and
- the suppliers.

The less reliable any of these components, the higher the safety stock (and therefore Minimum and Maximum stock levels) needed.

Selecting the level of safety stock should not be a purely subjective decision. Data should be available on timing and reliability of shipments, both in country and from international suppliers. Comparisons of past forecasts to actual performance gives a quantitative idea of forecast reliability. Generally, safety stock and Minimum and Maximum policies are set at relatively high levels initially; they can be increased or decreased as more experience is gained.

Because stock balances are intended to fluctuate between Maximum and Minimum, Desired Stock at End of Period (in months) is ideally calculated by summing the Maximum and Minimum Months' Supply at each level of the distribution system, and dividing by two. This calculation yields a Desired Stock at End of Period (in months) equal to the average of Maximum and Minimum, which is appropriate for stable, mature distribution systems. In a less reliable system, managers should adopt the more conservative approach of setting Desired Stock at End of Period equal to the *Maximum* Stock Level, so that all facilities are topped up completely at the end of the period. In this case, Desired Stock at End of Period (in months) is just equal to the sum of the Maximum Months of Supply at each level of the distribution system. These calculations are illustrated in Figure 33.

In either case the Desired Stock at End of Period (in months) is converted to an actual quantity of product for use in the requirements estimation formula simply by multiplying by the projected average *monthly* consumption in the *following* time period. The following time period's forecast is used instead of the current time period's projection because the end of period balance for each period should be sufficient to cover demand during the subsequent time period. Where usage of a commodity is growing or shrinking rapidly, it is especially important that the following period's forecast be used in this calculation.

In distribution systems with multiple levels or long lead times for procurement, the forecaster and program managers must also be concerned with the total length of the pipeline implied by these calculations. All contraceptives, and particularly condoms, have limited shelf-lives and are susceptible to deterioration in storage. While a program never wants to run short of commodities, neither does it want to destroy contraceptives because of expiration or quality problems. For these reasons, every effort should be made to limit the length of the in-country pipeline, and therefore the Desired Stock at End of Period, to no more than twelve months. A longer pipeline increases the risk that contraceptives will expire before they can

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Figure 33

CALCULATING DESIRED STOCK AT END OF PERIOD
(In Months of Supply)

PROGRAM LEVEL	MAXIMUM STOCK LEVEL (Months)	MINIMUM STOCK LEVEL (Months)
Central	6	3
District	3	2
SDP	3	1
TOTAL	12	6

NORMAL CALCULATION:

$$\text{Desired Stock at End of Period (Months)} = \frac{\text{Total Max Stock Level} + \text{Total Min Stock Level}}{2}$$

$$= \frac{12 + 6}{2}$$

$$= 9 \text{ Months of Supply}$$

CONSERVATIVE CALCULATION:

$$\text{Desired Stock at End of Period (Months)} = \text{Total Max Stock Level}$$

$$= 12 \text{ Months of Supply}$$

be distributed.

G. DETERMINING DESIRED SHIPMENT FREQUENCY

If the time period covered by the requirements estimate is very short, or if the program is quite small, a single shipment from each supplier may be sufficient to provide the required commodities. At the national level, requirements estimates are normally made annually, and, at least in the case of programs which receive product from USAID, for multi-year periods. In these cases, and always for larger programs, multiple shipments will be required to meet the program's commodity needs. Determining the desired shipment schedule should be a part of the requirements estimation process.

Several factors should be considered in determining an appropriate shipment schedule, including at least the following:

- *Ability to store product in country.* Basic storage capacity calculations are described in Chapter VII. If storage space is at a premium, more frequent, smaller shipments can be scheduled; if there is a surplus of storage space, less frequent, larger shipments can be scheduled.

- *Undesirable seasons for product receipt.* Some countries are subject to a monsoon season, typhoons, hurricanes, or other weather problems which make it undesirable to receive shipments during certain time periods. Also, there may be times when the port is busier than others, making it difficult to clear shipments through customs. These factors may necessitate less frequent, larger shipments, or irregular shipping schedules.

- *Economies of scale in shipment costs.* Most ports are equipped to handle containerized freight. This type of freight is usually less costly than bulk shipments, and it is easier to manage, in addition to being safer in terms of product loss and damage. Minimizing the cost, however, requires that full containers be used. Maximum savings will be obtained if shipments can be scheduled in quantities that result in full containers.

- *Product shelf-life.* Less frequent shipments imply higher stock levels and a longer pipeline. Where product shelf-lives are short, procurement lead times are long, or product storage conditions are severe, shipments should be scheduled more frequently. Family

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planning and AIDS/STD prevention programs clearly fall into this category.

- *In-country resupply schedules.* It may be desirable to coordinate shipments from suppliers with the in-country distribution schedule. For example, some programs operate on a quarterly resupply system. If central storage capacity is limited, program managers may want to receive quarterly shipments into the central warehouse after the outgoing shipments to lower program levels have been completed.

All of these factors should be discussed with logistics system managers and central warehouse staff to determine the most desirable shipment schedules. The shipping schedule at the central level is constrained by the central Maximum and Minimum stock level policies, just as the in-country resupply schedules at lower levels of the distribution system are constrained. As described in Chapter VII:

$$\text{Resupply Interval} \leq \text{Max Stock Level} - \text{Min Stock Level}$$

Thus, in the example of Figure 33, shipments must be scheduled at least quarterly.[13]

H. PREPARING MULTI-YEAR REQUIREMENTS ESTIMATES

Donor procurement cycles are very long, and lead times even for commercial procurement of large quantities of contraceptives or AIDS/STD prevention condoms may be measured in years. USAID, for example, begins procurement planning as much as three years in advance of production of commodities. For these reasons, most family planning and AIDS/STD prevention programs will need requirements estimates calculated for two to three years into the future.

Multi-year estimates are made simply by repeating the Net Supply Requirement calculation for as many years as necessary, using the Desired Stock at End of Period as the opening Stock on Hand figure for the following period, and substituting the appropriate projections for Estimated Consumption and Losses/Adjustments. The calculations for each year might be presented to program managers simply as multiple copies of the table format shown in Figure 30 above.

[13] The reader who wishes to understand the reasons for this inter-relationship is referred to WHO's Managing Condom Supplies.

As an alternative, a single table can be prepared for each *product*, showing estimated consumption and requirement estimates year by year. Figure 34 shows an example of such a table, completed using the projection for Anyland.

Note that in this example, the table includes historical data for two years prior to the forecast year, thus showing at least in part the basis for consumption and loss projections. Requirements estimates are produced for two forecast years, and consumption and loss projections are shown for three years. This corresponds to the procurement process used by USAID for commodities it supplies; similar Contraceptive Procurement Tables, supported by desired shipping schedules and documentation of assumptions, are required of programs to which USAID donates contraceptives.[14]

[14] For a complete description of these tables and instructions for their completion, see the USAID Contraceptive Procurement Tables (CPTs) Guidance, produced annually by USAID/G/PHN/POP/CLM.

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Figure 34
1994 Contraceptive Procurement Table

Country: Anyland			Prepared by: Richard C. Owens, Jr.		
Program: MOH/Dept. of Family Planning			Prepared on: January 28, 1994		
Contraceptive: Lo Femenal					
All Numbers in 1,000's					
	1992	1993	1994	1995	1996
1. Beginning of Year Stock	1,419.9	1,146.2	1,283.4	2,149.7	2,357.3
MINUS					
2. Estimated Consumption					
a) Sales or Distribution	1,273.7	1,460.6	1,646.0	1,834.0	2,012.0
b) Loss or Disposal	0	0	12	10	10
c) Transfer or Adjustment	0	0	0	0	0
PLUS					
3. Additional Contraceptives Received or Scheduled					
a) Received	1,000.0	1,597.8	186.0		
b) Scheduled			376.8		
EQUALS					
4. End of Year Stock	1,146.2	1,283.4	188.2	305.7	
MINUS					
5. Desired End of Year Stock: 14 months			2,149.7	2,357.3	
EQUALS					
6. Net Supply Situation					
a) Surplus **OR**					
b) Quantity Needed			1,961.5	2,051.6	

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XII. MONITORING THE FORECAST AND THE DISTRIBUTION CYCLE

The forecaster's job does not end when the requirements estimation is completed. Whether or not the needed commodities are locally procured[15], the entire process of obtaining, distributing, and dispensing the products should be monitored so that quantities to be procured and/or desired shipping schedules can be adjusted to ensure that the needs of the program are continuously met.

A. MONITORING THE DISTRIBUTION CYCLE

Data items which should be monitored throughout the forecast period mirror the actions which should take place in the process of obtaining supplies and getting them to the clients who need them. In particular, the forecaster and program managers should regularly examine the following:

- Quantities needed by the program as calculated in the requirements estimate;
- Quantities purchased by the program or promised by donors;
- Quantities planned to be shipped by commercial suppliers or donors;
- Quantities actually shipped by commercial suppliers or donors;
- Quantities received by the program; and
- Quantities dispensed or sold to clients, and losses due to expiry, damage or other reasons.

In a perfect logistics system supported by perfect forecasts, all of these numbers would be the same. In practice of course, they are not. The safety stocks which should be built into Maximum and Minimum stock policies at all levels of the distribution system provide short-term protection against stockouts when performance at any of these steps is different than

[15] Readers needing information on local procurement are referred to Contraceptive Procurement: Options for Programme Managers, UNFPA, 1994; and Competitive Procurement of Public Sector Contraceptive Commodities: A Reference Manual, PATH, May 1993.

anticipated. If differences are significant, however, program managers must take corrective action swiftly to avoid interruption of supply.

The two basic corrective actions available to program managers are:

1. *Increasing or decreasing the amount of product to be purchased or requested.* Because of contractual arrangements, it may be impossible or very expensive to change the total quantity to be received. The managers of the logistics system must know how much lead time is required for making adjustments in quantities that have been ordered; this lead time may be *very* long.

2. *Changing the shipment schedule to speed up or delay delivery of particular shipments.* In most circumstances it will be easier to change shipment schedules than to change total quantities. However, such changes may also be very expensive (for example if it is necessary to ship by air instead of sea), and the lead time to make such changes may also be long.

In cases where consumption or loss is less than originally forecast, some additional flexibility may be provided by the relatively long shelf-life of most contraceptive products. If storage space is available, in-country stock balances can be allowed to rise above the desired Maximum level, and procurement in subsequent time periods can be reduced to compensate for excess in the current period. Because condoms may deteriorate rapidly in poor storage conditions, it is more difficult to make such adjustments for this product.

The amount by which stock balances can be allowed to fall *below* desired Minimums depends on the amount of safety stock built into the system, and on the length of time needed for subsequent corrections to become effective. Increasing safety stock levels can help to compensate for inflexibility in the procurement and shipping processes, but such a strategy lengthens the pipeline, increases inventory costs, and requires additional storage space at some or all levels of the distribution system.

For all these reasons, it is very important for the initial forecast to be as accurate as possible. One way to monitor the distribution cycle is to set up stock balance records for each commodity, where the estimated quantities to be used and lost are entered for each month of the forecast period. Stock on Hand at the beginning of the period should also be entered, and quantities expected to be received according to the requirements estimate should be entered in the appropriate month. Once this balance record is set up, the projections of consumption, losses, and receipts can be replaced by actual figures on a monthly or quarterly basis, and the stock balances can be recalculated to see that they do not vary significantly from established Maximum and Minimum stock levels.

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An example of such a balance record is shown in Figure 35; this example is from Bangladesh's Logistics MIS. The table displays *nationwide* balances for the Ministry of Health program ("GOB" in the table) and for non-governmental organizations supplied through the MOH ("NGO" in the table). The report was produced in July, 1994, and thus includes actual data through June, 1994, and projections for the remainder of the forecast period. As stated above, the most important data item is Months of Supply on Hand (called "MOS" in the table), as compared to desired Maximum and Minimum levels. These data are easier to understand when displayed as a graph, as shown in Figure 36.

In addition to this program-wide monitoring effort, it is necessary to monitor the entire in-country distribution system, in order to detect and correct local supply imbalances. This is the task of the program's logistics managers; a functioning LMIS is essential for its performance.[16]

B. MONITORING THE FORECAST

The final step is monitoring the accuracy of the forecast itself by comparison of projected consumption and losses to actual consumption and losses. It is through this process that the forecaster and program managers gain the program-specific knowledge and experience to improve their forecasts in subsequent periods.

Actual consumption will always be different from projected consumption. If the differences are significant, the reasons for them should be investigated. It is useful to categorize these into:

- predictable causes; and
- unpredictable causes.

Predictable causes are those which would have been taken into consideration by the forecaster if they had been known. For example, actual consumption of one or more methods might exceed projections if the program mounted a significant promotion half-way through the year. If Information, Education, and Communications (IEC) staff knew of plans for the promotion at the beginning of the forecast period but the forecaster did not, then steps should be taken to ensure that future forecasts adequately account for program plans.

Program performance is of course also affected by causes which cannot be predicted in advance. For example, a rumor that oral contraceptives cause cancer might cause clients to

[16] See CDC's Logistics Guidelines or WHO's Managing Condom Supplies for a full discussion of the necessary techniques.

Figure 35

TABLE 5 : PROCUREMENT AND PIPELINE, DIRECTORATE OF FAMILY PLANNING

STANDARD DOSE ORAL PILLS (C-5) (Cycles)

Period	Opening Stock	Received	Funded By	Shipping Schedule	Consumption GOB+NGO	Yearly Consumption	Closing Stk GOB+NGO	MOS	Remarks
Jul-92		174,498	IDA		4,011,626 R				Ideal Sock level
Aug-92		9,349,331	IDA		4,181,344 R				is between 10-14 Months
Sep-92		6,696,220	IDA		4,352,748 R				of stock (MOS)
Oct-92		18,942,720	IDA		4,278,527 R				
Nov-92		5,313,141	IDA		4,340,712 R				
Dec-92		699,828	IDA		4,398,600 R	25,590,457			
Jan-93		9,792,192	IDA		4,271,159 R				
Feb-93		8,200,000	IDA		4,241,221 R				
Mar-93					4,284,578 R				
Apr-93		5,276,680	KfW,ADB		4,452,851 R				
May-93		6,189,231	KfW,ADB		4,557,181 R				
Jun-93		11,299,251	KfW,ADB		4,608,195 R				
Jul-93		12,265,440	KfW,ADB		4,733,613 R				
Aug-93		5,056,603	KfW,ADB		4,822,151 R				
Sep-93		4,856,670	KfW,ADB		4,919,817 R				
Oct-93		12,644,880	KfW		4,871,318 R				
Nov-93		5,660,460	KfW		4,966,990 R				
Dec-93		5,331,000	KfW		4,890,332 R	55,529,605			
Jan-94		10,128,570	KfW		5,063,425 R				
Feb-94		7,812,000	KfW		5,030,748 R				
Mar-94		3,164,139	KfW		5,061,810 R				
Apr-94					5,224,951 R				
May-94		5,000,000	IDA		5,187,418 R				
Jun-94					5,268,103 R		54,156,885		
Jul-94	54,156,885				5,255,145 F		48,901,740	9.3	
Aug-94	48,901,740				5,307,640 F		43,594,100	8.2	
Sep-94	43,594,100				5,360,136 F		38,233,964	7.1	
Oct-94	38,233,964				5,412,632 F		32,821,332	6.1	
Nov-94	32,821,332		IDA	6,000,000 P	5,466,877 F		33,354,455	6.1	
Dec-94	33,354,455		IDA	5,000,000 P	4,681,912 F	62,320,798	34,672,543	7.4	Low Dose Introduced
Jan-95	34,672,543		UNFPA	5,000,000 P	4,727,913 F		34,944,630	7.4	in 8 pilot districts
Feb-95	34,944,630		UNFPA	5,000,000 P	4,773,913 F		35,170,717	7.4	
Mar-95	35,170,717				4,819,913 F		30,350,804	6.3	
Apr-95	30,350,804				4,865,914 F		25,484,890	5.2	
May-95	25,484,890				4,911,914 F		20,572,976	4.2	
Jun-95	20,572,976				4,957,914 F		15,615,062	3.1	
Jul-95	15,615,062				5,003,915 F		10,611,147	2.1	
Aug-95	10,611,147				5,049,915 F		5,561,233	1.1	
Sep-95	5,561,233				300,467 F		5,260,766	17.5	Low Dose Introduced
Oct-95	5,260,766				303,179 F		4,957,587	16.4	nation-wide
Nov-95	4,957,587				305,891 F		4,651,696	15.2	
Dec-95	4,651,696				308,604 F	40,329,451	4,343,092	14.1	
Jan-96	4,343,092				311,316 F		4,031,776	13.0	
Feb-96	4,031,776				314,028 F		3,717,748	11.8	
Mar-96	3,717,748				316,740 F		3,401,008	10.7	
Apr-96	3,401,008				319,453 F		3,081,555	9.6	
May-96	3,081,555				322,165 F		2,759,390	8.6	
Jun-96	2,759,390				324,877 F		2,434,513	7.5	
Jul-96	2,434,513				327,590 F		2,106,923	6.4	
Aug-96	2,106,923				330,302 F		1,776,621	5.4	
Sep-96	1,776,621				333,014 F		1,443,607	4.3	
Oct-96	1,443,607				335,726 F		1,107,881	3.3	
Nov-96	1,107,881				338,439 F		769,442	2.3	
Dec-96	769,442				341,151 F	3,914,801	428,291	1.3	
Jan-97	428,291				343,863 F		84,428	0.2	
Feb-97	84,428				346,313 F				
Mar-97					346,576 F				
Apr-97					349,288 F				
May-97					352,000 F				
Jun-97					354,712 F	2,092,752			
Total				22,000,000	189,777,864	189,777,864			

Legend

E = The Donor/Procuring Agent is expecting this shipment at the specified month; F = The consumption is forecasted;
N = The shipment is needed to maintain satisfactory stock level; P = The shipment is planned by GOB or Donor; R = The consumption is reported;

Note

- 12 million will be procured from IDA fund. Shipments shown Nov. 94. thru Dec'94, though UNFPA has not yet received written confirmation.
- GOB has asked UNFPA to procure 8 million C-5 from unspent balance of KfW fund. Not shown here due to uncertain status (ref LCC meeting 3/7/94).
- At 13/06/94 meeting MoHFW requested UNFPA to procure 10 m. additional cycles of C-5 (shown arriving Jan'95 - Feb'95). Though this has not been confirmed.
- The reported consumption figures may change due to additional reporting and/or correction sent from stores.
- Forecasted consumption is based on World Bank projection done in April 1993. Forecast assumes low-dose pilot begins in Dec'94 and nationwide in Sep'95.
- Reported/Forecasted closing balance does not include stock in field. (estimated to be 1.6 MOS)

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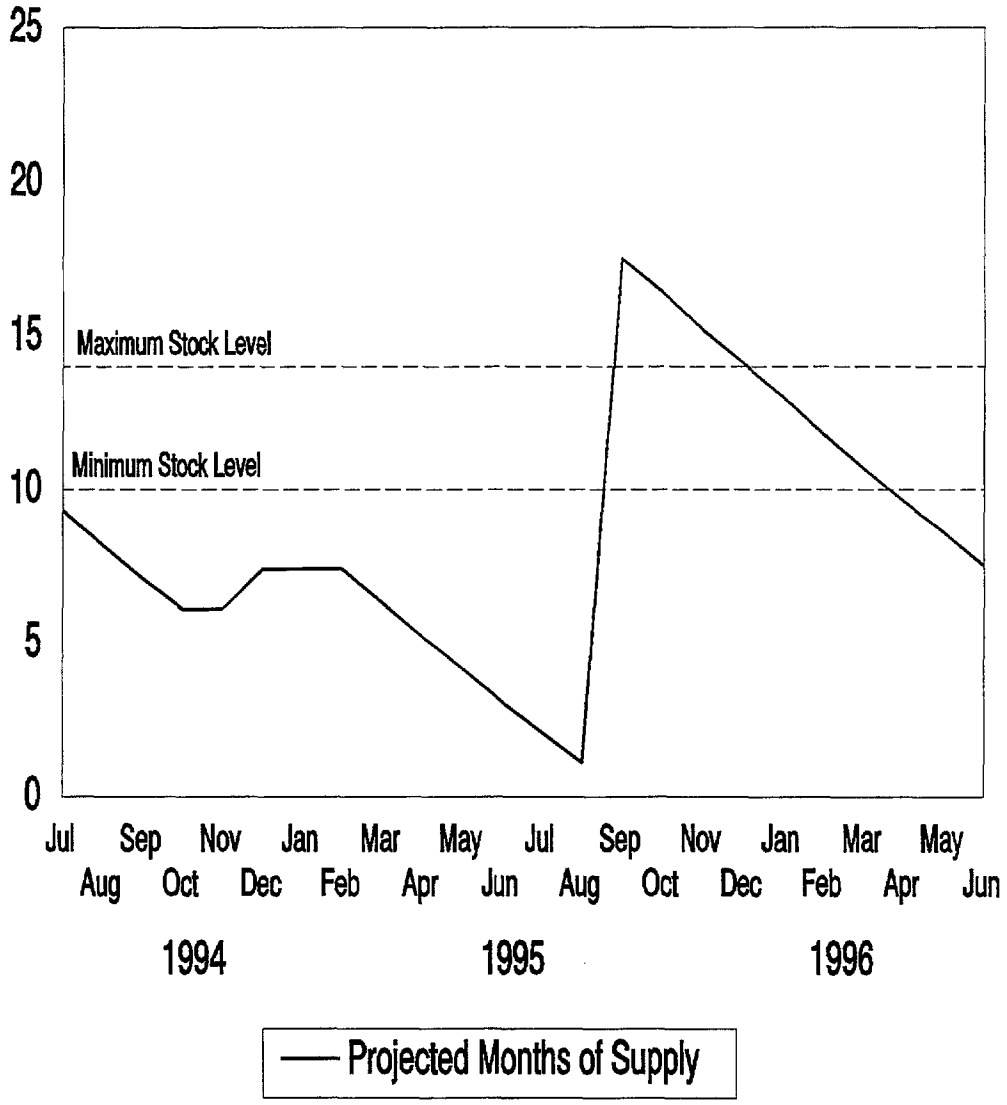
Figure 36

STOCK POSITIONS FOR GOB AND NGO PROGRAMS, BANGLADESH STANDARD DOSE ORAL PILL



switch to another method or to drop out of the program altogether, decreasing demand for orals and perhaps increasing demand for other products. Such differences cannot be eliminated by improving the forecasting process; however, other changes which improve the logistics system's capacity to respond to such variability (e.g., increasing safety stocks or negotiating more flexible contracts with suppliers) may be indicated.

Above all, the forecaster should not be discouraged by such differences. Forecasting for family planning and AIDS/STD prevention programs, as for any human service program, remains as much an art as a science. If the science described in this manual has been applied, if the art has been honest, and if every effort has been made to ensure a continuous supply of products to the clients who need them, then the job was well done.

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APPENDIX 1:
RELATED PUBLICATIONS

A. *FORECASTING AND FORECASTING TOOLS*

Futures Group. Target-Cost: A Model for Projecting the Family Planning Service Requirements and Costs to Achieve Demographic Goals. The Futures Group, 80 Glastonbury Boulevard, Glastonbury, CT 06033 USA. Phone 203-633-3501. Fax: 203-657-9701.

Jain, C. L., and Al Migliaro. Understanding Business Forecasting. Graceway Publishing Company, Inc., New York.

John Snow, Inc. NEWCPT User's Guide, Version 2.2. Family Planning Logistics Management Project, JSI, 1616 N. Fort Myer Drive, 11th Floor, Arlington, VA 22209 USA. Phone: 703-528-7474. Fax: 703-528-7480. Also available from Contraceptives and Logistics Management Division, Office of Population, G/PHN/POP/CLM, SA-18, Room 803, U.S. Agency for International Development, Washington, DC 20523 USA. Phone: 703-875-4412. Fax: 703-875-4413. October, 1994.

Wheelwright, Steven C., and Spyros Makridakis. Forecasting Methods for Management, 4th Edition. Wiley, New York. 1985.

B. *DEMOGRAPHIC DATA*

Bongaarts, John, W. Parker Mauldin, and James F. Phillips. "The Demographic Impact of Family Planning Programs." Studies in Family Planning 21, 6 (1990): 299-310.

Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. Reproductive Health and Family Planning Surveys. CDC Division of Reproductive Health, Behavioral Epidemiology and Demographic Research Branch, Mail Stop K-35, 4770 Buford Highway NE, Atlanta, GA 30341 USA. Phone: 404-488-5260. Fax: 404-488-5965.

Macro International. Demographic and Health Surveys. Macro International, Inc., 11785 Beltsville Drive, Suite 300, Calverton, MD 20705-3119 USA. Phone: 301-572-0200. Fax: 301-572-0999.

Population Reference Bureau. World Population Data Sheet. Population Reference Bureau, Inc., 1875 Connecticut Avenue NW, Suite 520, Washington, DC 20009-5728. Phone: 202-483-1100. Fax: 202-328-3937. Published annually.

United Nations Department for International Economic and Social Information and Policy Analysis, Population Division. Levels and Trends of Contraceptive Use as Assessed in 1988. Department for International Economic and Social Information and Policy Analysis, Population Division, Office of Fertility, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-4996. Fax: 212-963-2147. 1989.

United Nations Department for International Economic and Social Information and Policy Analysis, Population Division. World Population Prospects. Department for International Economic and Social Information and Policy Analysis, Population Division, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-3181. Fax: 212-963-2147. Published biennially.

United Nations Department for International Economic and Social Information and Policy Analysis, Population Division. World Contraceptive Use 1994. Department for International Economic and Social Information and Policy Analysis, Population Division, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-3179. Fax: 212-963-2147. 1994.

United States Bureau of the Census. The International Database. Center for International Programs, Room 207, Washington Plaza 2, Bureau of the Census, Washington, DC 20233-8860. Phone: 301-763-4811. Fax: 301-763-7610.

C. STATISTICAL REFERENCE TEXTS

Sage Publications, Inc. Quantitative Applications in the Social Sciences: A Sage University Paper Series. A series of more than 40 monographs designed for readers with limited background in statistics or mathematics on various data analysis techniques applicable to the social sciences. Sage Publications, C-23

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Defence Colony, New Delhi 110 024, India; 28 Banner Street, London EC1Y 8QE, England.

Zar, Jerrold H. Biostatistical Analysis, 2nd Edition. Prentice Hall, Inc., Englewood Cliffs, NJ USA. 1984.

D. LOGISTICS MANAGEMENT

Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. Family Planning Logistics Guidelines. CDC Division of Reproductive Health, Program Services and Development Branch, Mail Stop K-22, 4770 Buford Highway NE, Atlanta, GA 30341 USA. Phone: 404-488-5612. Fax: 404-488-5967. December 1993.

Program for Appropriate Technology in Health. Competitive Procurement of Public Sector Contraceptive Commodities: A Reference Manual. PATH, 4 Nickerson Street, Seattle, WA 98109-1699 USA. Phone: 206-285-3500. Fax: 206-285-6619. Draft, May, 1993.

United Nations Fund for Population Activities. Contraceptive Procurement: Options for Programme Managers. UNFPA, 220 East 42nd Street, New York, NY 10017. Phone: 212-297-5226. Fax: 212-297-4915. Document Number E/2,250/1993. (French and English.)

United States Agency for International Development. Contraceptive Procurement Tables (CPT) Guidance. Contraceptives and Logistics Management Division, Office of Population, G/PHN/POP/CLM, SA-18, Room 803, U.S. Agency for International Development, Washington, DC 20523 USA. Phone: 703-875-4412. Fax: 703-875-4413. Published annually.

World Health Organization, Global Programme on AIDS. Managing Condom Supplies. Family Planning Logistics Management Project, John Snow, Inc., 1616 N. Fort Myer Drive, 11th Floor, Arlington, VA 22209 USA. Phone: 703-528-7474. Fax: 703-528-7480. Also available from Program for Appropriate Technology in Health (PATH), 4 Nickerson Street, Seattle, WA 98109-1699. Phone: 206-285-3500. Fax: 206-285-6619. Draft 11, June 18, 1991.

E. OTHER RELATED PUBLICATIONS AND REFERENCES

Bertrand, Jane T., Robert J. Magnani, and James C. Knowles. Handbook of Indicators for Family Planning Program Evaluation. The EVALUATION Project, Carolina Population Center, CB 8120 University Square, Chapel Hill, NC 27516-3997 USA. Phone: 919-966-7482. Fax: 919-966-2391. 1994.

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APPENDIX 2:
LMIS ASSESSMENT GUIDELINES

PURPOSE

An LMIS assessment is used to identify gaps which may exist between how an LMIS in a given program should work and how it actually does. Problems, and their possible causes, are identified in an effort to distinguish LMIS-related problems from other issues. Once the causes of LMIS problems are identified, solutions for remedying them can be recommended.

The following guidelines are intended as a general reference for field advisors conducting LMIS assessments. They are intended to be comprehensive in terms of **what** elements of a logistics system and logistics management information system an advisor needs to assess and **how** the assessment should be conducted. In some instances the advisor will be familiar with the system in question and may already know the answers to many of the questions raised by the guidelines. Accordingly, the guidelines will need to be condensed or adapted based on what is and is not known, as well as on the scope of the assessment trip.

Use of these guidelines should not be restricted to formal LMIS assessment visits. Most logistics technical assistance, whether it's commodity requirements estimation, logistics management assistance, or even training needs assessments, requires achieving an understanding of the design and functioning of the LMIS.

STRATEGY

The job of the advisor is to assess the functionality of the LMIS, identify what the problems are and propose solutions. LMIS problems can be divided into three basic types:

Design Problems	(i.e., does it collect and report the essential data)
Operation Problems	(i.e., are reporting procedures followed, does the data flow in a timely fashion)
Use Problems	(i.e., are managers throughout the system actually using the LMIS for decision making)

Using the framework embodied in this guideline, the advisor works through five steps to determine:

What are the logistics system problems,

Which of the logistics problems have LMIS causes, and

Which of the LMIS problems are design versus operation versus use problems.

The advisor should then be better able to identify solutions and make recommendations.

The steps in this process are:

I. Outline the logistics system

II. Outline the design of the current LMIS as it exists on paper

III. Identify design problems

IV. Assess functionality of the logistics system and "actual" LMIS in the field

V. Identify logistics system problems with LMIS causes and recommend solutions

Each of these steps is presented in more detail below. The tasks involved in completing the first three steps can typically be accomplished in the national capital. The fourth step is a field assessment requiring travel outside the capital city. The last step is analytical (based on the first four) and can be completed anywhere.

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STEPS

I. Outlining the Logistics System

To assess an LMIS the advisor needs to first understand the logistics system it serves. For example, an advisor cannot evaluate the reporting-feedback loop without knowing whether a "push" or "pull" type system is employed. Other elements of the logistics system essential to understanding the LMIS include:

- source/s of supply
- products delivered
- type of inventory control system
- maximum-minimum stock levels
- number of levels in the system
- number and type/s of facilities at each level
- type/s of delivery system/s (clinic, CBD, etc.)
- management/supervision structure for distribution
- periodicity of orders and deliveries
- lead times
- storage capacities and constraints
- transport modes/mechanisms (how products are moved between facilities)
- vertical or integrated logistics system (i.e., FP supplies only or integrated with other primary health care supplies)

II. Outlining the Current LMIS Design (as it exists on paper)

Step 2 requires the advisor to interview central level logistics managers and to review all related forms, manuals and guidelines to ascertain what the "de jure" LMIS looks like and

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how it is supposed to work. If this information is not available at the central level the advisor may be able to infer the intended LMIS design from observations at lower levels.

This is an important step because there are often good LMIS designs that exist officially, but which are not actually used, or used uniformly, in the field. This will help the advisor to determine whether the LMIS suffers from *design* problems as opposed to *operation* or *use* problems.

The advisor needs to determine at least the following:

- is there more than one LMIS design for the same program?
- are the ordering and reporting systems the same or do they follow different tracks (i.e., are the people who collect, report, and process the data the same staff who actually order and issue supplies)?
- what logistics data are supposedly collected?
- what forms are supposed to be used for the LMIS?
- who is supposed to be responsible for collecting the data, reporting the data, and processing the data?
- who is supposed to be responsible for overseeing the above?
- how is the reporting cycle supposed to work (reporting interval and flow of data)?
- what decisions are supposed to be made with this data to manage the logistics system and who is supposed to make them?
- when, how often, are the decisions supposed to be made?
- is the LMIS intended to stand alone or is it integrated with other program reporting such as service statistics?
- is the LMIS supposed to be for family planning only or is it integrated with LMIS for other primary health care supplies?

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III. Identifying Design Problems

This step follows from step 2. After outlining the current LMIS the advisor should be able to identify obvious/serious design constraints. Areas to look at include the following:

- are the essential logistics data being collected (beginning and ending balances, quantities received, quantities issued, quantities distributed to users, consumption, lead time, adjustments, quantities needed)?
- are data being collected which do not serve any management purpose?
- is the reporting cycle consistent with timing of decisions which need to be made?
- are the forms for collecting and reporting the data well designed, easy to fill in, easy to aggregate?
- do the forms and data collection procedures actually reflect the service delivery and management structures?
- are the reporting forms consistent with the primary collection forms?
- are there guidelines for system parameters such as definition of terms, standard quantities for distribution to clients, reporting periods, flow of reporting, supervision, feedback, staff responsibilities, etc.?
- are there systems manuals which set out the system parameters?

IV. Assessing the Logistics System and the "Actual" LMIS

This is **the** key step in the assessment. It requires the advisor to make site visits at all levels in the system. The primary goals of the field assessment are to:

- identify the nature and extent of logistics system problems, and
- assess the design, operation and use of the LMIS as it exists in the field.

The field assessment requires the advisor to visit a representative sample of facilities at all levels in the system. It is essential that the advisor get systematic, first-hand knowledge of the functioning of the LMIS and the logistics system in the field. As a rule of thumb, approximately half of an assessment visit should be spent in the field.

Sample Selection: It is important that the sites selected be as representative as possible. The sample should be selected to represent the overall pipeline along a number of characteristics: urban vs. rural, remote vs. central, high vs. low use of family planning, good vs. bad LMIS reporting, etc. For example, in a pipeline with central, regional, district and SDP levels, the advisor might select 2 of the regions to investigate, at least 2 districts in both of the selected regions, and 2 SDPs in each of the selected districts. The goal is to visit as many facilities as possible in the allotted time, and to select a diverse sample which will represent low as well as high end locations. Once the sample and the route of the site visits have been determined, the advisor needs to make travel arrangements and whatever arrangements are dictated by protocol.

Methodology: Although the advisor can begin at SDPs and track logistics information as it flows up from level to level, protocol will often require the advisor to begin at the central level and work his/her way down to SDPs. At each level there are eight steps to be completed. The steps are:

a. Records & Forms Check: identify which LMIS records and forms are used

b. Records & Forms Review: are the records and forms being properly maintained and up-to-date

c. Logistics System Status: are the right quantities of the right contraceptives going to the right places at the right time

d. Management Supervision Structure: identify supervision protocols and actual practices

e. Operation: do staff understand and follow LMIS parameters

f. Use: do managers use the LMIS data to manage the logistics system

g. Cross-check for Consistency: between different records and physical inventory at one level

h. Cross-check for Consistency: between inventory records and reports at different levels

These steps are presented in a more detailed checklist form at the end of this Appendix.

The cross-checks are particularly important. Visiting facilities along a direct reporting chain will allow the advisor to follow specific logistics information as it moves up the system, and supplies as they move down. Specifically, the cross-checks of information between levels,

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and between the logistics information and the flow of supplies will highlight shortcomings in the operation and use of the LMIS data. For example, by cross-checking the quantities ordered, received, and dispensed to clients at the SDP level against the data the SDP reports up to the next level as well as against the quantity issued from the higher level to the SDP, the advisor will be able to evaluate:

- how order quantities are set at the SDP,
- whether the link between recording and reporting data is functioning,
- whether commodity loss/wastage is significant,
- how orders are verified at the next higher level, and
- whether there were enough supplies at the next level to fill the order.

In order to organize the field assessment findings the advisor should rate the LMIS from 1-4 (where 1 = best performance) at each facility, and for the system overall, regarding:

DESIGN

___ collects only essential data

___ forms and reports easy to understand and use

___ LMIS structure and parameters support the logistics system design

OPERATION

___ knowledge and use of system standards and reporting procedures

___ completeness of data recording and reporting

___ timeliness of data recording and reporting

___ quality/accuracy of reported data

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USE

___ use of data for determining and validating order quantities

___ use of data for managing/troubleshooting the logistics system

The rankings should be used to identify problem facilities, and problem components, within the logistics system. This will provide a baseline assessment of the logistics system, as well as focus future assistance toward problem areas.

V. Recommending Solutions for Logistics System Problems with LMIS Causes

Having completed the first four steps, the advisor should be able to:

- assess any differences between the de jure LMIS identified in the capital and the de facto LMIS found in the field,
- identify the nature and extent of logistics system problems found at the different levels in the pipeline (i.e., overstocking, stockouts, bottlenecks, expired stock, etc.),
- identify and distinguish between problems with the design, operation and use of the LMIS and the impact of these problems on the functioning of the logistics system, and
- recommend solutions to problems with the LMIS design, operation and use.

Distinguishing between what we have called the de jure and the de facto LMISs is important in terms of understanding whether the problems are with the design or with the operation and use of the system. This will facilitate understanding the types of interventions that are required and will be helpful for communicating with policy makers who may be unaware of the situation in the field.

The primary reason for going beyond identifying LMIS problems to identifying the logistics system consequences of LMIS problems is that this exercise will give weight to the advisor's recommendations. Information system problems are somewhat intangible, but stockouts are not. It is easier for decision makers to commit resources to LMIS interventions when they can relate the activity to resolving high profile problems such as under-supply or expired stocks. Furthermore, putting the LMIS problems in context will help the advisor to better develop and prioritize strategies for improving the LMIS.

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Having identified the major logistics problems, and their LMIS causes, the advisor should organize the recommended solutions by type of LMIS problem they address: design, operation, and use.

Some problems will require design interventions and some will require training interventions. Most will require both. Whatever the problem, fixing it will involve not only developing recommendations, but also building a consensus among decision makers in support of the recommendations before attempting to implement them.

FIELD ASSESSMENT TOOL

Facility level/type_____

Facility name/location_____

1. Records/Forms Check

Identify which LMIS forms and records are used, e.g.:

- daily activity records
- inventory control records
- order forms
- requisition/issue vouchers
- stock reports (i.e., quarterly report form)
- other types of forms and reports

Are the forms:

- well designed and easy to fill out?
- easy to aggregate to produce reports?
- available and used uniformly across time and SDPs?

2. Records/Forms Review

Review all forms to determine:

- are the essential data collected? (beginning and ending balances, quantities received, quantities issued, quantities distributed to users, consumption, lead time, adjustments, quantities needed)?
- are the forms properly filled out?
- does the math add up?
- are the records up to date and complete?
- have there been stockouts in the last six months?

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3. Logistics System Assessment

- Are contraceptives being supplied at regular intervals?
- Are facilities receiving the correct mix of contraceptives in the right quantities?
- Have there been stockouts in the last six months?
- Have supplies expired in the pipeline?

4. Management/Supervision Structure

- Who is responsible for recording, reporting and processing data?
- Who is responsible, at each level, for overseeing the recording, processing and reporting of data?
- What do supervisors look at regarding LMIS?
- How often?
- What sort of feedback do they give staff?

5. Operation

Interview staff responsible for data collection, reporting and supplies management to determine their knowledge of:

- data definitions
- standard quantities to dispense to clients (new vs. continuing)
- how to maintain/fill-out records/forms
- how to aggregate data
- when to update records
- when and where to forward reports to/receive reports from

6. Use

Interview supervisory/management staff to assess their knowledge of:

- how to calculate an order quantity
- how to verify an order
- how to process an order
- how to use the data to forecast program need
- how to use the data to set/adjust minimum and maximums stock levels

- how to identify under/over-supply situations and their causes
- how to identify and rectify incomplete, poor quality or slow reporting

7. Cross-Checks (at one level)

Compare for consistency:

- between inventory record and physical inventory (balance on hand)
- between inventory record and daily activity register (quantity dispensed to users)
- between daily activity register and stock report (quantity dispensed to users)
- between inventory record and receipt voucher (quantity received)
- between quantity ordered and quantity received

8. Cross-Checks (between levels)

Compare for consistency:

- between quantity ordered from the lower level and quantity issued from the higher level
- between quantity issued from the higher level and quantity received at the lower level
- between quantity dispensed to users at the SDP and quantity reported to the higher level as having been dispensed to users from that SDP

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APPENDIX 3:
JSI/FPLM TARGET-COST PREPARATION GUIDELINES

The following guidelines present the technical standards for JSI/FPLM Target-Cost preparation. They also provide step by step guidance on which data source/s, as well as which measurement of the variable, to select for each input. Inputs are listed below in order of their appearance in the Target-Cost program and the highlighted number/s at the end of each section refer to the corresponding attached table number. Kenya is used as the country example in this guideline and the DHS is the primary data source. For countries where there is not a DHS survey, a relatively current CPS, Reproductive Health and Family Planning survey, or other reliable prevalence survey should be used.

INPUTS

Beginning Year

The beginning year of the forecast should correspond to the year of the main source material for data inputs; typically the most recent DHS for that country.

Ending Year

2000 A.D. until further notice.

Method Mix

Beginning year method mix is calculated from the DHS table on "Current use of Contraception, by Method." Method mix for the ending year should be estimated based on trends evidenced by local surveys (e.g., where there are 2 DHSs), program plans, logistics data and other knowledge of trends in method mix. **(Figure 1)**

Number of WRA

Should be taken for the beginning and ending years directly from the U.S. Bureau of the Census, Center for International Research's International Data Base. The U.N.'s World Population Prospects is also acceptable as a data source. **(Figures 2, 3)**

% WRA Married

This input variable attempts to estimate the proportion of the population at risk, but, for a number of reasons, MWRA often

underestimates this population. A better estimate is provided by "% in Union" which can be calculated by adding together the % WRA Married and the % WRA "Living Together" as reported by DHS and other surveys. The % of WRA in Union should always be used instead of MWRA when data are available. WRA in Union should be used in conjunction with the CPR for currently married women as this CPR includes both married women and those reported in the DHS as living together.

However, the % in Union may also underestimate the proportion of the population at risk in certain countries (e.g., sub-Saharan Africa). One suggested strategy for estimating the population at risk, in countries where you have reason to believe that the % in Union is an underestimate, is to enter 100% for the % WRA Married and then use the CPR for "All Women". However, care must be taken because in other countries, with stricter cultural parameters regarding sexual activity, the % WRA Married will closely approximate the proportion of the population actually at risk. **(Figure 4)**

PPI

PPI (postpartum infecundability) should be taken from the DHS current status table titled "Postpartum amenorrhea, abstinence and insusceptibility by age." The mean value for postpartum insusceptibility (composed of amenorrhea and abstinence components) should be selected. **(Figure 5)**

Abortion Rate

Should be entered when there is a reputable data source reporting the total abortion rate (as opposed to crude rates or other rates of abortions per pregnancy), and when it is politically feasible. In other settings the default of 0 should be used.

Sterility

Includes both natural and pathological sterility. Although it's known that pathological sterility can be quite significant in countries with high incidence of STDs, there are few good country-specific sources for estimates of sterility. As an approximation of sterility, use the % of ever married women age 45-49 with 0 children from the DHS table on "Children Ever Born and Living." **(Figure 6)**

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TFR

Taken for the beginning year from the DHS. Ending year (2000) TFR estimate should be taken from the UN World Population Prospects 1992, medium variant, or from the World Bank Population Projections 1992/93.

A key issue in using the Target-Cost model is setting the Target level of CPR or TFR. As we have access to more historical trend data regarding TFR change, and better guidance on setting future levels of TFR, we recommend setting the TFR target and solving for CPR. For historical trends in TFR decline refer to the Target-Cost manual table on historical trends in TFR, and for estimates of future levels of TFR, by country, see the UN's World Population Prospects 1992 and the World Bank's 1992/3 Population Projections (by region). **(Figures 7, 8, 9, 10)**

CPR

Taken for the beginning year from the DHS table on current use of contraception. Typically we will not enter an ending year value for CPR because that is the value that we will solve for.

The first question is which CPR to use, of those provided in the DHS table on "Current Use of Contraception by Age": All Women /Any Method, or Currently Married Women/Any Method. The selection of CPR depends on which estimate of % WRA Married is used. If MWRA, or WRA in Union, is selected then the CPR for currently married women should be used. If you believe that the % in Union does not adequately represent the % of WRA at risk then enter 100 for % WRA Married and use the CPR for All Women.

The CPR for any method, as opposed to for any modern method, should be used. The traditional methods component of that CPR may be included in the "Other" category in the Target-Cost input. Using the CPR for any method may aid in analysis as replacing traditional methods with modern methods is a common program goal. **(Figure 1)**

Effectiveness

Use the global defaults unless you have reasonable country-specific or even region-specific data.

Discontinuation	Use country specific data, where available. Although the DHS does not publish discontinuation data in their summary reports they can sometimes provide this information upon request; their U.S. phone number is 301-572-0200. If no country-specific data are available use program defaults.
Average Age	Can be calculated from the DHS table on Current Use of Contraception. These data are summarized for the DHS countries in Tables 12 and 13 of the Target-Cost manual. **(Figure 11)**
CYP Factors	Use the current USAID conversion factors unless reasonable local factors have been developed.
Source	Refers to source of contraceptives which is an input to Target-Cost and a table in the DHS. This allows the user to refine estimates of contraceptive need, among other things, from what's required to meet all in-country needs to what is required to meet the needs of a given sector. This works well if you are forecasting for a nationwide public-sector program, but may not help if the program in question targets a sub-population not broken out in the DHS table on source of contraceptives. **(Figure 12)**

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DATA SOURCE TABLES

Table 4.5 Trends in ever use of family planning methods

Percentage of women who have ever used specific family planning methods, Kenya, 1977/78, 1984, 1989, and 1993

Contraceptive method	1977/78 KFS[1]	1984 KCPS[1]	1989 KDHS	1993 KDHS
Any method	29.0	28.5	39.1	45.6
Any modern method	11.0	14.1	24.1	34.0
Pill	7.0	9.0	15.1	21.9
IUD	2.0	4.0	6.8	7.2
Injection	2.0	2.0	5.5	10.8
Diaphragm/foam/jelly	1.0	1.0	1.8	2.1
Condom	3.0	2.0	3.6	6.8
Female sterilisation	1.0	2.0	3.8	3.9
Male sterilisation	0.0	0.0	0.2	0.1
Any traditional method	U	U	21.9	19.8
Rhythm/counting days	13.0	13.0	19.4	17.0[2]
Withdrawal	4.0	4.0	2.4	2.8
Other traditional methods	U	U	2.7	1.8
Number of women	8100	6581	7150	7540

U = No information
[1]Published data are presented in whole numbers; decimal was added to balance this table.
[2]Refers to calendar rhythm only, not to natural family planning
Sources: KFS--CBS. 1980, p. 130, 132; KCPS--CBS. 1984, p. 78, 83; 1989 KDHS--NCPD. 1989, p.33.

Table 4.6 Current use of contraception

Percent distribution of all women and of currently married women by contraceptive method currently used, according to age, Kenya 1993

	Modern method									Traditional method							
Background characteristic	Any method	Any modern method	Pill	IUD	Injection	Diaphragm/foam/jelly	Condom	Female sterilisation	Norplant	Any trad. method	Rhythm counting days	Natural family planning	Withdrawal	Other	Not currently using	Total	Number of women
ALL WOMEN																	
15-19	5.7	2.4	1.4	0.1	0.3	0.0	0.4	0.1	0.0	3.3	3.0	0.0	0.2	0.0	94.3	100.0	1754
20-24	23.0	16.2	9.7	1.3	3.6	0.0	1.4	0.2	0.0	6.7	6.3	0.2	0.1	0.1	77.0	100.0	1638
25-29	37.5	31.5	16.5	3.6	8.3	0.0	1.2	1.8	0.0	6.0	4.9	0.2	0.3	0.5	62.5	100.0	1221
30-34	38.3	32.2	8.9	5.2	11.5	0.1	1.1	5.2	0.0	6.2	4.9	0.4	0.3	0.6	61.7	100.0	1088
35-39	34.6	30.4	5.5	6.0	7.6	0.3	0.7	10.3	0.0	4.2	2.7	0.2	0.4	1.0	65.4	100.0	768
40-44	34.2	29.4	4.8	4.5	7.0	0.1	0.8	12.3	0.0	4.9	3.4	0.3	0.6	0.6	65.8	100.0	638
45-49	26.7	22.3	1.8	3.2	5.2	0.0	0.5	11.5	0.0	4.4	3.1	0.0	0.0	1.3	73.3	100.0	434
Total	25.9	20.7	7.5	2.8	5.5	0.1	0.9	3.9	0.0	5.2	4.3	0.2	0.3	0.4	74.1	100.0	7540
CURRENTLY MARRIED WOMEN																	
15-19	10.3	6.1	4.6	0.0	0.8	0.0	0.4	0.0	0.3	4.1	3.0	0.0	1.1	0.0	89.7	100.0	261
20-24	23.6	18.3	11.5	1.8	4.0	0.0	0.8	0.1	0.0	5.3	4.9	0.2	0.2	0.0	76.4	100.0	937
25-29	37.2	31.5	17.0	3.9	7.6	0.0	1.1	1.9	0.0	5.7	4.5	0.3	0.3	0.5	62.8	100.0	1003
30-34	39.7	33.2	8.8	5.6	11.9	0.0	0.9	6.0	0.1	6.5	5.0	0.4	0.3	0.7	60.3	100.0	918
35-39	35.9	31.6	5.2	7.0	7.3	0.3	0.7	11.1	0.0	4.3	2.5	0.2	0.4	1.2	64.1	100.0	644
40-44	37.3	31.9	5.0	5.1	7.7	0.1	0.9	13.0	0.0	5.5	3.8	0.3	0.7	0.7	62.7	100.0	519
45-49	30.4	24.9	2.2	4.0	5.7	0.0	0.7	12.3	0.0	5.5	3.8	0.0	0.0	1.7	69.6	100.0	348
Total	32.7	27.3	9.5	4.2	7.2	0.1	0.8	5.5	0.0	5.5	4.2	0.2	0.4	0.6	67.3	100.0	4629

Figure 1: Kenya Demographic and Health Survey (DHS), 1993

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U.S. Bureau of the Census 10/28/93

<<<International Data Base>>>

Table 094. Midyear Population, by Age and Sex for KENYA: 1990-2005

Year and age	Population			Percent		
	Both sexes	Male	Female	Both sexes	Male	Female
20-24.....	2,410,930	1,204,144	1,206,786	9.2	9.2	9.1
25-29.....	1,861,956	922,533	939,423	7.1	7.1	7.1
30-34.....	1,400,827	688,958	711,869	5.3	5.3	5.4
35-39.....	1,118,840	544,099	574,741	4.3	4.2	4.4
40-44.....	897,879	431,334	466,545	3.4	3.3	3.5
45-49.....	730,003	348,799	381,204	2.8	2.7	2.9
50-54.....	587,514	279,712	307,802	2.2	2.1	2.3
55-59.....	466,835	219,435	247,400	1.8	1.7	1.9
60-64.....	360,291	167,522	192,769	1.4	1.3	1.5
65-69.....	257,743	119,552	138,191	1.0	0.9	1.0
70-74.....	170,383	77,402	92,981	0.6	0.6	0.7
75-79.....	95,920	42,631	53,289	0.4	0.3	0.4
80+	57,114	24,851	32,263	0.2	0.2	0.2
1993						
All ages....	27,372,266	13,591,867	13,780,399	100.0	100.0	100.0
0- 4.....	5,144,304	2,598,087	2,546,217	18.8	19.1	18.5
5- 9.....	4,400,806	2,219,238	2,181,568	16.1	16.3	15.8
10-14.....	3,746,865	1,888,180	1,858,685	13.7	13.9	13.5
15-19.....	3,160,302	1,584,776	1,575,526	11.5	11.7	11.4
20-24.....	2,525,608	1,258,324	1,267,284	9.2	9.3	9.2
25-29.....	1,973,531	974,969	998,562	7.2	7.2	7.2
30-34.....	1,467,814	719,700	748,114	5.4	5.3	5.4
35-39.....	1,166,786	566,237	600,549	4.3	4.2	4.4
40-44.....	933,986	447,185	486,801	3.4	3.3	3.5
45-49.....	759,836	361,553	398,283	2.8	2.7	2.9
50-54.....	613,617	290,823	322,794	2.2	2.1	2.3
55-59.....	486,677	228,539	258,138	1.8	1.7	1.9
60-64.....	378,761	175,372	203,389	1.4	1.3	1.5
65-69.....	271,277	125,720	145,557	1.0	0.9	1.1
70-74.....	179,623	81,582	98,041	0.7	0.6	0.7
75-79.....	101,556	45,100	56,456	0.4	0.3	0.4
80+	60,917	26,482	34,435	0.2	0.2	0.2
1994						
All ages....	28,240,658	14,025,599	14,215,059	100.0	100.0	100.0
0- 4.....	5,234,323	2,642,926	2,591,397	18.5	18.8	18.2
5- 9.....	4,533,144	2,285,410	2,247,734	16.1	16.3	15.8
10-14.....	3,865,687	1,947,986	1,917,701	13.7	13.9	13.5
15-19.....	3,272,854	1,643,384	1,629,470	11.6	11.7	11.5
20-24.....	2,629,227	1,311,393	1,317,834	9.3	9.3	9.3
25-29.....	2,066,909	1,022,228	1,044,681	7.3	7.3	7.3
30-34.....	1,529,957	751,026	778,931	5.4	5.4	5.5
35-39.....	1,203,342	585,110	618,232	4.3	4.2	4.3
40-44.....	960,958	460,522	500,436	3.4	3.3	3.5
45-49.....	780,929	371,228	409,701	2.8	2.6	2.9
50-54.....	632,567	299,213	333,354	2.2	2.1	2.3
55-59.....	501,441	235,515	265,926	1.8	1.7	1.9
60-64.....	391,271	180,448	210,823	1.4	1.3	1.5
65-69.....	281,460	129,956	151,504	1.0	0.9	1.1

Figure 2: U.S. Bureau of the Census, Center for International Research, International Data Base

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<<<International Data Base>>>

Table 094. Midyear Population, by Age and Sex for KENYA: 1990-2005

Year and age	Population			Percent		
	Both sexes	Male	Female	Both sexes	Male	Female
70-74.....	217,825	96,753	121,072	0.7	0.6	0.8
75-79.....	127,296	55,296	72,000	0.4	0.3	0.5
80+	79,860	33,809	46,051	0.3	0.2	0.3
2000						
All ages....	32,479,014	16,181,337	16,297,677	100.0	100.0	100.0
0- 4.....	5,480,806	2,764,533	2,716,273	16.9	17.1	16.7
5- 9.....	5,010,793	2,521,534	2,489,259	15.4	15.6	15.3
10-14.....	4,520,436	2,275,565	2,244,871	13.9	14.1	13.8
15-19.....	3,846,073	1,937,687	1,908,386	11.8	12.0	11.7
20-24.....	3,236,661	1,639,101	1,597,560	10.0	10.1	9.8
25-29.....	2,539,031	1,276,508	1,262,523	7.8	7.9	7.7
30-34.....	1,940,448	966,748	973,700	6.0	6.0	6.0
35-39.....	1,414,874	698,251	716,623	4.4	4.3	4.4
40-44.....	1,091,545	532,122	559,423	3.4	3.3	3.4
45-49.....	877,586	419,263	458,323	2.7	2.6	2.8
50-54.....	716,755	336,649	380,106	2.2	2.1	2.3
55-59.....	579,114	268,555	310,559	1.8	1.7	1.9
60-64.....	448,607	205,062	243,545	1.4	1.3	1.5
65-69.....	333,616	147,348	186,268	1.0	0.9	1.1
70-74.....	226,045	99,598	126,447	0.7	0.6	0.8
75-79.....	132,598	57,404	75,194	0.4	0.4	0.5
80+	84,026	35,409	48,617	0.3	0.2	0.3
2005						
All ages....	35,687,869	17,752,134	17,935,735	100.0	100.0	100.0
0- 4.....	5,491,616	2,770,271	2,721,345	15.4	15.6	15.2
5- 9.....	5,288,688	2,660,571	2,628,117	14.8	15.0	14.7
10-14.....	4,970,574	2,499,502	2,471,072	13.9	14.1	13.8
15-19.....	4,447,871	2,242,510	2,205,361	12.5	12.6	12.3
20-24.....	3,682,690	1,863,292	1,819,398	10.3	10.5	10.1
25-29.....	2,956,914	1,503,763	1,453,151	8.3	8.5	8.1
30-34.....	2,213,962	1,111,062	1,102,900	6.2	6.3	6.1
35-39.....	1,644,134	807,623	836,511	4.6	4.5	4.7
40-44.....	1,198,466	576,922	621,544	3.4	3.2	3.5
45-49.....	947,031	448,779	498,252	2.7	2.5	2.8
50-54.....	780,278	361,714	418,564	2.2	2.0	2.3
55-59.....	640,184	290,262	349,922	1.8	1.6	2.0
60-64.....	507,951	225,441	282,510	1.4	1.3	1.6
65-69.....	380,247	165,395	214,852	1.1	0.9	1.2
70-74.....	267,431	112,630	154,801	0.7	0.6	0.9
75-79.....	161,688	67,975	93,713	0.5	0.4	0.5
80+	108,144	44,422	63,722	0.3	0.3	0.4

Sources:
Prepared by the U.S. Bureau of the Census, Center for International Research, April 9, 1993.

Figure 2: U.S. Bureau of the Census, Center for International Research, International Data Base

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KENYA

A. ESTIMATES

Indicator	1950	1955	1960	1965	1970	1975	1980	1985	1990
Population (thousands)									
Total	6265	7189	8332	9749	11498	13741	16632	19873	23585
Males	3159	3612	4176	4880	5750	6870	8315	9936	11794
Females	3105	3577	4156	4870	5748	6872	8317	9938	11791
Sex ratio (per 100 females)	101.7	101.0	100.5	100.2	100.0	100.0	100.0	100.0	100.0
Percentage urban	5.6	6.4	7.4	8.6	10.3	12.9	16.1	19.7	23.6
Age distribution									
Percentage aged 0-4	17.4	19.1	19.6	19.9	20.1	20.7	21.3	20.0	19.1
Percentage aged 5-14	22.4	23.1	26.0	27.5	28.1	28.4	28.8	30.0	30.0
Percentage aged 15-24	18.9	17.8	15.8	16.1	17.9	18.6	18.6	18.9	19.5
Percentage aged 60 or over	6.3	6.4	6.4	6.2	5.9	5.5	5.0	4.7	4.5
Percentage aged 65 or over	3.9	4.1	4.1	4.1	3.9	3.7	3.4	3.2	3.0
Percentage of women aged 15-49	45.6	43.7	41.3	40.5	40.6	40.7	40.5	40.9	42.3
Median age (years)	20.0	19.2	17.7	16.4	15.9	15.4	15.0	15.0	15.4
Population density (per sq km)	11	12	14	17	20	24	29	34	41

	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985	1985-1990
Average annual change (thousands)								
Population	185	228	284	350	449	578	648	742
Births	355	411	477	555	668	814	890	990
Deaths	170	182	194	205	219	236	242	248
Population growth rate (percentage)	2.75	2.95	3.14	3.30	3.56	3.82	3.56	3.43
Crude birth rate (per 1,000 population)	52.8	52.9	52.8	52.2	52.9	53.6	48.8	45.6
Crude death rate (per 1,000 population)	25.3	23.5	21.4	19.3	17.3	15.5	13.2	11.4
Total fertility rate (per woman)	7.51	7.82	8.12	8.12	8.12	8.12	7.50	6.80
Gross reproduction rate (per woman)	3.70	3.85	4.00	4.00	4.00	4.00	3.70	3.35
Net reproduction rate (per woman)	2.23	2.43	2.65	2.77	2.90	3.02	2.87	2.69
Infant mortality rate (per 1,000 births)	150	130	118	108	98	88	81	72
Life expectancy at birth (years)								
Males	39.0	41.5	44.0	46.5	49.0	51.5	53.8	55.9
Females	43.0	45.4	48.0	50.5	53.0	55.5	58.0	59.9
Both sexes combined	40.9	43.4	45.9	48.4	51.0	53.4	55.8	57.9

B. MEDIUM-VARIANT PROJECTIONS

	1990	1995	2000	2005	2010	2015	2020	2025
Population (thousands)								
Total	23585	27885	32818	38351	44387	50809	57396	63826
Males	11794	13950	16426	19203	22234	25455	28753	31964
Females	11791	13935	16392	19147	22153	25354	28643	31861
Sex ratio (per 100 females)	100.0	100.1	100.2	100.3	100.4	100.4	100.4	100.3
Percentage urban	23.6	27.7	31.8	35.7	39.7	43.7	47.6	51.5
Age distribution								
Percentage aged 0-4	19.1	18.5	17.9	17.0	15.9	14.7	13.3	11.9
Percentage aged 5-14	30.0	28.9	28.3	27.9	27.3	26.3	24.9	23.4
Percentage aged 15-24	19.5	20.6	20.9	20.5	20.5	20.7	20.8	20.6
Percentage aged 60 or over	4.5	4.4	4.2	3.9	4.0	4.3	4.8	5.5
Percentage aged 65 or over	3.0	2.9	2.9	2.8	2.6	2.7	3.1	3.5
Percentage in school ages 6-11	18.6	17.8	17.5	17.2	16.8	16.1	15.2	14.1
Percentage in school ages 12-14	8.0	7.8	7.6	7.5	7.5	7.4	7.1	6.8
Percentage in school ages 15-17	6.9	7.2	6.9	6.8	6.8	6.8	6.7	6.6
Percentage in school ages 18-23	11.1	11.8	12.2	11.9	11.9	12.0	12.2	12.2
Percentage of women aged 15-49	42.3	44.5	45.8	45.9	48.2	49.7	51.4	53.0
Median age (years)	15.4	16.1	16.7	17.3	18.1	19.1	20.4	22.0
Population density (per sq km)	41	48	57	66	76	88	99	110

	1985-1990	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025
Average annual change (thousands)								
Population	742	850	987	1106	1207	1284	1317	1286
Births	990	1125	1265	1386	1485	1552	1581	1555
Deaths	248	255	278	282	277	268	264	269
Net migration	..	0	0	0	-1	0	0	0
Population growth rate (percentage)	3.43	3.35	3.28	3.12	2.92	2.70	2.44	2.12
Crude birth rate (per 1,000 population)	45.6	43.7	41.7	39.0	35.9	32.6	29.2	25.7
Crude death rate (per 1,000 population)	11.4	10.3	9.2	7.9	6.7	5.6	4.9	4.4
Net migration rate(per 1,000 population)	..	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total fertility rate (per woman)	6.80	6.29	5.76	5.23	4.71	4.19	3.67	3.14
Gross reproduction rate (per woman)	3.35	3.09	2.83	2.58	2.32	2.06	1.81	1.55
Net reproduction rate (per woman)	2.69	2.55	2.40	2.25	2.08	1.89	1.68	1.46
Infant mortality rate (per 1,000 births)	72	66	59	49	41	33	27	23
Life expectancy at birth (years)								
Males	55.9	57.1	58.5	60.7	63.2	65.9	70.0	69.6
Females	59.9	60.8	62.1	64.3	67.1	70.0	72.4	74.1
Both sexes combined	57.9	58.9	60.3	62.5	65.1	67.9	70.2	71.8

Figure 3: United Nations, World Population Prospects, 1992

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CHAPTER 5

OTHER PROXIMATE DETERMINANTS OF FERTILITY

5.1 Introduction

Addressed in this chapter are the principal factors, other than contraception, that affect a woman's risk of becoming pregnant: nuptiality and sexual intercourse, postpartum amenorrhoea and abstinence from sexual relations, and termination of exposure to pregnancy.

While it is not by any means exact, marriage is an indicator of exposure of women to the risk of pregnancy, and is therefore important for the understanding of fertility. Populations in which age at marriage is low also tend to experience early childbearing and high fertility; hence, the motivation to examine trends in age at marriage.

This chapter also includes more direct measures of the beginning of exposure to pregnancy and the level of exposure: age at first sexual intercourse and the frequency of intercourse. Measures of other proximate determinants of fertility are the durations of postpartum amenorrhoea and postpartum abstinence.

5.2 Marital Status

Data on the marital status of respondents at the time of the survey are shown in Table 5.1. As in other reports on demographic surveys and censuses in Kenya, this report defines marriage to include informal unions. Although shown separately in Table 5.1, the categories of "married" and "living together" are combined in subsequent tables and are referred to as "currently married." Respondents who are currently married, widowed, divorced or no longer living together (separated) are referred to as "ever married."

Table 5.1 shows that 30 percent of women of childbearing age in Kenya have never married, 61 percent are currently married, and 8 percent are either widowed, divorced or no longer living with a partner. The proportion who have never married falls sharply from 84 percent of women age 15-19 to 3 percent in the age group 45-49. The universality of marriage is evident from the fact that, among women age 35 and over, 97 percent are, or have been, married.

Table 5.1 Current marital status

Percent distribution of women by current marital status, according to age, Kenya 1993

	Marital status							
Age	Never married	Married	Living together	Widowed	Divorced	Not living together	Total	Number of women
15-19	83.8	13.6	1.2	0.2	0.4	0.7	100.0	1754
20-24	35.5	54.1	3.1	0.7	2.2	4.4	100.0	1638
25-29	10.4	78.7	3.5	1.3	3.5	2.6	100.0	1221
30-34	5.4	79.5	4.8	2.8	3.9	3.6	100.0	1088
35-39	2.6	81.0	2.8	6.6	3.8	3.1	100.0	768
40-44	1.7	76.5	4.7	10.1	4.9	2.1	100.0	638
45-49	2.8	76.8	3.5	12.3	3.0	1.7	100.0	434
Total	30.2	58.3	3.1	3.1	2.7	2.6	100.0	7540

Figure 4: Kenya Demographic and Health Survey (DHS), 1993

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Table 5.9 indicates that a majority (58 percent) of the women interviewed in the KDHS were sexually active in the four weeks prior to the interview. Ten percent had not had sexual relations since delivering a recent baby (postpartum) and 32 percent were abstaining for reasons other than having recently given birth. Most of these women had been sexually inactive for less than 2 years; only 6 percent of women had not had sexual intercourse for two years or longer.

The likelihood that a woman has been sexually active in the last four weeks declines with marital duration. Single women who have ever had sexual intercourse are less likely to report that they have recently been sexually active. Urban women and women in Nairobi are more likely than other women to have been sexually active.

5.7 Postpartum Amenorrhoea and Insusceptibility

The risk of pregnancy following a birth is largely influenced by two factors: breastfeeding and sexual abstinence. Postpartum protection from conception can be prolonged by breastfeeding through its effect on the length of amenorrhoea (the period prior to the return of menses). Protection can also be prolonged by delaying the resumption of sexual relations. Women are defined as insusceptible if they are not exposed to the risk of pregnancy, either because they are amenorrhoeic or abstaining following a birth.

The percentage of births whose mothers are postpartum amenorrhoeic, abstaining and postpartum insusceptible is shown in Table 5.10 by the number of months since birth. These distributions are based on current status data, i.e., on the proportion of births occurring *x* months before the survey for which mothers

Table 5.10 Postpartum amenorrhoea, abstinence and insusceptibility

Percentage of births whose mothers are postpartum amenorrhoeic, abstaining and insusceptible, by number of months since birth, and median and mean durations, Kenya 1993

Months since birth	Amenor-rhoeic	Abstaining	Insus-ceptible	Number of births
<2	98.6	84.2	100.0	149
2-3	77.5	51.3	85.4	183
4-5	70.7	34.3	77.1	209
6-7	61.8	30.4	69.7	213
8-9	56.1	22.3	62.8	225
10-11	56.2	14.1	61.4	190
12-13	41.2	20.8	52.0	229
14-15	36.4	10.2	41.7	199
16-17	23.3	16.0	35.3	189
18-19	23.0	13.0	29.8	218
20-21	10.4	9.0	19.4	193
22-23	17.6	10.3	25.0	179
24-25	7.5	5.3	12.4	217
26-27	5.7	5.5	10.4	197
28-29	3.7	2.4	5.7	208
30-31	0.6	3.4	4.0	207
32-33	1.9	2.8	4.7	217
34-35	3.1	6.7	9.7	176
Total	32.2	18.0	38.5	3596
Median	10.8	3.0	12.9	-
Mean	12.2	7.2	14.4	-
Prevalence/incidence mean	11.4	6.4	13.7	-

Figure 5: Kenya Demographic and Health Survey (DHS), 1993

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Table 3.8 Children ever born and living

Percent distribution of all women and of currently married women by number of children ever born (CEB) and mean number ever born and living, according to five-year age groups, Kenya 1993

Age group	Number of children ever born (CEB)											Total	Number of women	Mean no. of CEB	Mean no. of living children
	0	1	2	3	4	5	6	7	8	9	10+				
ALL WOMEN															
15-19	83.2	13.6	2.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	1754	0.20	0.18
20-24	29.5	29.2	24.1	11.9	4.1	1.2	0.0	0.1	0.0	0.0	0.0	100.0	1638	1.36	1.25
25-29	5.8	10.3	21.0	21.6	21.0	13.1	4.8	2.0	0.4	0.1	0.0	100.0	1221	3.13	2.85
30-34	4.5	5.2	8.5	14.1	15.3	18.9	15.4	10.0	4.3	2.5	1.2	100.0	1088	4.53	4.06
35-39	2.5	1.5	3.4	5.8	11.1	14.8	17.1	13.0	13.8	9.0	8.0	100.0	768	6.13	5.45
40-44	2.7	3.1	3.6	4.5	7.8	8.5	9.7	13.0	13.7	14.1	19.2	100.0	638	6.95	6.11
45-49	1.1	2.6	4.1	2.4	5.1	6.6	9.1	11.2	14.3	12.8	30.8	100.0	434	7.87	6.72
Total	27.9	12.5	11.4	9.3	8.6	7.7	6.1	4.9	4.1	3.2	4.4	100.0	7540	3.17	2.82
CURRENTLY MARRIED WOMEN															
15-19	41.0	42.9	14.3	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	261	0.77	0.65
20-24	11.0	30.7	31.8	17.8	6.6	2.0	0.0	0.1	0.0	0.0	0.0	100.0	937	1.85	1.71
25-29	2.5	7.7	19.6	23.5	22.9	15.2	5.7	2.3	0.4	0.1	0.0	100.0	1003	3.40	3.10
30-34	2.5	3.7	7.0	13.9	16.3	20.3	16.4	10.9	4.9	2.6	1.5	100.0	918	4.79	4.30
35-39	1.5	1.3	3.1	5.4	10.2	15.3	16.2	13.8	14.7	9.7	8.9	100.0	644	6.32	5.67
40-44	2.2	2.3	2.8	4.7	6.2	8.4	8.8	13.3	13.9	15.0	22.3	100.0	519	7.28	6.45
45-49	1.2	1.4	4.3	2.5	3.5	6.6	8.9	11.2	14.2	14.9	31.4	100.0	348	8.04	6.94
Total	6.1	11.6	13.9	13.0	11.9	11.3	8.4	6.9	5.7	4.7	6.4	100.0	4629	4.40	3.94

A comparison of the mean number of children ever born reported in the 1993 KDHS and various other surveys is presented in Table 3.9. Except for the data from the 1984 KCPS, which are uniformly higher than the other sources,[2] the figures show a steady decline in completed fertility over time. The one exception is the apparent rise in mean children ever born to women age 45-49 between the 1989 and 1993 KDHSs. It is unlikely that this is actually true; a more likely explanation is that for some reason the figure was either underreported in the 1989 survey, overreported in the 1993 survey or both.

Table 3.9 Trends in children ever born

Mean number of children ever born by age group as reported in various surveys

Age	1977/78 KFS	1984 KCPS	1989 KDHS	1993 KDHS
15-19	0.4	0.4	0.3	0.2
20-24	1.8	2.0	1.6	1.4
25-29	3.8	4.0	3.5	3.1
30-34	5.6	5.7	5.0	4.5
35-39	6.8	7.0	6.5	6.1
40-44	7.6	7.8	7.4	7.0
45-49	7.9	8.2	7.6	7.9

Sources: KFS--CBS. 1980, p. 84; KCPS--CBS. 1984, p. 45; 1989 KDHS--NCPD. 1989, p. 24.

3.6 Birth Intervals

Information on birth intervals provides insight into birthspacing patterns which have far-reaching impact on both fertility and child mortality levels. Research has shown that children born too close to a previous birth are at increased risk of dying at an early age.

[2]The KCPS is the only one of these surveys in which a complete birth history was not asked for each respondent; instead, the survey relied on summary data on the number of children ever born. Studies have shown that summary data produce higher estimates of cumulative fertility than birth histories (Central Bureau of Statistics, 1975 and 1977).

Figure 6: Kenya Demographic and Health Survey (DHS), 1993

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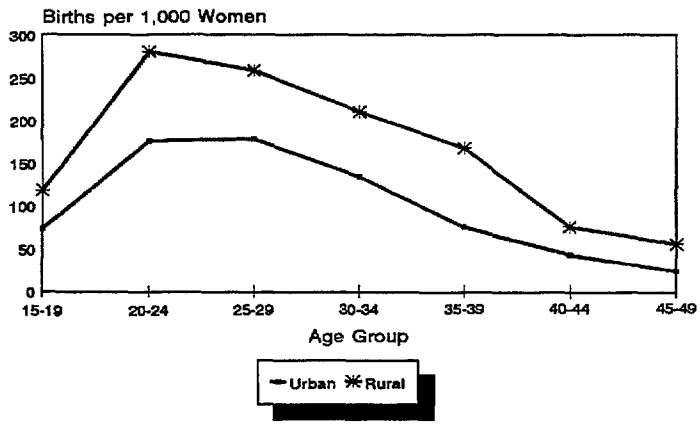
Table 3.1 Current fertility

Age-specific and cumulative fertility rates and the crude birth rate for the three years preceding the survey, by urban-rural residence, Kenya 1993

	Residence		
Age group	Urban	Rural	Total
15-19	74	119	110
20-24	176	281	257
25-29	178	258	241
30-34	133	209	197
35-39	74	166	154
40-44	(34)	74	70
45-49	(21)	53	50
TFR 15-49	3.44	5.80	5.40
TFR 15-44	3.34	5.54	5.15
GFR	129	194	182
CBR	35.1	35.9	35.8

Note: Rates are for the period 1-36 months preceding the survey. Rates for age group 45-49 may be slightly biased due to truncation. Rates in parentheses are based on fewer than 250 woman-years of exposure.
TFR: Total fertility rate expressed per woman
GFR: General fertility rate (births divided by number of women 15-44), expressed per 1,000 women
CBR: Crude birth rate, expressed per 1,000 population

Figure 3.1
Age-Specific Fertility Rates
By Urban-Rural Residence



KDHS 1993

Figure 7: Kenya Demographic and Health Survey (DHS), 1993

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TFR DECLINE BY FAMILY PLANNING PROGRAM EFFORT AND LEVEL OF DEVELOPMENT (1960/65 - 1980/85)

DEVELOPMENT INDEX	PROGRAM EFFORT			
	STRONG	MODERATE	WEAK	VERY WEAK
HIGH	Colombia 2.8	Fiji 2.5	Brazil 2.3	Iraq 0.5
	Hong Kong 3.5	Jamaica 2.1	Chile 2.5	Jordan 0.7
	Korea Rep 3.0	Malaysia 2.8	Costa Rica 3.4	Kuwait 2.2
	Mauritius 3.3	Panama 2.5	Cyprus 1.1	Saudi Arabia 0.0
	Mexico 2.6	Trinidad and	Guyana 2.8	
	Singapore 3.2	Tobago 2.1	Venezuela 2.4	
	AVERAGE 3.1	AVERAGE 2.4	AVERAGE 2.4	AVERAGE 0.8
UPPER MIDDLE	China 3.6	Dominican	Algeria 0.7	Bolivia 0.4
	Sri Lanka 1.9	Republic 3.1	Botswana 0.4	Congo -0.1
		El Salvador 1.6	Peru 1.9	Paraguay 2.0
		Philippines 1.9	Turkey 2.2	Syria 0.3
		Thailand 2.9		
		Tunisia 2.3		
	AVERAGE 2.7	AVERAGE 2.4	AVERAGE 1.4	AVERAGE 0.8
LOWER MIDDLE	Indonesia 1.3		Egypt 1.8	Burma 1.3
			Guatemala 0.7	Ghana 0.4
			Honduras 1.2	Cote d'Ivoire -0.1
			Kenya 0.0	Lesotho 0.0
			Liberia -0.2	Nigeria -0.2
			Morocco 1.7	Togo 0.1
			P.N.G. 0.6	Zaire -0.1
			Tanzania -0.2	Zambia -0.6
			Zimbabwe 1.3	
	AVERAGE 1.3		AVERAGE 0.8	AVERAGE 0.1
LOW	India 1.1	Bangladesh 0.5	Gambia 0.0	Benin -0.2
			Haiti 1.1	Burkina Faso 0.2
			Pakistan 0.0	Burundi -0.8
			Rwanda -0.8	C.A.R. -0.2
			Senegal 0.2	Ethiopia 0.7
				Guinea 0.2
				Madagascar 0.0
				Malawi -0.1
				Mozambique -0.1
				Niger 0.0
				Sierra Leone -0.2
				Sudan 0.1
				Uganda 0.0
				Yemen N. -0.1
				Yemen PDR 0.2
	AVERAGE 1.1	AVERAGE 0.5	AVERAGE 0.1	AVERAGE 0.0

Figure 8: Bongaarts, et. al. "The Demographic Impact of Family Planning Programs", Source: The Futures Group Target-Cost User's Manual, Table 6

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Table A.12 (continued)

Medium variant

Total fertility rate (per women)							Major area, region and country	No.
1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025		
3.26	3.08	2.91	2.78	2.62	2.46	2.36	World total	1
1.91	1.97	2.02	2.05	2.01	1.97	1.90	More developed regions (*)	2
3.64	3.38	3.13	2.94	2.75	2.55	2.44	Less developed regions (+)	3
6.00	5.66	5.11	4.68	4.25	3.81	3.44	Africa	4
6.76	6.26	5.77	5.28	4.79	4.29	3.80	Eastern Africa (1)	5
6.80	6.28	5.76	5.23	4.71	4.19	3.67	Burundi	6
7.05	6.50	5.95	5.40	4.85	4.30	3.75	Comoros	7
6.60	6.15	5.70	5.25	4.80	4.35	3.90	Djibouti	8
7.00	6.51	6.02	5.53	5.04	4.55	4.06	Ethiopia	9
6.28	5.76	5.23	4.71	4.19	3.67	3.14	Kenya	10
6.60	6.15	5.70	5.25	4.80	4.35	3.90	Madagascar	11
7.60	7.05	6.50	5.95	5.40	4.85	4.30	Malawi	12
2.00	1.90	1.85	1.85	1.85	1.85	1.85	Mauritius (2)	13
6.50	6.06	5.62	5.18	4.74	4.30	3.86	Mozambique	14
2.32	2.10	2.10	2.10	2.10	2.10	2.10	Reunion	15
8.49	7.78	7.07	6.36	5.65	4.94	4.23	Rwanda	16
7.00	6.51	6.02	5.53	5.04	4.55	4.06	Somalia	17
7.30	6.72	6.14	5.57	4.99	4.41	3.83	Uganda	18
6.80	6.33	5.86	5.39	4.92	4.45	3.98	United Rep. of Tanzania	19
6.33	5.90	5.48	5.06	4.64	4.21	3.79	Zambia	20
5.33	4.87	4.41	3.94	3.48	3.02	2.56	Zimbabwe	21
6.47	6.04	5.60	5.16	4.71	4.27	3.83	Middle Africa (3)	22
7.20	6.69	6.18	5.67	5.16	4.65	4.14	Angola	23
5.70	5.30	4.90	4.50	4.10	3.70	3.30	Cameroon	24
6.20	5.79	5.38	4.97	4.56	4.15	3.74	Central African Republic	25
5.89	5.51	5.13	4.75	4.37	3.99	3.62	Chad	26
6.29	5.87	5.45	5.03	4.61	4.19	3.78	Congo	27
5.89	5.51	5.13	4.75	4.37	3.99	3.62	Equatorial Guinea	28
5.34	5.70	5.30	4.90	4.50	4.10	3.70	Gabon	29
6.70	6.24	5.78	5.32	4.86	4.40	3.94	Zaire	30
4.66	4.22	3.79	3.37	2.96	2.56	2.49	Northern Africa (4)	31
4.87	4.32	3.77	3.21	2.66	2.10	2.10	Algeria	32
4.12	3.72	3.31	2.91	2.50	2.10	2.10	Egypt	33
6.39	5.91	5.43	4.96	4.48	4.00	3.52	Libyan Arab Jamahiriya	34
4.37	3.92	3.46	3.01	2.55	2.10	2.10	Morocco	35
6.05	5.65	5.26	4.86	4.47	4.07	3.68	Sudan	36
3.40	2.91	2.46	2.25	2.10	2.10	2.10	Tunisia	37
4.22	3.93	3.64	3.35	3.06	2.76	2.47	Southern Africa	38
5.07	4.65	4.22	3.80	3.38	2.95	2.52	Botswana	39
4.71	4.42	4.13	3.84	3.55	3.26	2.97	Lesotho	40
6.00	5.57	5.13	4.70	4.27	3.83	3.40	Namibia	41
4.09	3.81	3.52	3.24	2.95	2.67	2.38	South Africa	42
4.93	4.62	4.30	3.99	3.67	3.36	3.04	Swaziland	43
6.63	6.05	5.57	5.10	4.63	4.15	3.68	Western Africa (5)	44
7.10	6.60	6.10	5.60	5.10	4.60	4.10	Benin	45
6.50	6.06	5.62	5.18	4.74	4.30	3.86	Burkina Faso	46
4.26	3.86	3.45	3.04	2.74	2.44	2.23	Cape Verde	47
7.41	6.88	6.35	5.82	5.29	4.75	4.22	Cote d'Ivoire	48
6.06	5.62	5.18	4.74	4.30	3.86	3.42	Gambia	49
5.96	5.53	5.10	4.67	4.24	3.81	3.38	Ghana	50
7.00	6.51	6.02	5.53	5.04	4.55	4.06	Guinea	51
5.79	5.42	5.05	4.68	4.31	3.94	3.58	Guinea-Bissau	52
6.80	6.33	5.86	5.39	4.92	4.45	3.98	Liberia	53
7.10	6.60	6.10	5.60	5.10	4.60	4.10	Mali	54
6.50	6.06	5.61	5.17	4.73	4.29	3.85	Mauritania	55
7.10	6.60	6.10	5.60	5.10	4.60	4.10	Niger	56
6.42	5.94	5.46	4.98	4.51	4.02	3.54	Nigeria	57
6.06	5.62	5.18	4.74	4.30	3.86	3.47	Senegal	58
6.50	6.06	5.62	5.18	4.74	4.30	3.86	Sierra Leone	59
6.58	6.08	5.58	5.09	4.59	4.09	3.59	Togo	60
3.21	2.97	2.74	2.57	2.40	2.22	2.15	Asia	61
2.15	2.00	1.85	1.86	1.86	1.86	1.86	Eastern Asia (6)	62
2.20	2.03	1.85	1.85	1.85	1.85	1.85	China	63
2.37	2.23	2.10	2.10	2.10	2.10	2.10	Dem. Peo. Rep. of Korea	64
1.44	1.53	1.61	1.70	1.70	1.70	1.70	Hong Kong	65
1.65	1.65	1.73	1.85	1.85	1.85	1.85	Japan	66
4.64	4.27	3.91	3.55	3.19	2.82	2.46	Mongolia	67
1.75	1.78	1.80	1.82	1.85	1.85	1.85	Republic of Korea	68

Figure 9: United Nations, World Population Prospects, 1992

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Table 12. *Estimates and Projections of Total Fertility Rate (TFR) for All Countries and Economies, 1985-90 to 2025-30*

Country, economy, or region	1985-89	1990-94	1995-99	2000-04	2005-09	2010-14	2015-19	2020-24	2025-29
World	3.44	3.24	3.03	2.88	2.74	2.61	2.52	2.44	2.35
Africa	6.06	5.85	5.50	5.10	4.59	4.09	3.64	3.27	2.92
East Africa	6.41	6.30	6.07	5.70	5.17	4.64	4.14	3.69	3.27
Botswana	5.30	4.33	3.35	2.92	2.54	2.22	2.10	2.09	2.08
Burundi	6.80	6.80	6.80	6.50	5.90	5.30	4.70	4.10	3.50
Comoros	7.00	6.70	6.10	5.50	4.90	4.30	3.70	3.13	2.65
Djibouti	6.60	6.60	6.30	5.70	5.10	4.50	3.90	3.30	2.91
Ethiopia	7.50	7.50	7.50	7.20	6.60	6.00	5.40	4.80	4.20
Kenya	6.70	6.43	5.86	5.28	4.68	4.08	3.48	3.02	2.61
Lesotho	5.80	5.50	4.90	4.30	3.70	3.17	2.72	2.34	2.20
Madagascar	6.46	6.16	5.56	4.96	4.36	3.76	3.24	2.79	2.40
Malawi	7.60	7.60	7.60	7.30	6.70	6.10	5.50	4.90	4.30
Mauritius	2.00	1.75	1.75	1.81	1.86	1.91	1.96	2.01	2.06
Mozambique	6.30	6.52	6.74	6.66	6.06	5.46	4.86	4.26	3.66
Namibia	6.09	5.79	5.19	4.59	3.99	3.39	2.97	2.59	2.27
Reunion	2.42	2.16	2.07	2.06	2.06	2.05	2.05	2.05	2.05
Rwanda	8.29	8.29	7.99	7.39	6.79	6.19	5.59	4.99	4.39
Seychelles	3.00	2.70	2.42	2.18	2.09	2.08	2.08	2.07	2.07
Somalia	6.77	6.77	6.77	6.47	5.87	5.27	4.67	4.07	3.47
South Africa	4.48	4.08	3.68	3.28	2.88	2.54	2.23	2.12	2.11
Swaziland	6.87	6.57	5.97	5.37	4.77	4.17	3.57	3.07	2.64
Tanzania	6.50	6.61	6.72	6.53	5.93	5.33	4.73	4.13	3.53
Uganda	7.30	7.30	7.00	6.40	5.80	5.20	4.60	4.00	3.40
Zaire	6.30	6.22	5.84	5.46	4.86	4.26	3.66	3.15	2.72
Zambia	6.75	6.67	6.29	5.91	5.31	4.71	4.11	3.51	3.06
Zimbabwe	5.40	4.55	3.70	3.19	2.76	2.38	2.24	2.22	2.19
Other East Africa	7.00	6.70	6.10	5.50	4.90	4.30	3.70	3.13	2.65
West Africa	6.28	6.14	5.76	5.33	4.76	4.16	3.65	3.19	2.79
Angola	6.39	6.56	6.72	6.59	5.99	5.39	4.79	4.19	3.59
Benin	6.50	6.20	5.60	5.00	4.40	3.80	3.20	2.88	2.59
Burkina Faso	6.50	6.50	6.50	6.20	5.60	5.00	4.40	3.80	3.20
Cameroon	5.90	5.85	5.50	5.14	4.54	3.94	3.34	2.93	2.57
Cape Verde	5.58	5.28	4.68	4.08	3.48	3.00	2.59	2.23	2.10
Central African Rep.	5.75	5.75	5.46	5.16	4.56	3.96	3.36	2.98	2.65
Chad	5.89	6.03	6.17	6.00	5.40	4.80	4.20	3.60	3.10
Congo, People's Rep. of the	6.50	6.61	6.43	6.24	5.64	5.04	4.44	3.84	3.24
Cote d'ivoire	6.80	6.61	6.12	5.63	5.03	4.43	3.83	3.23	2.86
Equatorial Guinea	5.50	5.50	5.50	5.20	4.60	4.00	3.40	3.00	2.65
Gabon	5.50	5.92	6.03	6.15	5.55	4.95	4.35	3.75	3.15
Gambia, The	6.50	6.50	6.50	6.50	6.20	5.60	5.00	4.40	3.80
Ghana	6.40	6.10	5.50	4.90	4.30	3.70	3.17	2.72	2.34
Guinea	6.50	6.50	6.50	6.50	6.20	5.60	5.00	4.40	3.80
Guinea-Bissau	6.00	6.00	6.00	6.00	5.70	5.10	4.50	3.90	3.39
Liberia	6.50	6.20	5.60	5.00	4.40	3.80	3.20	2.85	2.54
Mali	7.00	7.06	7.11	6.87	6.27	5.67	5.07	4.47	3.87
Mauritania	6.80	6.80	6.80	6.80	6.50	5.90	5.30	4.70	4.10
Niger	7.10	7.18	7.27	7.35	7.05	6.45	5.85	5.25	4.65
Nigeria	6.10	5.86	5.31	4.77	4.17	3.57	3.24	2.89	2.57
Sao Tome and Principe	5.25	4.95	4.35	3.75	3.15	2.78	2.45	2.16	2.06
Senegal	6.50	6.50	6.50	6.20	5.60	5.00	4.40	3.80	3.20
Sierra Leone	6.50	6.50	6.50	6.50	6.20	5.60	5.00	4.40	3.80
Togo	6.80	6.50	5.90	5.30	4.70	4.10	3.50	3.04	2.65
Other West Africa	2.99	2.71	2.46	2.23	2.14	2.12	2.09	2.07	2.05
North Africa	5.03	4.55	4.01	3.54	3.15	2.80	2.53	2.40	2.31
Algeria	5.50	4.82	4.14	3.46	2.99	2.58	2.23	2.11	2.09
Egypt, Arab Rep. of	4.38	3.84	3.30	2.92	2.59	2.29	2.18	2.15	2.12

Figure 10: World Bank, Population and Human Resources Department, Regional Population Projections, 1992-93 Edition

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Table 12

AVERAGE AGE OF USERS BY METHOD

Country	Pill	IUD	Inject-ables	Condom	Female Ster.	Male Ster.
Indonesia	30.2	32.7	28.9	33.2	37.1	37.7
Thailand	30.9	31.2	29.4	31.1	35.7	36.7
Sri Lanka	28.9	33.6	27.5	33.7	36.2	34.2
Botswana	29.3	32.1	33.4	31.5	39.5	38.6
Ghana	31.0	35.7	35.8	25.4	30.5	-
Kenya	28.8	33.1	33.3	27.2	37.8	-
Mali	26.1	31.7	35.5	17.0	35.7	-
Nigeria	33.2	35.5	39.1	30.9	-	-
Senegal	32.6	31.9	23.8	30.1	37.4	-
Togo	32.9	31.5	38.3	30.1	38.1	-
Uganda	28.4	31.2	34.0	27.0	40.0	-
Zimbabwe	28.6	32.0	36.9	30.6	40.7	34.1
Egypt	33.2	33.0	37.1	35.2	40.3	47.0
Morocco	32.1	34.0	33.9	34.9	39.7	40.0
Tunisia	32.2	31.8	33.5	34.2	40.1	-
Ecuador	29.4	29.0	29.6	31.3	36.9	37.0
El Salvador	25.2	27.2	27.4	26.3	33.9	35.2
Peru	29.8	31.0	28.4	29.6	38.6	47.0
Trinidad	28.1	32.9	28.3	32.1	38.9	34.7

Figure 11: Futures Group, Target-Cost: A Model for Projecting the Family Planning Service Requirements and Costs to Achieve Demographic Goals

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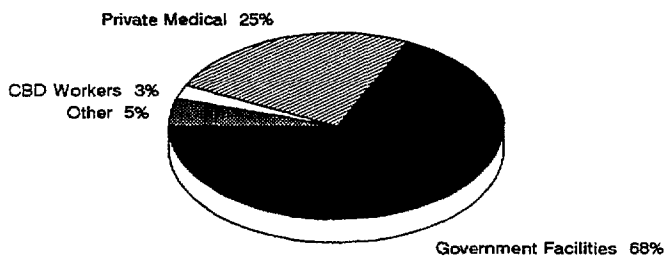
Table 4.13 Source of supply for modern contraceptive methods

Percent distribution of current users of modern contraceptive methods by most recent source of supply, according to specific methods, Kenya 1993

Source of supply	Pill	IUD	Injection	Condom	Female sterilisation	All modern methods
Public	72.5	68.9	70.5	36.6	63.9	68.2
Government hospital	24.2	29.6	18.2	13.2	60.6	29.6
Government health centre	29.1	27.5	34.2	12.8	2.9	24.6
Government dispensary	19.1	11.8	18.2	10.6	0.4	13.9
Medical private	16.2	31.1	26.5	25.6	33.2	24.7
Mission/church hospital	4.5	5.6	8.8	2.4	15.1	7.7
FPAK clinic[1]	3.3	7.3	5.1	3.3	5.1	4.8
Other nongovernment service	0.4	0.6	1.6	0.0	0.9	0.8
Private hospital/clinic	4.5	11.6	8.8	3.3	11.2	7.8
Pharmacy	0.9	0.0	0.0	14.6	0.0	1.0
Private doctor	2.6	6.0	2.2	2.0	0.9	2.6
Other private	2.5	0.0	0.0	21.9	0.0	1.9
Shop	0.0	0.0	0.0	9.2	0.0	0.4
Friends/relatives	2.5	0.0	0.0	12.7	0.0	1.5
Mobile clinic	1.0	0.0	1.8	1.9	0.4	1.0
Community distribution/ health worker	6.3	0.0	0.4	3.2	0.0	2.5
Other	0.6	0.0	0.3	0.0	0.0	0.3
Don't know	0.2	0.0	0.0	10.1	0.3	0.6
Missing	0.6	0.0	0.5	0.7	2.2	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number	562	213	418	70	292	1560

Note: Total includes 4 users of foam tablets/jelly/diaphragm and 1 Norplant user.
[1]FPAK = Family Planning Association of Kenya

Figure 4.4
Percent Distribution of Current Users of Modern Methods by Most Recent Source of Supply



KDHS 1993

Figure 12: Kenya Demographic and Health Survey (DHS), 1993

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APPENDIX 4:
LEVELS AND TRENDS OF CONTRACEPTIVE USE AS ASSESSED IN 1988

The following pages reproduce Table 4, "Trends in the percentage of women using contraception: developing and developed countries with two or more survey-based estimates" from the United Nations publication Levels and Trends of Contraceptive Use as Assessed in 1988. The complete document may be obtained from the United Nations Department for International Economic and Social Information and Policy Analysis, Population Division, Office of Fertility; United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-4996. Fax: 212-963-2147.

An updated version of this document is expected in the near future. In the meantime, more current estimates of Contraceptive Prevalence Rate increases may be obtained from the World Contraceptive use 1994 Wall Chart, available from the United Nations Department for International Economic and Social Information and Policy Analysis, Population Division, United Nations, United Nations Plaza, New York, NY 10017 USA. Phone: 212-963-3179. Fax: 212-963-2147.

Table 4. Trends in the percentage of women using contraception: developing and developed countries with two or more survey-based estimates

	Marital status and age range	Earlier date: Year	Earlier date: Percentage currently using contraception	More recent date: Year	More recent date: Percentage currently using contraception	Average annual change a/ ((5)-(3))/((4)-(2))
	(1)	(2)	(3)	(4)	(5)	(6)
A. Developing countries						
AFRICA						
Eastern Africa						
Kenya	CM 15-49	1977/78	7	1984	17	1.6
Mauritius	b/ 15-49	1975	46	1985	75	3.0 b/
Northern Africa						
Egypt	CM 15-49	1974/75	25	1984	30	0.5
Morocco	CM 15-49	1980	20	1987	36	2.3
Tunisia	CM 15-49	1978	31	1983	41	2.0
Western Africa						
Senegal	CM 15-49	1978	4	1986	11	1.0
AMERICAS						
Latin America						
Caribbean						
Dominican Republic	CM 15-49	1975	32	1986	50	1.6
Haiti	CM 15-49	1977	15	1983	7	-1.4
Jamaica	CM 15-49	1975/76	38 c/	1983	51 c/	1.8
Puerto Rico	EM 15-49	1968	60	1982	65	0.3
Trinidad and Tobago	CM 15-49	1977	52	1987	53	0.1
Central America						
Costa Rica	CM 20-44	1976	70 d/	1986	71 d/	0.1
El Salvador	CM 15-44	1975	22	1985	48	2.7
Guatemala	CM 15-44	1978	19	1987	23	0.4
Honduras	CM 15-44	1981	27	1984	35	2.2
Mexico	CM 15-49	1976	30	1987	53	2.1
Panama	CM 20-44	1976	57 c/d/	1984	63 c/d/e/	0.7
Tropical South America						
Colombia	CM 15-49	1976	43	1986	65	2.1
Ecuador	CM 15-49	1979	34	1987	44	1.4
Paraguay	CM 15-44	1977	29 c/	1987	38 c/	0.9
Peru	CM 15-49	1977	31	1986	46	1.6
ASIA						
East Asia						
China	CM 15-49	1982	71	1985	74	1.1
Hong Kong	CM 15-49	1972	50	1982	72	2.3
Republic of Korea	CM 15-44	1975	37	1985	70	3.1
South Asia						
Southeastern Asia						
Indonesia	CM LT 50	1976	18	1987	48	2.6
Malaysia (Peninsular)	CM 15-49	1974/75	33	1984	51	1.9
Philippines	CM 15-44	1978	38	1986	46	0.9
Singapore	CM 15-44	1973	60	1982	74	1.6
Thailand	CM 15-44	1978	54	1987	68	1.7

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Table 4 (continued)

	Marital status and age range	Earlier date: Year	Earlier date: Percentage currently using contraception	More recent date: Year	More recent date: Percentage currently using contraception	Average annual change a/ ((5)-(3))/((4)-(2))
	(1)	(2)	(3)	(4)	(5)	(6)
Asia (continued)						
Southern Asia						
Bangladesh	CM LT 50	1976	8	1985	25	1.9
India	CM 15-44	1970	14	1980	32	1.9
Nepal	CM 15-49	1976	2	1986	14	1.2
Pakistan	CM 15-49	1975	5	1984/85	8	0.3
Sri Lanka	CM 15-49	1975	34 e/	1987	62	2.4
Western Asia						
Jordan	CM 15-49	1972	22	1983	26 c/	0.3
Turkey	CM 15-44	1973	38	1983	53	1.5
B. Developed countries						
AMERICAS						
Northern America						
United States	CM 15-45	1973	70	1982	68	-0.2
ASIA						
East Asia						
Japan	CM LT 50	1975	60	1986	64	0.4
EUROPE						
Eastern Europe						
Czechoslovakia	FM LT 45	1970	66 f/	1977	95 f/	4.0
Hungary	CM 15-39	1977	73	1986	73	0.0
Poland	CM LT 45	1972	60 g/	1977	75 g/	2.9
Northern Europe						
Denmark	FM LT 45	1970	67 g/h/	1975	63 g/	-0.8
Finland	FM LT 45	1971	77	1977	80	0.5
United Kingdom	EM LT 40	1970	75 j/	1983	81 j/	0.5
Southern Europe						
Spain	CM 18-49	1976	51 k/	1985	59	0.9
Yugoslavia	FM LT 45	1970	59 g/	1976	55 g/	-0.7
Western Europe						
Belgium (Flemish population)	CM 20-44	1975/76	87	1982/83	81	-0.9
France	FM LT 45	1972	64	1978	79	2.5
Netherlands	CM 21-39	1977	73 l/	1985	76	0.4

Note: CM: currently married; EM: ever-married; FM: currently in the first marriage; LT: less than.

a/ Computed as the difference in percentage using contraception divided by the number of years between surveys. When possible the difference in percentage using contraception was computed before rounding, and note was taken of the timing of the surveys within the year when computing the difference in dates. Where only the year of the survey was reported in the sources cited (see the section entitled "Data sources") the survey was assumed to have taken place at mid-year.

b/ Trend probably overstated because earlier figure is based on ever-married women and later figure on currently married women.

c/ Excluding use of douche, abstinence and folk methods.

d/ Including sterilization for health reasons.

e/ Special tabulation for the same areas as covered in the other survey shown.

f/ Ever-use (percentage who named a method "normally" or "most often" used).

g/ Excluding sterilization.

h/ Including remarried women.

i/ For England and Wales.

j/ Excluding Northern Ireland.

k/ Women in first marriage, aged 15-44.

l/ Women in first marriage, aged 16-49.

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APPENDIX 5:
WEIGHTS AND VOLUMES OF COMMONLY SUPPLIED CONTRACEPTIVES

The following charts show the shipping carton weight and volume of contraceptive commodities supplied by USAID and several other major international donors, along with the number of units of product included in each carton. A blank in any column means that the data item was not known at the time of printing. In such cases, or where commodities are procured from other sources, the supplier should be contacted directly to obtain shipping information.

CONDOMS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID Sourced domestically in the U.S. to ASTM and ISO standards and USAID specifications	6,000 condoms per carton	
49 mm lubricated Plain (no logo) Raja Blue & Gold Panther		For 49 mm condoms: 3.7 $ft.^3$ (.104 m^3); 40 lbs. (18 kg)
52 mm lubricated Plain (no logo) Blue & Gold Panther Raja Sathi		For 52 mm condoms: 3.7 $ft.^3$ (.104 $m.^3$); 46 lbs. (21 kg.)
IPPF Sourced globally to recipient's choice of following specifications:		
ISO standard, WHO specifications	7,200 condoms per carton	———————
UK/BSI specifications	7,200 condoms per carton	———————
USAID specifications	6,000 condoms per carton	———————
UNFPA Source globally to ISO standard, WHO specifications	7,200 condoms per carton	———————

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ORAL CONTRACEPTIVES		
Donor/Manufacturer/Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID		
Syntex: Norminest, Norquest, Noriday (for social marketing programs; discontinued 4th quarter 1994)	1,200 monthly cycles per shipping carton	1.33 ft.^{3} (0.04 m.^{3}); 18.25 lbs. (8.28 kg.)
Wyeth-Ayerst: Lo-Femenal, Lo-Gentrol (Philippines only), Ovrette	1,200 cycles per shipping carton	19lbs/8.55kg; 1.3 ft.^{3} (0.04 m^3)
Duofem, Monofem (for social marketing program; procurement begun 4th quarter 1994)	1,200 cycles per shipping carton	———
IPPF		
Medimpex: Rigevidon	600 monthly cycles per shipping carton	———
Organon: Exulton, Marvelon Ovostat	600 monthly cycles shipping carton	———
Ortho: Micronor, Ortho/Novum 1/35, Ortho/Novum 1/50	576 monthly cycles per shipping carton	———
Schering AG: Combination 3 (Blue Lady), Eugynon ED Fe (Blue Lady), Microgynon 30, Neogynon ED Fe (Blue Lady), Triquilar ED Fe (Blue Lady)	600 monthly cycles per shipping carton	———
Eugynon 21, Microlut, Neogynon 21, Triquilar 21	600 monthly cycles per shipping carton	———
Wyeth-Ayerst: Nordette 28 (Blue Lady), Nordette 21, Nordiol 28 (Blue Lady), Ovral 28 (Blue Lady)	600 monthly cycles per shipping carton	———
Microval 35, Nordiol 21	600 monthly cycles per shipping carton	———

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ORAL CONTRACEPTIVES (continued)		
Donor/Manufacturer/Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
UNFPA		
Medimpex: Ovidon, Rigevidon		
Organon: Marvelon 28	24 inner boxes per carton (2400 cycles)	49.5 x 40 x 36 cm; 14.0 kg
Exulton 28	16 inner boxes per carton (1600 cycles)	47.8 x 33.2 x 25.9 cm; 10.6 kg
Ortho UK/US: Micronor, Trinovum		
Schering: Microgynon 30 ED Fe, Eugynon 30 ED Fe, Neogynon 30 ED Fe, Triquilar ED Fe, Eugynon ED Fe, Combination 5 Fe	880 inner boxes per carton (2640 cycles)	60 x 40 x 44 cm; 20 kg
Microlut 35, Eugynon 21, Triquilar 21, Logynon 21, Microgynon 30, Neogynon 21, Microgynon 21, Microgynon 30 (3 x 21), Neogynon 3 x 21	240 inner boxes per carton (2400 cycles)	60 x 40 x 36 cm; 18.7 kg
Wyeth-Ayerst USA: Lo-Femenal 28, Lo-Gentrol 28	1200 cycles per carton	21.6 x 48.9 x 39.4 cm; 7.7 kg
Ovrette, Ovral 28		40.6 x 31.8x 22.9 cm; 5 kg
Wyeth Germany: Nordette 28, Ovral 28, Nordiol 28	200 inner boxes per carton (600 cycles)	39 x 24 x 25 cm, 4.8 kg
Nordette 21	200 inner boxes per carton (600 cycles)	40 x 24 x 25 cm; 3.9 kg
Trinordial 28	400 cycles per carton	35 x 25 x 33 cm; 3.8 kg
Microval 35	700 cycles per carton	———— ;5.0 kg
Gedeon Richter: Rigevidon, Ovidon	36 inner boxes per carton	56 x 51 x 38 cm; 23 kg
Tri-Regol	22 inner boxes per carton	56 x 51 x 38; 14 kg

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IUDs		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID Finishing Enterprises: Copper T 380A	10 inner boxes (200 IUDs) per carton	1.54 ft.^{3} (0.04 m.^{3}); 16.6 lbs. (7.5 kg.)
IPPF Leiras: Nova T Manufacturer varies: Copper T 380A Copper T 200B Organon: Multiload Cu 250 (Standard size) Multiload Cu 250 (Short size) Multiload Cu 375	_____ _____ _____	_____ _____ _____
UNFPA Organon: Multiload Cu375 Multiload Cu250 Orthol Canada: CopperT 380A CopperT 200	_____ _____	_____ _____

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INJECTABLE CONTRACEPTIVES		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID		
Upjohn: Depo-Provera® (DMPA) 150 mg; Single dose 1cc	4 inner boxes per carton (400 vials)	17.875" x 16.438" x 7.5"
IPPF		
Organon: Megestron (MPA)	_____	_____
Schering: Noristerat (NET-EN)	_____	_____
Upjohn: Depo-Provera® (DMPA); 150 mg; Single dose 1cc	_____	_____
UNFPA		
Organon: Megestron (MPA)	1400 vials per carton	49.4 x 27.8 x 32.4 cm; 13.0 kg
Schering: Noristerat (NET-EN)	3600 ampoules per carton	40 x 30 x 44 cm; 15.4 kg
Upjohn: Depo-Provera® (DMPA)	_____	_____
Gedeon Richter: Doryxas (NET-EN)	1000 vials per carton	46 x 19 x 16.5 cm; 6.8 kg

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IMPLANTS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID Leiras Pharmaceuticals NORPLANT® Levonorgestrel Implants	Packed according to size of each order	Packed according to size of each order
IPPF Leiras Pharmaceuticals NORPLANT® Levonorgestrel Implants	_____	_____
UNFPA Leiras Pharmaceuticals NORPLANT® Levonorgestrel Implants	Cartons may contain (a) 10 inner boxes (100 sets), (b) 100 inner boxes (100 sets), (c) 100 inner boxes (1000 sets), or (d) 1000 inner boxes (1000 sets) in a double carton	(a) 35 x 25 x 22 cm; 1 kg (b) 35 x 39 x 47 cm; 2.5 kg (c) 35 x 39 x 47 cm; 10 kg (d) 60 x 40 x 48 cm; 23 kg

SPERMICIDAL/VAGINAL BARRIER METHODS		
Donor/Manufacturer/ Brand	Units per Shipping Carton	Dimensions & Weight of Carton (if known)
USAID		
VAGINAL FOAMING TABLETS Ortho: Flower or Conceptrol logos	48 inner boxes per shipping carton	1.58 $ft.^3$ (0.04 m^3); 19.9 lbs. (9.0 kg.)
IPPF		
VAGINAL FOAMING TABLETS Eisai: Neo Sampoon	_____	_____
FOAM Ortho UK/USA: Delfen Foam	_____	_____
DIAPHRAGMS Ortho USA	_____	_____
JELLIES Holland Rantos Co.: Koromex II; Applicator	_____	_____
Ortho UK/USA: Ortho-Gynol II; Applicator	_____	_____
Schmid: Ramses-Jelly; Applicator	_____	_____
SUPPOSITORIES: Ortho UK/USA; Ortho-forms	_____	_____
Syntex: Staycept	_____	_____
UNFPA		
VAGINAL FOAMING TABLETS Eisai: Neo Sampoon	_____	_____
FOAM Ortho UK/USA: Delfen	_____	_____
DIAPHRAGMS Ortho UK/USA	_____	_____
JELLIES Ortho UK/USA: Ortho-Gynol II	_____	_____

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APPENDIX 6:
AN EXAMPLE FORECAST USING ALL DATA SOURCES

The following example provides the reader with sample forecasts made using all of the forecasting methodologies presented in this manual. The data is for the mythical country of Anyland, a small country with a relatively well-established family planning program. For the sake of simplicity, this example includes only the forecast for one oral contraceptive, Lo-Femenal. The first year for which a forecast is required is calendar year 1994, and it is assumed (again for simplicity) that the forecast is being prepared in January 1994, after all the historical data for 1993 have been received. The forecast is to extend through calendar year 1996.

A. DISTRIBUTION SYSTEM DESCRIPTION

The Logistics Unit of the Government of Anyland's Family Planning Department is based in the capital city, where the Central Warehouse is also located. The country is administratively divided into three regions. There is a regional warehouse for each region staffed by a Regional Logistics Coordinator responsible for maintaining logistics records. There are a total of 100 SDP's in the three regions of Anyland.

There are considerable data with which to prepare a forecast of contraceptive needs. A Demographic and Health Survey (DHS) was recently completed for Anyland. The Ministry of Health of Anyland also has logistics records and service statistics, which are transmitted from the SDPs to the Regional Logistics Coordinator, who aggregates the data for transmission to the central level. The Ministry is, however, concerned about the completeness and accuracy of some of the data. The MOH has also expressed concern about whether the capacity of its contraceptive distribution system is sufficient to meet the program's needs.

Although the government has extensive data for preparation of a forecast, staff are unsure which data source will provide the most reliable data for forecasting, or whether a combination of these sources should be used.

The following sections of this appendix present the relevant data for use in forecast preparation, along with an explanation of data problems and adjustments that were required, the forecasts prepared using each data source, the recommended "final" forecast, and the rationale for its selection. The techniques used for adjusting the data are those described in Chapter III of this manual; forecasts for each method were prepared using the methodologies

described in Chapters II, IV, V, VI, and VII. Considerations applied in validating and reconciling the forecasts are described in Chapter X. The methodology for preparing the requirements estimate is described in Chapter XI.

B. THE LOGISTICS DATA BASED FORECAST

As described in Chapter IV, the basic steps in preparing a logistics data based forecast are evaluating, correcting, and adjusting the logistics data, and preparation and adjustment of the consumption projection.

Adjustments to Historical Logistics Data

Figure 1 displays both reported and adjusted logistics data for Lo Femenal for Anyland Region 1. The two apparent issues with the reported figures, and the adjustments made were as follows:

- Both 1992 and 1993 reporting included only 92% of the SDP's. Under the assumption that these 92% were representative of the entire country, the adjusted Quantities Dispensed was obtained by dividing the reported Quantities Dispensed by 0.92, using the formula shown in Chapter III.

- Reported Quantities Dispensed in Quarter 2 of both years is significantly lower than the figures for the other three quarters. This discrepancy could be due to any number of reasons, including stockouts and reporting errors. However, the pattern shown in the data and the order of magnitude of the difference in Quarter 2 is the same in both years, which suggests a recurrent seasonality pattern in Lo Femenal use. Program managers therefore concluded that Quarter 2 service activity is in fact lower than in other quarters of each year. Accordingly, no additional adjustments were made to Quarter 2 data.

Figure 2 displays both reported and adjusted logistics data for Region 2. Issues and adjustments are as follows:

- 1992 reported Quantities Dispensed included 92% of the SDP's, and 1993 Quantities Dispensed included only 75%. These figures were adjusted by dividing reported Quantities Dispensed by 0.92 and 0.75 respectively, using the formula shown in Chapter III.

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Figure 1

SUMMARY LOGISTICS DATA FOR REGION 1: LO FEMENAL

1992

% REPORTING FOR YEAR: 92%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	18,400	Divide by .92 to estimate quantity if 100% reporting	20,000
Quarter 2	11,960	(same)	13,000
Quarter 3	16,560	(same)	18,000
Quarter 4	19,320	(same)	21,000
Total	66,240		72,000

1993

% REPORTING FOR YEAR: 92%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	19,320	Divide by .92 to estimate quantity if 100% reporting	21,000
Quarter 2	12,880	(same)	14,000
Quarter 3	16,560	(same)	18,000
Quarter 4	20,240	(same)	22,000
Total	69,000		75,000

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Figure 2

SUMMARY LOGISTICS DATA FOR REGION 2: LO FEMENAL

1992

% REPORTING FOR YEAR: 92%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	184,000	Divide by .92	200,000
Quarter 2	161,000	(same)	175,000
Quarter 3	202,400	(same)	220,000
Quarter 4	202,400	(same)	220,000
Total	749,800		815,000

1993

% REPORTING FOR Q1 - Q3: 75%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	160,000	Divide by .75	213,333
Quarter 2	140,000	(same)	186,667
Quarter 3	170,000	(same)	226,667
Quarter 4	Missing data; calculated value: 156,667	Average of 1st 3 quarters (adjusted data)	Missing data; calculated value: 208,889
Total	626,667		835,556

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- In addition, 4th quarter data for 1993 were missing completely. Usage in Region 2 fluctuates fairly significantly in the quarters for which data were available, but shows no consistent pattern of increasing or decreasing trend, nor any clear indication of seasonality. Quarter 4 data for 1993 were therefore estimated using a simple average of data from the first three quarters. In accordance with the formulas in Chapter III, the adjustment for incomplete reporting was made first, and the average of the *adjusted* figures for the first three quarters was used to calculate the adjusted estimate for Quarter 4.

Figure 3 displays both reported and adjusted data for Region 3. In this case also, there were two significant issues:

- As in Regions 1 and 2, reporting was incomplete. 1992 reported figures were divided by 0.90 and 1993 reported figures were divided by 0.92 to correct for underreporting, using the formula shown in Chapter III.

- Reported Quantities Dispensed for Quarter 3 of 1992 was very low. This case differs from the data for Region 1 in that a similar pattern is *not* seen in the 1993 data; accordingly it would be inappropriate to assume that seasonality accounts for the lower value in Quarter 3. A more likely explanation is a stockout or a serious reporting error in this time period, and therefore an adjustment to the data should be made. Since the 1993 data show no clear increasing or decreasing trend in Quantities Dispensed, a simple average of the other three quarters was used as the adjusted value for Quarter 3 of 1992.

The estimate of Quantities Dispensed for the entire country is calculated as the sum of the adjusted values for all three regions. These figures, taken from Figure 1, Figure 2, and Figure 3, are shown in Figure 4.

The Logistics Data Projection

The next step is to graph the (adjusted) data. At this point a decision must be made regarding which of the techniques described in Chapter II should be used to make the projection. In this case the data show a clear increase in Quantities Dispensed over time, so the simple averages technique should not be used. Because there is significant variation from quarter to quarter, use of the linear trend method would also be dangerous, since it depends solely on the first and last data points for extrapolation. It would be easy to draw a "by eye" line through these data points, but the procedure of semi-averages gives a reproducible and more defensible result.

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Figure 3

SUMMARY LOGISTICS DATA FOR REGION 3: LO FEMENAL

1992

% REPORTING FOR YEAR: 90%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	90,000	Divide by .90	100,000
Quarter 2	81,000	(same)	90,000
Quarter 3	18,000 (Equivalent to no data)	Average of Q1, Q2, and Q4	Calculated value: 96,667
Quarter 4	90,000	(same as Q1)	100,000
Total	279,000 + ???		386,667

1993

% REPORTING FOR YEAR: 92%	QUANTITIES DISPENSED (REPORTED)	ADJUSTMENTS	QUANTITIES DISPENSED (ADJUSTED)
Quarter 1	110,400	Divide by .92	120,000
Quarter 2	156,400	(same)	170,000
Quarter 3	128,800	(same)	140,000
Quarter 4	110,400	(same)	120,000
Total	506,000		550,000

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Figure 4

SUMMARY LOGISTICS DATA FOR ANYLAND: LO FEMENAL

1992

	QUANTITIES OF LO FEMENAL DISPENSED 1992			
	REGION 1	REGION 2	REGION 3	TOTAL
Quarter 1	20,000	200,000	100,000	320,000
Quarter 2	13,000	175,000	90,000	278,000
Quarter 3	18,000	220,000	96,667	334,667
Quarter 4	21,000	220,000	100,000	341,000
Total	72,000	815,000	386,667	1,273,667

1993

	QUANTITIES OF LO FEMENAL DISPENSED 1993			
	REGION 1	REGION 2	REGION 3	TOTAL
Quarter 1	21,000	213,333	120,000	354,333
Quarter 2	14,000	186,667	170,000	370,667
Quarter 3	18,000	226,667	140,000	384,667
Quarter 4	22,000	208,889	120,000	350,889
Total	75,000	835,556	550,000	1,460,556

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For these reasons, it was decided that the procedure of semi-averages would be used to make the projection.

The semi-average data points were obtained as follows: Since there are eight quarters of data available, the two needed data points can be calculated by averaging the first four quarters (1992) and separately averaging the second four (1993). That is,

$$\text{Estimated Use in First Half of Series} = \frac{\text{Total Quantity Consumed in Quarters 1 - 4 of 1992}}{4}$$

$$= \frac{(320{,}000 + 278{,}000 + 334{,}667 + 341{,}000)}{4}$$

$$= \frac{1{,}273{,}667}{4} = 318{,}417$$

and, similarly,

$$\text{Estimated Use in Second Half of Series} = \frac{\text{Total Quantity Consumed in Quarters 1 - 4 of 1993}}{4}$$

$$= \frac{(354{,}333 + 370{,}667 + 384{,}667 + 350{,}889)}{4}$$

$$= \frac{1{,}460{,}556}{4} = 365{,}139$$

These two points were plotted in Figure 5, and a straight line through them forms the initial logistics data based projection.

In the absence of any known plans for major changes in Anyland's service delivery program, no adjustments to the forecast were made, corresponding to the assumption that the pattern represented by the historical data is representative of the likely future trend.

C. THE SERVICE STATISTICS BASED FORECAST

As described in Chapter V, the basic steps in preparing a service statistics data based forecast are evaluating, correcting, and adjusting the service data, and preparation and adjustment of the consumption projection.

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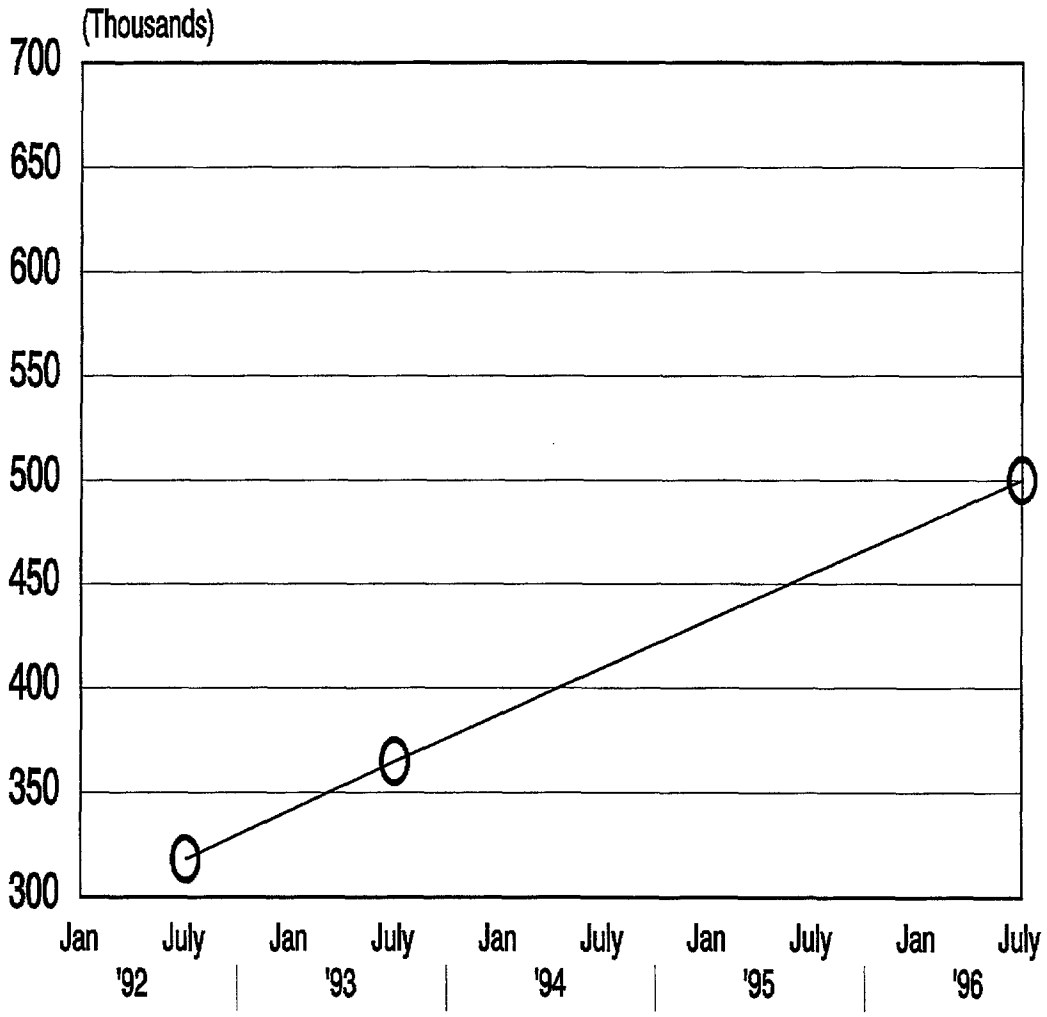
Figure 5

LOGISTICS DATA BASED PROJECTION FOR ANYLAND



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Adjustments to Historical Service Statistics Data

Anyland's Management Information System reports New Visits and Revisits separately. Figure 6 displays both reported and adjusted service statistics data for Region 1. The apparent issues with the reported figures, and the adjustments made, were as follows:

- As with the logistics data, there was underreporting in both years: 74% in 1992 and 86% in 1993. Under the assumption that the reporting facilities were representative of the entire country, adjusted figures for New Visits and Revisits were obtained by dividing the reported figures for each year by 0.74 and 0.86 respectively, using the formulas shown in Chapter III.

- In 1993, Quarter 2 data were missing. It is *not* appropriate to estimate the missing time period with the simple average formula used for the Region 2 logistics example, because both New Visits and Revisits in *1992* for Quarter 2 are very much lower than the other three quarters; thus a simple average is unlikely to provide a good estimate for the missing data. In this case a more complex adjustment is required, as discussed below.

It is first necessary to decide whether the pattern represented by the data for 1992 is an accurate reflection of program performance, or whether in fact there was a stockout or some other additional problem with the reported figures. Because the logistics data for Region 1, which were more complete, show a seasonal decrease in the second quarter for both years, it seems reasonable to assume that the 1992 service data for Quarter 2 are in fact representative, and that the Quarter 2 decreases represent a recurrent seasonal trend. It is therefore possible to estimate the missing period for 1993 based on the pattern shown by the data in 1992, as discussed in Chapter III. For each type of visit:

$$\text{Proportion of Visits Represented by a Single Period} = \frac{\text{Visits in Single Period}}{\text{Total Visits}}$$

For New Visits, for example,

$$\text{Proportion of Visits Represented by Quarter 2 1992} = \frac{1{,}091}{10{,}605} = 0.103$$

(It is important to remember to use the *adjusted* 1992 figures in this calculation.) If the Proportion of New Visits represented by Quarter 2 is 0.103, then the Proportion of New

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Figure 6

SUMMARY SERVICE DATA FOR REGION 1: LO FEMENAL

1992

% REPORTING FOR YEAR: 74%	NEW VISITS			REVISITS		
	REPORTED	ADJUST-MENTS	ADJUSTED	REPORTED	ADJUST-MENTS	ADJUSTED
Quarter 1	2,415	Divide by .74	3,264	7,680	Divide by .74	10,378
Quarter 2	807	(same)	1,091	2,299	(same)	3,107
Quarter 3	1,982	(same)	2,678	6,004	(same)	8,114
Quarter 4	2,643	(same)	3,572	8,177	(same)	11,050
Total	7,847		10,605	24,160		32,649

1993

% REPORTING FOR YEAR: 86%	NEW VISITS			REVISITS		
	REPORTED	ADJUST-MENTS	ADJUSTED	REPORTED	ADJUST-MENTS	ADJUSTED
Quarter 1	2,360	Divide by .86	2,744	7,350	Divide by .86	8,547
Quarter 2	Missing data; calculated value: 796	See text	926	Missing data; calculated value: 2,260	See text	2,628
Quarter 3	1,827	(same)	2,124	5,805	(same)	6,750
Quarter 4	2,744	(same)	3,191	8,378	(same)	9,742
Total	7,727		8,985	23,793		27,667

Visits represented by the other three quarters must be 0.897, since the sum of the proportions must equal 1.0. According to the procedure described in Chapter III, Estimated *Reported* Total New Visits for 1993 is then calculated by dividing the Quantity Reported by this latter proportion:

$$\begin{aligned} \textit{Estimated Total New Visits for 1993} &= \frac{\textit{New Visits for Quarter 1, 3, 4}}{0.897} \\ &= \frac{2{,}360 + 1{,}827 + 2{,}744}{0.897} \\ &= 7{,}727 \end{aligned}$$

and Estimated *Reported* New Visits for the missing quarter is calculated by multiplying this Estimated Total by the proportion which Quarter 2 represents:

$$\textit{Estimated New Visits for 1993 Quarter 2} = 7{,}727 \times 0.103 = 796$$

Finally, this figure is adjusted for underreporting in the same fashion as the other quarters:

$$\textit{Adjusted New Visits for 1993 Quarter 2} = \frac{796}{0.86} = 926$$

This same procedure is used to estimate adjusted Revisits for Quarter 2 of 1993.

Figure 7 displays the service statistics data for Region 2. Here again, several adjustments were required:

- In 1992, reporting was 98% complete. Given the likely level of error in the other assumptions made, this underreporting was considered negligible. Accordingly, no adjustment was made.

- In 1993, reporting was only 50% complete; however, program managers estimated that the sites which did report accounted for some 75% of the program's activity. Thus the data were adjusted by dividing by 0.75 rather than 0.50.

- Finally, Quarter 4 data were missing in 1993. As with the logistics data for Region 2 (and for the same reasons), it was decided to use the average of the first three quarters to estimate the missing period.

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Figure 7

SUMMARY SERVICE DATA FOR REGION 2: LO FEMENAL

1992

% REPORTING FOR YEAR: 98%	NEW VISITS			REVISITS		
	REPORTED	ADJUSTED	ADJUSTED	REPORTED	ADJUSTED	ADJUSTED
Quarter 1	17,750	None	17,750	65,750	None	65,750
Quarter 2	15,500	(same)	15,500	58,500	(same)	58,500
Quarter 3	18,250	(same)	18,250	74,500	(same)	74,500
Quarter 4	21,000	(same)	21,000	77,750	(same)	77,750
Total	72,500		72,500	276,500		276,500

1993

% REPORTING FOR YEAR: 50% (=75% OF USE)	NEW VISITS			REVISITS		
	REPORTED	ADJUST-MENTS	ADJUSTED	REPORTED	ADJUST-MENTS	ADJUSTED
Quarter 1	13,200	Divide by .75	17,600	49,500	Divide by .75	66,000
Quarter 2	12,150	(same)	16,200	44,750	(same)	59,667
Quarter 3	14,500	(same)	19,333	53,500	(same)	71,333
Quarter 4	Missing data; calculated value: 13,283	Average of first three quarters (adjusted data)	17,711	Missing data; calculated value: 49,250	Average of first three quarters (adjusted data)	65,667
Total	53,133		70,844	197,000		262,667

Figure 8 displays the service statistics data for Region 3. The only adjustments required were for underreporting; these were made by dividing by the proportion reporting, as in the previous cases.

Conversion of New and Revisit Data to Consumption Estimates

This completes the adjustments needed to the basic service statistics data. With adjusted figures for all three regions in hand, it is next necessary to convert the estimates of New Visits and Revisits to estimates of quantities of Lo Femenal consumed, using the program's prescribing protocol. In the Anyland program, one cycle of oral contraceptives is given at the first visit, and the client is asked to return at the end of one month for a followup check. If there are no problems, she is then given three cycles of pills at each revisit.

Given this protocol, national level consumption estimates can be prepared by summing New Visits for all regions and multiplying by one cycle to give Estimated Quantities Dispensed for New Visits, summing Revisits for all regions and multiplying by three cycles to give Estimated Quantities Dispensed for Revisits, and then totalling the Estimated Quantities Dispensed figures for each quarter. Figure 9 displays the results of these calculations.

The Service Statistics Data Projection

The final step is to graph the data and make the projection. In this case the procedure of semi-averages was chosen, for the same reasons it was used for making the logistics data projection. As in that case, the two data points are the average of the four quarters' consumption in 1992 and the average in 1993, with a straight line through these points forming the initial service statistics based projection. The results are displayed in Figure 10. As there are no known plans for major changes in Anyland's service delivery program, no adjustments to this initial forecast were made, again corresponding to the assumption that the pattern represented by the historical data is representative of the likely future trend.

D. THE POPULATION DATA BASED FORECAST

As described in Chapter VI, steps in preparation of the population data based forecast include gathering and adjusting demographic data for the base year of the forecast, estimating changes in demographic variables over the forecast period, and preparation of consumption estimates.

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Figure 8

SUMMARY SERVICE DATA FOR REGION 3: LO FEMENAL

1992

% REPORTING FOR YEAR: 55%	NEW VISITS			REVISITS		
	REPORTED	ADJUST-MENTS	ADJUSTED	REPORTED	ADJUST-MENTS	ADJUSTED
Quarter 1	5,297	Divide by .55 to estimate 100% reporting	9,631	21,789	Divide by .55 to estimate 100% reporting	39,616
Quarter 2	4,827	(same)	8,776	20,887	(same)	37,976
Quarter 3	3,949	(same)	7,180	16,790	(same)	30,527
Quarter 4	3,553	(same)	6,460	25,912	(same)	47,113
Total	17,626		32,047	85,378		155,232

1993

% REPORTING FOR YEAR: 60%	NEW VISITS			REVISITS		
	REPORTED	ADJUST-MENTS	ADJUSTED	REPORTED	ADJUST-MENTS	ADJUSTED
Quarter 1	5,243	Divide by .60 to estimate 100% reporting	8,738	24,108	Divide by .60 to estimate 100% reporting	40,180
Quarter 2	6,358	(same)	10,597	30,456	(same)	50,760
Quarter 3	6,634	(same)	11,057	27,949	(same)	46,582
Quarter 4	6,620	(same)	11,033	26,247	(same)	43,745
Total	24,855		41,425	108,760		181,267

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Figure 9

CONVERSION OF SERVICE DATA TOTALS INTO QUANTITY ESTIMATES: LO FEMENAL

1992

	NEW VISITS			REVISITS			ESTIMATED TOTAL QUANTITY DISPENSED
	TOTAL ADJUSTED NEW VISITS	X	ESTIMATED QUANTITY DISPENSED	TOTAL ADJUSTED REVISITS	X	ESTIMATED QUANTITY DISPENSED	
Quarter 1	30,645	1	30,645	115,744	3	347,232	377,877
Quarter 2	25,367	1	25,367	99,583	3	298,749	324,116
Quarter 3	28,108	1	28,108	113,141	3	339,423	367,531
Quarter 4	31,032	1	31,032	135,913	3	407,739	438,771
Total	115,152		115,152	464,381		1,393,143	1,508,295

1993

	NEW VISITS			REVISITS			ESTIMATED TOTAL QUANTITY DISPENSED
	TOTAL ADJUSTED NEW VISITS	X	ESTIMATED QUANTITY DISPENSED	TOTAL ADJUSTED REVISITS	X	ESTIMATED QUANTITY DISPENSED	
Quarter 1	29,082	1	29,082	114,727	3	344,181	373,263
Quarter 2	27,723	1	27,723	113,055	3	339,165	366,888
Quarter 3	32,514	1	32,514	124,665	3	373,995	406,509
Quarter 4	31,935	1	31,935	119,154	3	357,462	389,397
Total	121,254		121,254	471,601		1,414,803	1,536,057

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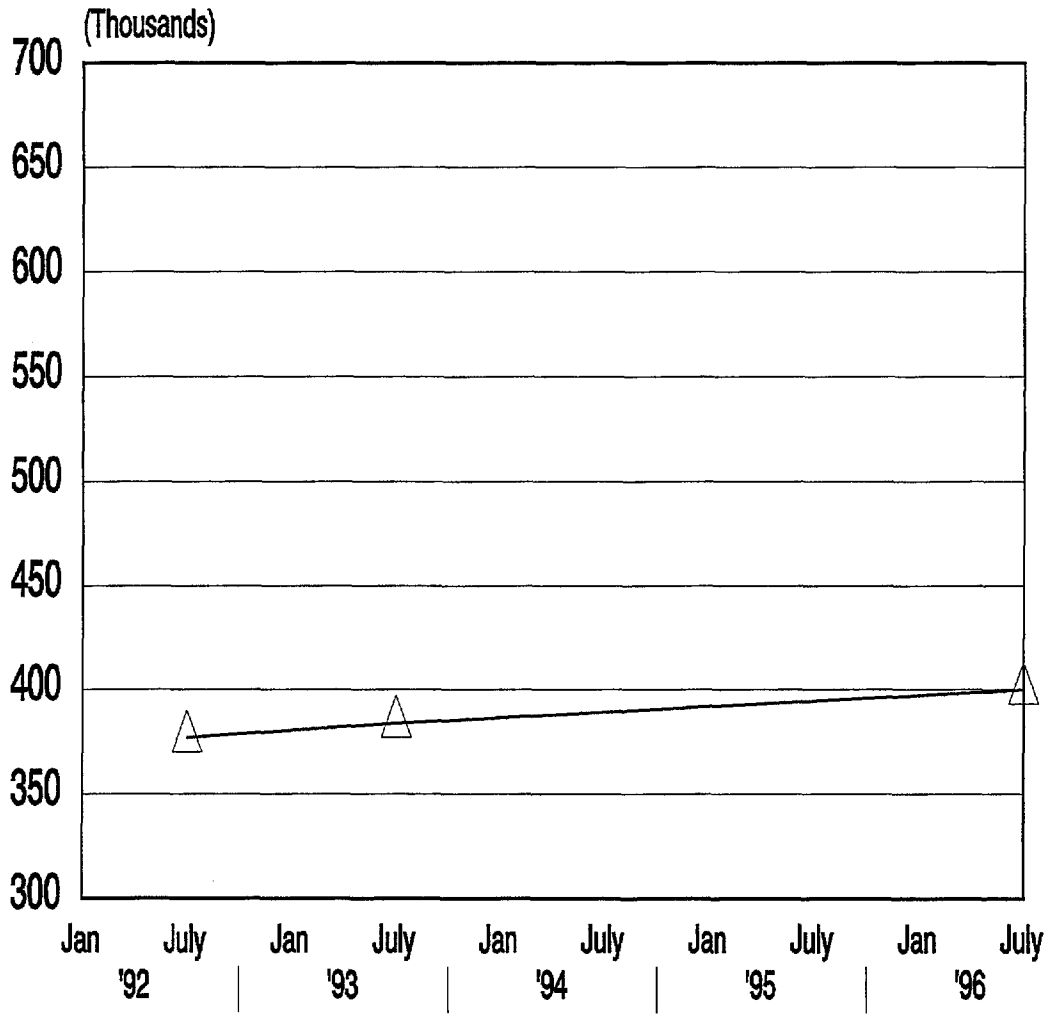
Figure 10

SERVICE STATISTICS DATA BASED PROJECTION FOR ANYLAND



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Demographic Data for the Beginning, Intermediate and Final Forecast Years

Anyland is fortunate to have recent demographic data available, in the form of a 1993 DHS. Like many other countries, Anyland demographic forecasts are included in the U.S. Census Bureau International Database, the PRB World Population Data Sheet, and in the U.N.'s Levels and Trends of Contraceptive Use. Because the major data sources are current as of 1993, this year was considered to be the base year for the forecast, even though 1994 is in fact the first year for which a forecast is required. Baseline demographic data for the 1993 base year are included in Figure 11.

Samples of the data sources used in preparing Figure 11 (for Kenya, not for Anyland) are shown in Appendix 3, and the calculations needed to convert DHS method mix figures into percentages relative to All Women *who are using any method of contraception* are those shown in Chapter VI.

Adjustments for the base year demographic figures, and projections for the final forecast year and the intermediate years were prepared as follows:

First, it was necessary to compute Women of Reproductive Age for the 1993 base year. For purposes of this illustration, it is assumed that the forecasters did *not* have access to U.S. Census Bureau International Data Base or U.N. World Population Prospects WRA estimates. As stated in Chapter VI, it is *much better to consult one of these sources if at all possible.* Here, however, the forecaster used the 1990 U.S. Census Bureau WRA estimate, and the PRB World Population Data Sheet from 1993 to estimate WRA, for the base year and all subsequent years. As shown in Chapter VI, the formula is:

$$\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } \underline{n+1}\end{array} = \begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } n\end{array} + \left(\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ \textit{Year } n\end{array} \times \begin{array}{c}\textit{Annual Rate}\\ \textit{of Population}\\ \textit{Increase}\end{array}\right)$$

So, for 1991, the calculation is:

$$\begin{array}{c}\textit{Estimated}\\ \textit{WRA for}\\ 1991\end{array} = 4{,}940{,}447 + (4{,}940{,}447 \times 0.03)$$

$$= 4{,}940{,}447 + 148{,}214 = 5{,}088{,}661$$

This calculation was repeated for each subsequent year, yielding a WRA estimate of 5,398,561 for the 1993 base year, and a figure of 5,899,153 for the 1996 final forecast year. The base year, intermediate year, and final year figures for WRA, along with the rest of the calculations for the population data based forecast, are shown in Figure 12.

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Figure 11

POPULATION DATA FOR ANYLAND
For 1993 Base Year Forecast

DATA ITEM	SOURCE	VALUE
Beginning (Base) Year: 1993 Ending Year: 1996		
Women of Reproductive Age (WRA)	U.S. Census Bureau International Data Base (1990)	4,940,447
Annual Rate of Population Increase	PRB World Population Data Sheet (1993)	3%
WRA in Union	DHS (1993)	100%
Contraceptive Prevalence Rate (CPR) -- all methods	DHS (1993)	16%
Annual CPR Increase (in percentage points)	UN Levels and Trends of Contraceptive Use (1988)	1.0
Method Mix: Condoms Orals Other	DHS (1993)	 9.0% 45.4% 45.6%
Brand Mix (orals): Lo-Femenal Other	Anyland Logistics MIS	 50% 50%
Source Mix (all methods): Public Sector Other	DHS (1993)	 65% 35%
CYP Conversion Factors: Condoms Orals	 USAID Defaults	 150 15

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Figure 12

POPULATION DATA BASED PROJECTION FOR ANYLAND MOH 1993 - 1996

DATA ITEM	1993	1994	1995	1996
Women of Reproductive Age (WRA)	5,398,561	5,560,518	5,727,333	5,899,153
WRA in Union (See Chapter VI)	100%	100%	100%	100%
Contraceptive Prevalence Rate (CPR)	16.00	17.00	18.00	19.00
Method Mix				
Condoms	9.0%	9.0%	9.0%	9.0%
Orals	45.4%	45.4%	45.4%	45.4%
Other	45.6%	45.6%	45.6%	45.6%
Brand Mix (orals)				
Lo Fememal	50%	50%	50%	50%
Other	50%	50%	50%	50%
Source Mix				
Public Sector	65%	65%	65%	65%
Other	35%	35%	35%	35%
CYP Conversion Factors				
Condoms	150	150	150	150
Orals	15	15	15	15
QUANTITY REQUIRED				
Lo Femenal	1,911,738	2,092,159	2,281,684	2,480,697

The forecaster next considered WRA in Union, but decided that the DHS figures for Anyland did not adequately reflect the population which is really sexually active. Accordingly, as explained in Chapter VI, 100% was used for WRA in Union, and the Contraceptive Prevalence Rate for *all* women, estimated at 16% by the DHS in 1993, was used for the base year CPR. This strategy was used for all subsequent forecast years as well.

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The Annual CPR Increase (in percentage points) in Anyland was estimated at 1.0 by the U.N. Levels and Trends of Contraceptive Use. This rate is reasonable, and not excessive when compared to performance of other nations' family planning programs, so the forecaster chose this rate of increase for the projection, giving an estimated CPR of 17% for 1994, 18% for 1995, and 19% for 1996.

According to the DHS, the Method Mix percentage for orals in 1993 was 45.4% (as translated to a percentage of women *using any method of contraception* from the DHS reported figure for the percentage of *all women*, using the formula in Chapter VI). Because the time frame for this projection is relatively short, and because the Anyland MOH program managers have expressed no specific plans to attempt to influence the method mix, these figures were held constant for the entire projection. For the same reasons, the Brand Mix and Source Mix were held constant. These assumptions are very likely reasonable for the case described here; for a longer-term projection for Anyland, or for a projection in a more volatile service program, variations in these data items would have to be taken into account.

Finally, in the absence of local data, the USAID default Couple Year of Protection Factors were used for the commodity calculation.

Calculation of Consumption Projections

With the figures of Figure 12 in hand, the calculation for the projection is straightforward. As shown in Chapter VI, the formula is:

$$\textit{Estimated Consumption of a Brand of a Method in Year } n = \textit{Estimated WRA for Year } n \times \textit{CPR for Year } n \times \textit{Method Mix for this Method for Year } n \times \textit{Brand Mix for this Brand for Year } n \times \textit{Program Proportion of this Method} \times \textit{CYP Conversion Factor}$$

So, for the 1993 base year, the Quantity of Lo Femenal which should have been required is:

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$$\text{Estimated Consumption of Lo Femenal in 1993} = 5{,}398{,}561 \times 0.16 \times 0.454 \times 0.5 \times 0.65 \times 15 = 1{,}911{,}738$$

The consumption estimates for the intermediate and final forecast years are made in the same fashion, with the results shown in Figure 12. As with the other projection methods, a graphical presentation of the projection is most instructive. The population data based projection is shown in Figure 13. Annual consumption estimates of Figure 12 were divided by 4 with the resulting quarterly average plotted at the midpoint of each year to give a graph comparable to the preceding two projections.

Because this projection is based on population data rather than program data, there is no need to modify the projection further based on program plans. Differing program plans would be reflected in different assumptions for Method Mix, Brand Mix, or Source Mix, rather than by an after-the-fact adjustment to the projection as the logistics data and service data projections might require.

E. THE DISTRIBUTION SYSTEM CAPACITY BASED FORECAST, PART 1

At this point it is necessary to decide whether and how to undertake a distribution system capacity based forecast. As mentioned in the introduction to this example, MOH staff are worried about the capability of the distribution system to meet increased demand. However, there are at present neither plans nor resources available for restructuring or expanding the distribution system, though program managers are willing to make procedural changes, and feel that they have a limited ability to adjust the capacity of warehouses or transportation links if absolutely necessary during the relatively short time period covered by this forecast.

In these circumstances, it is necessary to consider that the existing distribution system capacity sets an upper limit to expansion of services. Accordingly, it is more appropriate to use a distribution system capacity based forecast to confirm the feasibility of meeting the demand projected by the other methods.

Thus the forecaster decided to reconcile the forecasts made using logistics, service statistics, and population data as the next step, and then to check whether the resulting projection of commodity distribution can be accommodated by the current logistics system.

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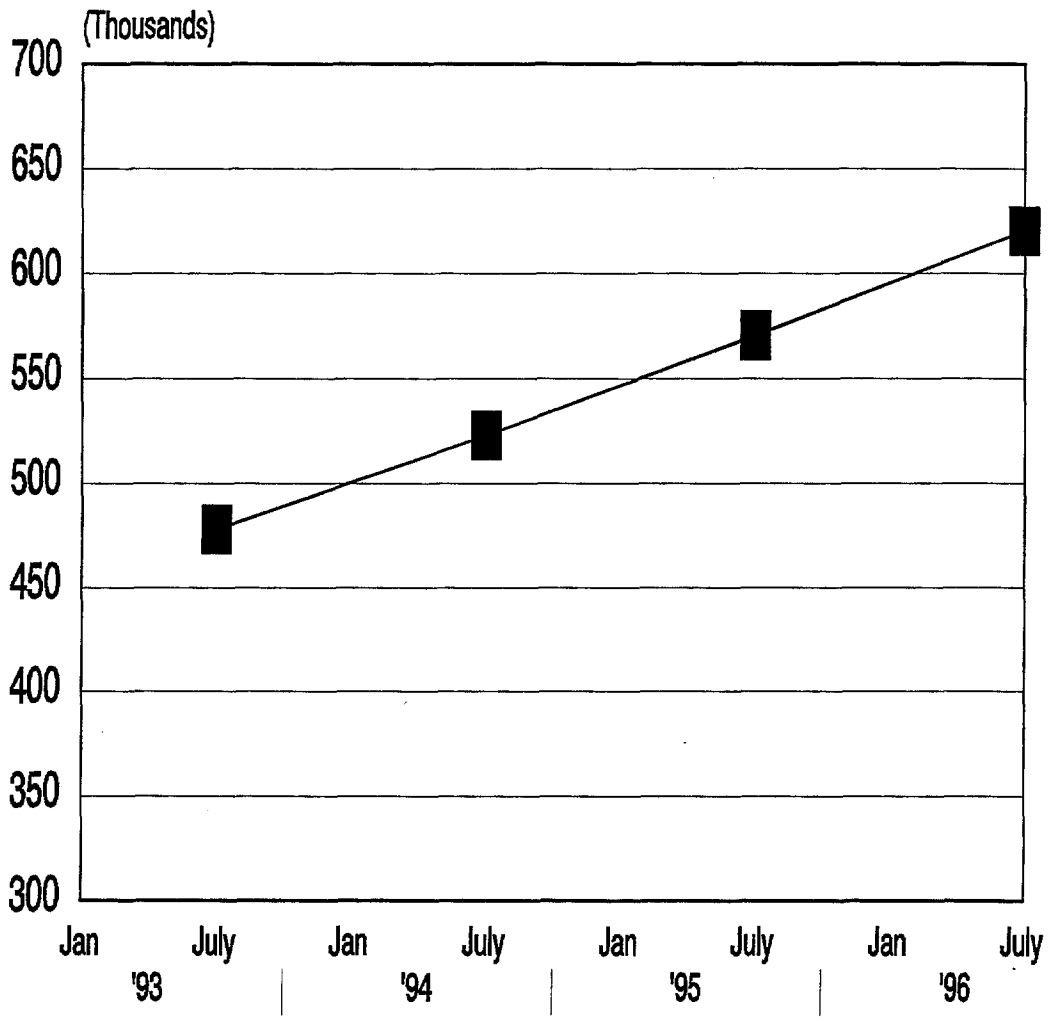
Figure 13

POPULATION DATA BASED PROJECTION FOR ANYLAND



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F. FORECAST VALIDATION AND RECONCILIATION

As described in Chapter X, validation includes review of the strengths and weaknesses of each data source and forecast, and reconciliation is the process of evaluating the available options and settling on the final forecast.

Forecast Validation

The strengths and weaknesses of each of the three projections are summarized in Figure 14, Figure 15, and Figure 16. A comparison of these tables reveals the following key points:

- The logistics data for both 1992 and 1993 are more complete than the service statistics data for either year. Though it was possible in both cases to adjust the data to estimate 100% reporting, the forecast error introduced by the adjustments is likely to be greater in the case of the service statistics projection.

- More complicated adjustments for missing data were required in the case of the service statistics projection.

- It is not known whether Dispensed to User data include losses or only commodities actually dispensed to clients. Similarly, it is not known whether service providers actually understand the definitions of New Visits and Revisits, or whether they regularly follow the prescribing protocol for any method.

- Sources of demographic data, with the exception of the U.S. Census Bureau International Data Base, were current. Estimates of WRA for the base and forecast years had to be calculated. Otherwise there were no known problems with the survey data.

- Local information for setting CYP factors was not available; in consequence, the USAID world-wide estimates were used.

These points suggest that the logistics data in this case provide the strongest projection, in particular because the service data are less complete, and because both the service data and population data based forecasts require additional assumptions which the logistics data based forecast does not.

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Figure 14

EVALUATING ANYLAND'S LOGISTICS DATA BASED FORECAST

QUESTION	ASSESSMENT
1. Were Dispensed to User data used to make the forecast? If not, what level issues data were used?	Dispensed to User data were used.
2. What percentage of reports from SDP's or warehouses were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	Percent reporting varied between 90% and 92%, except in 1993 in Region 2, where 75% of sites reported. Data were adjusted to estimate 100% reporting.
3. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	Eight quarters of data were used. Data were missing for Quarter 4 of 1993 in Region 2, and for Quarter 3 of 1992 in Region 3. Adjustments were made to estimate 100% reporting.
4. Were losses reported separately from consumption or issues data? If not, what adjustments were made to account for system losses?	Logistics reporting is based on "Quantities Dispensed" which implies that the figures are for commodities actually given to users. It is not possible to know for sure from the available information whether losses are reported separately.
5. Were there stockouts during the time period covered by the data? If so, what adjustments were made to estimate true demand?	It is likely that there was a stockout in Region 3 during Quarter 3 of 1992. It is less likely but possible that there were stockouts in Region 1 in Quarter 2 of 1992 and Quarter 2 of 1993. Adjustments were made in Region 3 data to estimate 100% reporting; Region 1 variations were assumed to be due to seasonality.

QUESTION	ASSESSMENT
6. Were there special circumstances affecting past demand which no longer affect the program? If so, what adjustments were made to consumption estimates?	There were no known special circumstances.
7. What was the basis for projection of future consumption? What adjustments, if any, were made to the extrapolation of historical data?	The projection was an extrapolation from the historical data, made using the procedure of semi-averages. No adjustments were made to this extrapolation.

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Figure 15

EVALUATING ANYLAND'S SERVICE STATISTICS BASED FORECAST

QUESTION	ASSESSMENT
1. Were Visit data (either in total or broken down by visit or client type) used to make the forecast? If not, what service statistics were used? Are service data definitions written down? Do service delivery staff understand them?	Visit data, broken down by New and Revisits, were used. Clarity of understanding on the part of service delivery staff is not known.
2. Are prescribing protocols documented and understood by service delivery staff? What evidence is there that such protocols are routinely followed?	There is a definite prescribing protocol, but it is not known whether the protocol is always followed.
3. What percentage of reports from SDP's were missing over the period covered by historical data? What adjustments were made for incomplete reporting?	The percentage reporting varied from 50% to 98%, with most periods in the 55% - 75% range. Data were adjusted to estimate 100% reporting.
4. How many time periods of data were used for the projection? What percentage of reporting periods were missing from the period covered by historical data? What adjustments were made for missing time periods?	Eight quarters of data were used for the forecast. Data were missing in Quarter 2 of 1993 for Region 1, and in Quarter 4 of 1993 for Region 2. Adjustments were made to compensate for these missing data.

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QUESTION	ASSESSMENT
5. Were there special circumstances affecting past service levels which no longer affect the program? If so, what adjustments were made to service activity estimates?	There were no known special circumstances.
6. What was the basis for projection of future service levels? What adjustments, if any, were made to the extrapolation of historical data?	The projection was an extrapolation from the historical data, made using the procedure of semi-averages. No adjustments were made to this extrapolation.

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Figure 16

EVALUATING ANYLAND'S POPULATION DATA BASED FORECAST

QUESTION	ASSESSMENT
1. What source(s) were used for Total Population, WRA, Percent in Union/Sexually Active, Total Fertility Rate (if used in the projection), CPR, Method Mix, Brand Mix, Source Mix? Are there known problems with or biases in these surveys?	Sources were: U.S. Census Bureau International Data Base (1990), PRB World Population Data Sheet (1993), DHS (1993), U.N. Levels and Trends of Contraceptive Use (1993), and the Anyland Logistics MIS. It was felt that the DHS Women in Union figures significantly underestimate the sexually active population; otherwise there are no known problems with the surveys.
2. How old were these demographic data? If adjustments were made to older data to obtain base year estimates for the forecasts, what methodologies were used?	All data were from 1993 except for the WRA figure (1990) and the estimate of Annual CPR Increase (1988). Base and forecast year estimates of WRA were prepared by updating the 1990 WRA figure using an Annual Rate of Population Increase of 3.0%, obtained from the PRB World Population Data Sheet (1993).
3. What was the basis for the estimate of Program Proportion of Each Method?	DHS (1993).
4. What CYP/SYP factors were used to calculate commodity requirements?	USAID worldwide default factors.
5. If brand-specific projections were made, what was the basis for disaggregating method-specific data into individual brands?	Anyland Logistics MIS reports were used to estimate the Brand Mix for orals.

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QUESTION	ASSESSMENT
6. How were population data changes over the forecast period estimated?	WRA estimates were calculated assuming a 3.0% Annual Rate of Population Increase as discussed above. CPR was estimated using the U.N. Levels and Trends of Contraceptive Use figure of 1.0 percentage points increase per year. Other variables were held constant for the time period of the projection.

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Before making any judgement, however, all of the forecasts should be graphed for comparison, or at least compared in tabular form as suggested in Chapter X. The graph is shown in Figure 17.

Examination of the graph reveals the following additional key points:

- Though the curves are not identical, the trend in consumption shown by the population data based forecast parallels the estimates made from logistics data.

This fact strengthened the forecaster's confidence in both of these projections.

- The service statistics projection did not show the same trend as the other two projections.

This observation reduced the forecaster's confidence in the service statistics data based projection further. At this point the forecaster and program managers decided to drop the service statistics projection.

Forecast Reconciliation

The remaining options are to select one or the other of the remaining forecasts, or to take a weighted or unweighted average of the two. It is possible that the logistics data forecast underestimates actual consumption, due for example to unidentified reporting errors or omissions. It is also possible that the population data forecast produces an overestimate, due for example to respondent error in identifying the source of contraceptive supply, or to an overly generous CYP factor (the USAID default factor includes two extra cycles per woman per year to account for client wastage). If errors in both projections were suspected, then it would be reasonable to take an average.

Because the trend lines for the two forecasts are more or less parallel, it seems reasonable to assume that the discrepancy is caused by an error in one of the multipliers used in the population data projection, since such a mathematical error would clearly produce parallel lines, but with one curve higher than the other. Because the logistics data projection required none of the types of assumptions that the population data based projection requires, and since the logistics data set had already been judged to be the least problematic of the data sources, managers and the forecaster decided to simply use the logistics data based forecast as the final projection.

The way in which this projection is used depends on the purpose of the forecast. In this case, a nationwide annual forecast for a three year period is being prepared, so the forecaster desired only an annual total consumption projection for each year. Since the graph is a

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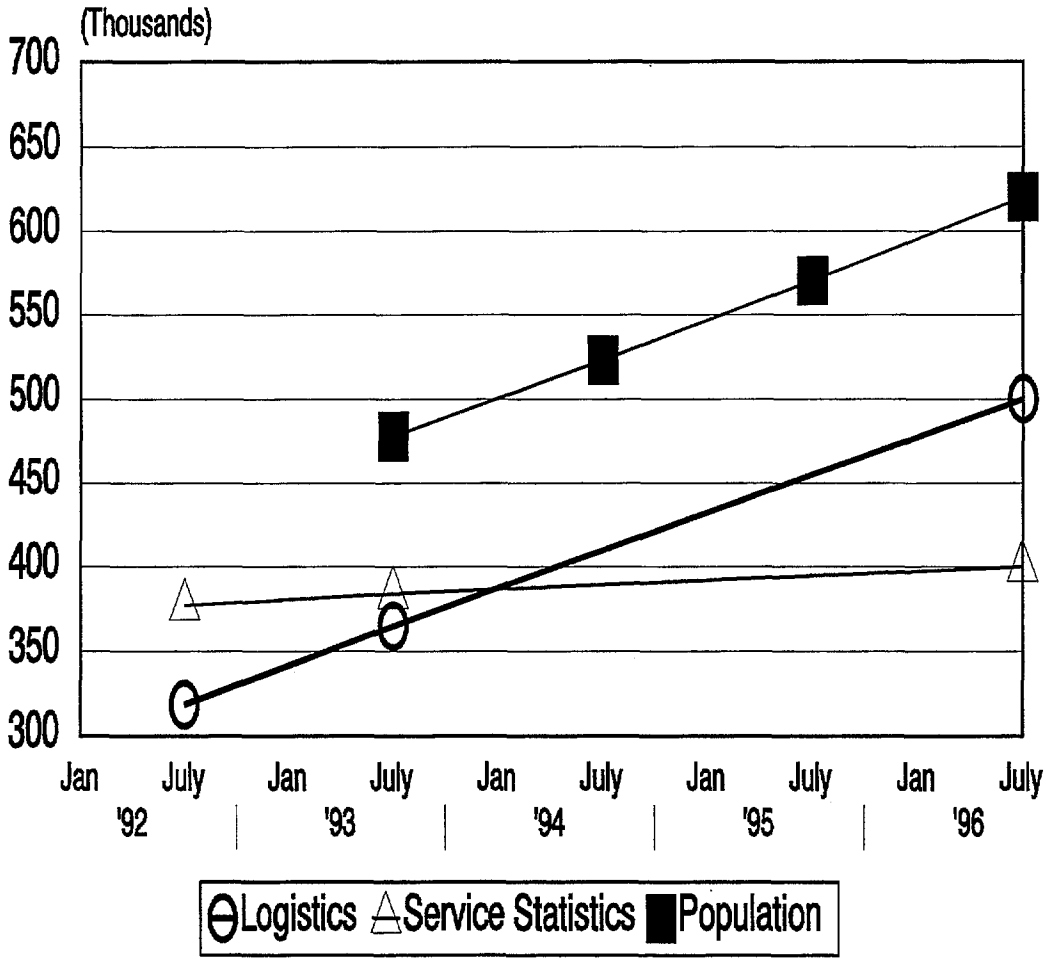
Figure 17

COMPARISON OF THREE ALTERNATIVE PROJECTIONS FOR ANYLAND



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projection of *quarterly* consumption, the desired total can be obtained by reading the estimate from the midpoint of each year and multiplying by 4. For maximum accuracy in this reading, the vertical scale should be as large as possible (that is, the graph should be as tall as can conveniently be drawn). The estimates which the forecaster read from Figure 5 are shown in Figure 18. The graph actually used was much taller than the example displayed here, allowing the forecaster to make a much more accurate reading than Figure 5 allows.

Figure 18

FINAL CONSUMPTION FORECAST FOR ANYLAND

YEAR	QUARTERLY ESTIMATE	ANNUAL ESTIMATE
1992	318,417	1,273,667
1993	365,139	1,460,556
1994	411,500	1,646,000
1995	458,500	1,834,000
1996	503,000	2,012,000

If the forecast is being used for other purposes (for example, for quarterly scheduling of shipments), then it may be necessary to take into account the growth in estimated consumption during the year, rather than using a single quarterly average.

G. THE DISTRIBUTION SYSTEM CAPACITY BASED FORECAST, PART 2

With this tentative "final" forecast in hand, the forecaster should be able to determine whether the MOH's distribution system has sufficient capacity to move and store the commodities required. Fortunately, Anyland has paid careful attention to inventory control and storekeeping procedures, and program managers are confident that the Max-Min inventory control system they have designed is operational. Most of the storage facilities and all of the Ministry's vehicles have been provided by a single donor, so there is reasonable consistency in capacity from place to place. The basic system structure is described in Figure 19.

Figure 19

ANYLAND MOH IN-COUNTRY DISTRIBUTION SYSTEM STRUCTURE

SYSTEM COMPONENT	CENTRAL LEVEL	REGIONAL LEVEL	SERVICE LEVEL
Number of Facilities	1 Central Medical Store	1 Regional Store per region	100 SDPs Region 1: 30 Region 2: 30 Region 3: 40
Storage Capacity	30′ x 40′ 15′ ceiling (building)	10′ x 10′ 10′ ceiling (room)	30" x 12" x 36" high (cabinet)
Max Stock Policy (Months of Supply)	9	6	2
Min Stock Policy (Months of Supply)	6	3	1
Transport Capacity	5 ton truck 657 ft^3 bed	1 pickup truck per region 48 ft^3 bed	None
Delivery Schedule to Lower Level Facilities	Quarterly	Monthly	N/A

In Anyland's distribution system, it is the responsibility of the higher level facility to transport commodities to all lower level facilities which it serves. As Figure 19 shows, the delivery schedule is quarterly from the center to the three Regional Stores, and monthly from the regions to the SDPs. At each resupply visit, the lower level facility is stocked up to its Maximum Stock Level, which is computed as the Max Stock Policy (in terms of Months of Supply) times the Average Monthly Consumption of the commodity.

Note that several simplifying assumptions are made in this example in the interests of clarity and brevity: First, it is assumed that storage capacity is the same at each facility of each type; all SDP's, for example, are assumed to have a single storage cabinet of the same size. Second, it is assumed that the Quantity Dispensed to Users is the same at every SDP. These assumptions allow a single calculation to be used in the example for each type of facility. In

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real life, of course, these assumptions are likely to be false. In such cases, the forecaster must either make a separate calculation for each facility and transportation link of interest, or determine an average for each level of the system and note exceptions to the average.

In addition, the example only assesses the system's capacity to store and distribute Lo Femenal. In a real life situation, space requirements would be calculated for *all* commodities and compared to the available capacity.

Since the final projection for Lo Femenal prepared above shows an increasing trend in consumption, the forecaster chose first to calculate storage requirements for 1996, the final forecast year, because if capacity is sufficient for those quantities, the system will obviously be able to accommodate quantities needed in the interim years.

Storage Capacity at the SDP Level

The average Quantity Dispensed to Users in each quarter of 1996 can be read from the graph of Figure 5, by tracing up to the projection line from the midpoint of 1996 on the horizontal axis, and then over to the vertical axis, giving an estimate of 503,000 cycles per quarter, or 2,012,000 cycles for the entire year. Since the Maximum Stock Policy is stated in *Months* of Supply, the annual figure is converted to a monthly figure simply by dividing by 12:

$$\text{Average Quantity Dispensed to Users per Month} = \frac{\text{Total Annual Quantity}}{12}$$

$$= \frac{2{,}012{,}000 \text{ cycles}}{12} = 167{,}667 \text{ cycles}$$

Under the assumption that all SDPs distribute the same quantity, Average Quantity Dispensed to Users per Month at each SDP can be calculated simply as:

$$\text{Average Quantity Dispensed to Users per Month at an SDP} = \frac{\text{Average Quantity Dispensed to Users per Month}}{\text{Number of SDPs}} = \frac{167{,}667 \text{ cycles}}{100}$$

$$= 1{,}677 \text{ cycles}$$

According to the formula in Chapter VII, the most Lo Femenal which must be stored is:

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$$\begin{array}{ccccc} \textit{Maximum Quantity to Store (in Units)} & = & \textit{Maximum Stock Level (in Months)} & \times & \textit{Average Quantity Dispensed to Users per Month} \\ & = & 2 \times 1{,}677 \textit{ cycles} & = & 3{,}354 \textit{ cycles} \end{array}$$

Appendix 5 lists weights and volumes for commonly supplied contraceptives, and the volume comparison can be made in cubic feet or cubic meters, as long as a consistent measure is used for all calculations. Presuming the Lo Femenal was obtained from USAID, a carton contains 1,200 cycles and occupies 1.33 ft^3. With these data, the required storage space is calculated as:

$$\begin{array}{ccccc} \textit{Cubic Feet of Storage Space} & = & \left(\dfrac{\textit{Maximum Quantity to Store}}{\textit{Quantity per Carton}}\right) & \times & \textit{Cubic Feet per Carton} \\ & = & \left(\dfrac{3{,}354 \textit{ cycles}}{1{,}200 \textit{ cycles per carton}}\right) & \times & 1.33\ ft^3 = 3.7\ ft^3 \end{array}$$

And finally, this volume must be compared to the available storage space. Converting the cabinet dimensions shown in Figure 19 from inches to feet gives:

$$\begin{array}{ccc} \textit{Cubic Feet of Storage Space Available} & = & \textit{Length} \times \textit{Width} \times \textit{Height} \\ & = & 2.5\ ft \times 1\ ft \times 3\ ft = 7.5\ ft^3 \end{array}$$

Based on this calculation, storage space for Lo Femenal at the SDP level is sufficient at least through 1996. In a real life situation, where multiple products would likely be stored at the SDP, space would in all probability be *insufficient*, since more than half the cabinet would be occupied by Lo Femenal. The other brand of orals alone, which according to the population data based projection constitutes 50% of the brand mix, would fill the cabinet.

It is not necessarily true, of course, that all commodities would have to be kept in the cabinet. Bulk storage (of condoms, for example) might be separate, with the limited cabinet space reserved for small and valuable commodities. Space requirements for bulk storage in a separate area would be made using the procedures shown below.

Storage Capacity at the Regional Level

Maximum Stock Policies at *all* levels in a properly functioning Max-Min system are based on the Quantity Dispensed to Users at the *service* level. At the regional level, then,

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storekeepers should expect to issue on average the same amount as all their SDPs dispense during the time period:

$$\begin{array}{c}\textit{Average Quantity}\\ \textit{to Issue}\\ \textit{per Month}\end{array} = \begin{array}{c}\textit{Average Quantity}\\ \textit{Dispensed to Users per Month}\\ \textit{at an SDP}\end{array} \times \begin{array}{c}\textit{Number}\\ \textit{of SDPs}\\ \textit{Served}\end{array}$$

So, for Regions 1 and 2, which each serve 30 SDPs,

$$\begin{array}{c}\textit{Average Quantity}\\ \textit{to Issue}\\ \textit{per Month}\end{array} = 1{,}677 \times 30 = 50{,}310 \textit{ cycles}$$

And for Region 3, which serves 40 SDPs,

$$\begin{array}{c}\textit{Average Quantity}\\ \textit{to Issue}\\ \textit{per Month}\end{array} = 1{,}677 \times 40 = 67{,}080 \textit{ cycles}$$

As with the SDPs, the Maximum Quantity to Store is this quantity times the Maximum Stock Policy. In Regions 1 and 2, this calculation is:

$$\begin{array}{c}\textit{Maximum Quantity}\\ \textit{to Store}\\ \textit{(in Units)}\end{array} = 6 \textit{ months} \times 50{,}310 \textit{ cycles per month} = 301{,}860 \textit{ cycles}$$

and in Region 3:

$$\begin{array}{c}\textit{Maximum Quantity}\\ \textit{to Store}\\ \textit{(in Units)}\end{array} = 6 \textit{ months} \times 67{,}080 \textit{ cycles per month} = 402{,}480 \textit{ cycles}$$

The volume of storage space required is calculated in exactly the same way as the SDPs. For Region's 1 and 2:

$$\begin{array}{c}\textit{Cubic Feet}\\ \textit{of Storage Space}\end{array} = \left(\frac{301{,}860 \textit{ cycles}}{1{,}200 \textit{ cycles per carton}}\right) \times 1.33\ ft^3 = 334.6\ ft^3$$

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For Region 3, the calculation is:

$$\text{Cubic Feet of Storage Space} = \left(\frac{402{,}480 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33\ ft^3 = 446\ ft^3$$

As discussed in Chapter VII, the maximum height of commodities stacked in bulk storage should be 2.5 meters or 8 feet, both for reasons of personal safety of warehouse workers, and to ensure that cartons on the bottom are not crushed. Chapter VII also suggests that an amount of handling space equal to the amount of space actually occupied by the commodities should be reserved for aisles and handling. Using the formulas shown there, the required floor space can be calculated for each region. In Regions 1 and 2, the calculation is:

$$\text{Square Feet of Storage Space} = \frac{\text{Cubic Feet of Storage Space}}{8 \text{ feet}}$$

$$= \frac{334.6}{8} = 41.8\ ft^2$$

and in Region 3 the calculation is:

$$\text{Square Feet of Storage Space} = \frac{446}{8} = 55.75\ ft^2$$

These figures are then doubled to allow for handling. For Regions 1 and 2, then, the final total is:

$$\text{Square Feet of Storage and Handling Space} = \text{Square Feet of Storage Space} \times 2$$

$$= 41.8 \times 2 = 83.6\ ft^2$$

and for Region 3:

$$\text{Square Feet of Storage and Handling Space} = 55.75 \times 2 = 111.5\ ft^2$$

The storage space available at the regional level is 100 ft^2, since the room is 10' by 10'. Thus Regions 1 and 2 have sufficient space for Lo Femenal storage in 1996, but Region 3 will not.

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At this point the forecaster had several options. The first is to perform these same calculations for Region 3 for the 1995 projection and then if necessary for the 1994 projection, to determine exactly when the available storage capacity will be exceeded. The second is to discuss the assumptions used in the calculations with storekeepers in Region 3, and identify alternatives for obtaining the required capacity. In this case, the shortage is very slight. Storekeepers felt that using a factor of 2 in calculating handling space is generous, particularly since no mechanical handling equipment (e.g., a forklift) is used in the store. Accordingly, it was decided to assume for the present that Region 3's store will be adequate, but to initiate discussions with donors aimed at expanding the available space in all regions over the medium term.

Transport Capacity at the Regional Level

In the first step above for calculating the required storage capacity at the regional level, the Average Quantity to Issue per Month was calculated as 50,310 cycles for Regions 1 and 2, and as 67,080 cycles for Region 3. This is the average quantity which must be transported on a monthly basis from each regional store to its SDPs. The volume occupied by these commodities can be calculated in the same fashion as above. In Regions 1 and 2 the result is:

$$\text{Cubic Feet of Storage Space} = \left(\frac{50{,}310 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33\ ft^3 = 55.8\ ft^3$$

and in Region 3, the result is:

$$\text{Cubic Feet of Storage Space} = \left(\frac{67{,}080 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33\ ft^3 = 74.3\ ft^3$$

As shown in Figure 19, the regional warehouse pickup trucks have 48 ft^3 of storage space; thus none of the regions can deliver to all their SDPs in a single trip. Two trips are required in each region.

Discussions with program managers indicated that multiple trips are normally made anyway, both for geographic reasons and because drivers have other responsibilities which necessitate returning to the regional headquarters. Therefore transport capacity at the regional level is not considered to be a constraint.

Again, it should be noted that if other methods were considered, the capacity would likely be insufficient. Addition of an equal quantity of the other orals alone, which the demographic projection suggests is required, would require four trips per month in Region 3 just to deliver the orals. Note also that this calculation is based on the *average* issue quantities,

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which is appropriate for an established program. If a new SDP is opened, its first delivery must be computed based on the Max Stock Policy, rather than the average distribution, in this case 2 Months of Supply.

Storage Capacity at the Central Level

Storage capacity requirements at the central level are calculated in exactly the same fashion as the regional storage requirements. Again, the calculation must be based on Quantity Dispensed to Users at the *service* level, so the Central Medical Store must plan on the basis of all 100 SDPs:

$$\text{Average Quantity to Issue per Month} = 1{,}677 \times 100 = 167{,}700 \text{ cycles}$$

Since the Max Stock Policy at the central level is 9 Months of Supply,

$$\text{Maximum Quantity to Store (in Units)} = 9 \text{ months} \times 167{,}700 = 1{,}509{,}300 \text{ cycles}$$

The volume which must be stored is:

$$\text{Cubic Feet of Storage Space} = \left(\frac{1{,}509{,}300}{1{,}200 \text{ cycles per carton}}\right) \times 1.33\ ft^3 = 1{,}672.8\ ft^3$$

The floor space which would actually be occupied by the commodities is:

$$\text{Square Feet of Storage Space} = \frac{1{,}672.8}{8 \text{ feet}} = 209.1\ ft^2$$

and the total space required for both storage and handling is:

$$\text{Square Feet of Storage and Handling Space} = 209.1 \times 2 = 418.2\ ft^2$$

Since the storeroom measures 30' by 40', the storage and handling space available at the central level is 1,200 ft^2. Thus storage space at the Central Medical Store is not a constraint.

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Transport Capacity at the Central Level

This calculation is performed in the same fashion as the regional level calculation shown above:

$$\text{Cubic Feet of Storage Space} = \left(\frac{167{,}700 \text{ cycles}}{1{,}200 \text{ cycles per carton}}\right) \times 1.33\ ft^3 = 185.9\ ft^3$$

Note that this is the quantity which must be transported *per month* to cover commodity needs for *all three regions*. But Anyland MOH's policy specifies quarterly delivery from the Central Medical Store to the regions. If the delivery schedule cannot be staggered, so that all three stores must be resupplied in a single month, then the quantity which must be transported is:

$$\text{Cubic Feet of Storage Space} = 185.9\ ft^3 \text{ per month} \times 3 \text{ months} = 557.7\ ft^3$$

As shown in Figure 19, the capacity of the Central Medical Store's truck is 657 ft^3. Thus transport capacity at the regional level is not a constraint, even if all three regional stores are resupplied in a single trip.

Note again that this calculation is based on the *average* issue quantities, which is appropriate for an established program. If a new SDP is opened, its first delivery must be computed based on the Max Stock Policy, rather than the average distribution, in this case 2 Months of Supply.

Distribution System Capacity Forecast Validation

The distribution system capacity based forecast should be evaluated for validity in the same fashion as the other forecasts; Figure 20 answers the questions for such a forecast which were shown in Chapter X.

Figure 20 suggests that the forecaster's confidence in the distribution system capacity estimates should be moderately high. The only significant simplifications are the assumptions that all SDP's have the same storage capacity and that they all dispense the same quantities. These assumptions reduce the accuracy of the calculation at the SDP level; however, there are almost unquestionably alternatives for bulk storage outside the cabinet provided, so more active SDPs are unlikely to be severely constrained by storage space. Of more concern is the assumption that the quantities they dispense are the same: this is clearly untrue, based on examination of logistics data for Regions 1 and 2, which have the same number of SDPs, but vastly different distribution figures. This suggests that some SDP's are in fact significantly larger than the average, and that the transport capacity calculation at the

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Figure 20

EVALUATING ANYLAND'S DISTRIBUTION SYSTEM CAPACITY BASED FORECAST

QUESTION	ASSESSMENT
1. Does the program have a properly designed and functioning Max-Min inventory control system at every program level and facility?	Yes. Program managers feel that the Max-Min system is functioning well.
2. What simplifying assumptions were made about stock level policies in preparing the projection?	None. Max and Min policies differ by system level but not from facility to facility. Actual values for the Max Stock Policy at each level were used in the calculations.
3. What simplifying assumptions were made about storage capacity?	Storage capacity was assumed to be the same for every facility of each type.
4. What simplifying assumptions were made about transportation capacity?	None. Transport capability at the regional level *is* the same at all three stores. Actual vehicle capacity was used at each level in the calculations.
5. What simplifying assumptions were made about Quantities Dispensed to Users at the service level of the distribution system?	Quantities to be transported are based on the average Quantity Dispensed to Users for resupply, calculated on the presumption that all SDPs dispense the same quantities monthly.

regional level in Regions 2 and 3 may be in error. The forecaster should consider refining this analysis by making individual adjustments for large facilities in the more active regions, or by using a different assumption in each region for average Quantity Dispensed to Users.

In summary, the analysis so far shows that the current distribution system is adequate for distribution of the quantities of Lo Femenal projected through 1996. However, the system at that time will be operating at capacity in several ways:

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1. Storage space at the regional store in Region 3 will be completely occupied by Lo Femenal. The other two regional stores will be nearly full.

2. Multiple trips for deliveries will be required monthly in all three regions.

3. The Central Medical Store truck will be more than 80% filled by the quarterly requirement of Lo Femenal for the three regional stores. If volumes exceed expectations, multiple trips will be required each quarter, or a larger truck will be needed.

Program managers should move now to begin addressing these upcoming problems, since acquiring additional vehicles and facilities is likely to be a long and difficult process in a public program. If it is expensive or impossible to obtain more space, changes in the Max and Min Stock Policies can be considered, or the frequency of deliveries can be increased in order to reduce the required maximum inventories.

H. THE REQUIREMENTS ESTIMATE

As described in Chapter XI, the forecaster needs data on Stock on Hand, Shipments Received/On Order, and Adjustments, in addition to the consumption estimates discussed above, in order to prepare the requirements estimate.

Stock on Hand Estimates

Figure 21 displays the Stock on Hand data which were available for 1992 and 1993 from Anyland's Logistics MIS, along with the adjustments the forecaster had to make to the reported figures. Since these data came from the same source as the consumption figures discussed above, they suffer the same shortcomings. Adjustments made were as follows:

- Reporting was incomplete in all cases. Using the same procedure discussed above, the forecaster adjusted the data by dividing the reported figure by the percentage of SDPs reporting to obtain adjusted figures, with the exception of the 1993 data for Region 2.

- 1993 fourth quarter LMIS data for Region 2 were missing, with the result that no year-end stock balance figures were available for the SDPs in that region. This case required a more complex adjustment, as described below.

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Figure 21

SDP STOCK DATA FOR ANYLAND: LO FEMENAL

1992

REGION (% REPORTING)	END OF YEAR STOCK (REPORTED)	ADJUSTMENTS	END OF YEAR STOCK (ADJUSTED)
Region 1 (92%)	6,796	Divide by .92 to estimate quantity if 100% reporting	7,387
Region 2 (92%)	76,930	(same)	83,620
Region 3 (90%)	35,705	Divide by .9	39,672
Total	119,431		130,679

1993

REGION (% REPORTING)	END OF YEAR STOCK (REPORTED)	ADJUSTMENTS	END OF YEAR STOCK (ADJUSTED)
Region 1 (92%)	7,079	Divide by .92 to estimate quantity if 100% reporting	7,695
Region 2 (75%)	Missing Data for Quarter 4	See Text	54,765
Region 3 (92%)	51,915	Divide by .92	56,429
Total	???		118,889

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As mentioned above, MOH program staff feel that their Max-Min inventory control system is functioning well; accordingly, it is reasonable to assume that the SDPs of Region 2 are maintaining stock balances that fluctuate between Max and Min. The forecaster therefore assumed that each SDP in Region 2 had Stock on Hand at the end of 1993 equal to the average of Max and Min. According to Figure 19, the Max Stock Policy is 2 Months of Supply at the SDP level, and the Min Stock Policy is 1 month. On average, then, each SDP should have had 1.5 Months of Supply on Hand.

Using the same logic applied in making the distribution system capacity based forecast for 1996, the Average Quantity Dispensed to Users per Month at an SDP in 1993 can be calculated by using the consumption estimate for the whole nation as a base:

$$\text{Average Quantity Dispensed to Users per Month} = \frac{\text{Total Annual Quantity}}{12}$$

$$= \frac{1{,}460{,}556 \text{ cycles}}{12} = 121{,}713 \text{ cycles}$$

and,

$$\text{Average Quantity Dispensed to Users per Month at an SDP} = \frac{\text{Average Quantity Dispensed to Users per Month}}{\text{Number of SDPs}} = \frac{121{,}713 \text{ cycles}}{100}$$

$$= 1{,}217 \text{ cycles}$$

Therefore, 30 SDP's with an average of 1.5 Months of Supply on Hand could be expected to have:

$$\text{Estimated Stock on Hand at Region 2 SDPs} = 30 \times 1.5 \times 1{,}217 = 54{,}765 \text{ cycles}$$

This is the figure that the forecaster used to estimate Stock on Hand data for Region 2 in 1993.

As an alternative, the calculation could have been based on LMIS distribution figures for Region 2 rather than on nationwide figures. Because Region 2 is clearly more active than other regions, this strategy would have resulted in a much higher estimate of Stock on Hand, since the Average Quantity Dispensed to Users per Month is higher in Region 2 than in the nation as a whole. Estimating a higher existing balance would reduce the estimate of

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additional quantities which might be needed, thus increasing the risk of stockouts if the SDP's in fact have less inventory on hand. Accordingly the more conservative strategy shown here was chosen.

Central and regional Stock on Hand data, which are provided directly by the four warehouses, were available for both years, and considered to be accurate. These data, along with the nationwide totals including the SDP estimates of Figure 21, are shown in Figure 22.

These data provide the basis for both Beginning of Year Stock and End of Year Stock in the requirements estimate shown below. Because the requirements estimate was prepared in January, 1994 on a calendar year basis, no adjustment of the Stock on Hand figures to estimate balances at the beginning of the forecast period was required.

Figure 22

CENTRAL, REGIONAL, AND SDP STOCK DATA FOR ANYLAND: LO FEMENAL

FACILITY	1992 END OF YEAR STOCK	1993 END OF YEAR STOCK
Central Medical Store	651,100	746,600 **
Region 1 Warehouse	20,600	21,450
Region 2 Warehouse	233,250	239,100
Region 3 Warehouse	110,600	157,400
SDP Total	130,679	118,889
Grand Total	1,146,229	1,283,439

(** 12,000 cycles expiring April 1994)

Shipments Received and On Order

Data on shipments already received or already scheduled were available from Central Medical Store records for 1992, 1993, and 1994. These are shown in Figure 23.

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Figure 23

LO FEMENAL SHIPMENTS RECEIVED OR SCHEDULED

YEAR	QUANTITY RECEIVED AT CMS	QUANTITY SCHEDULED FOR SHIPMENT
1992	1,000,000	N/A
1993	1,597,800	N/A
1994	186,000	376,800

Current and Future Losses

As stated in Figure 22, 12,000 cycles of Lo Femenal are expected to expire in April, 1994, and the forecaster discovered that these are presently stored at the Central Medical Store. Although there are nearby service facilities which could dispense a portion of these supplies quickly, program policy prohibits dispensing products which have less than a three month shelf life remaining, since clients may store products for some time before using them. Accordingly, these commodities will have to be destroyed.

No data were available for losses for previous years, since Anyland's LMIS has only recently been modified to track losses. In a properly operating Max-Min inventory control system which keeps sufficient stock to ensure that there are *never* any stockouts, there will always be some level of loss due to expiry; accordingly, the forecaster assumed that losses of 10,000 cycles per year — about the 1994 level — will be experienced in future years as well.

Other Adjustments to Inventory

The Anyland MOH does not routinely share product with other programs; therefore no other adjustments to inventory were anticipated.

Desired Inventory Levels

As described in Chapter XI, the Desired Stock at End of Period in a normally functioning Max-Min system is the average of the Max Stock Policy and the Min Stock Policy for the

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whole distribution system. Using the policies specified in Figure 19, the forecaster calculated the Desired End of Year Stock as:

$$\text{Desired End of Year Stock} = \frac{9 + 6 + 2 + 6 + 3 + 1}{2} = 13.5 \textit{ months}$$

which was rounded up to 14 Months of Supply.

The Requirements Estimate

Figure 24 shows the requirements estimate prepared on the basis of these assumptions. This multi-year requirements table embodies the basic requirements estimation calculation of Chapter XI directly into the table format.

Notes on the table are as follows:

- *Beginning of Year Stock* figures for 1993 and 1994 are taken from Figure 22. For these years, the Beginning of Year Stock in each case must be equal to the End of Year Stock from the previous year. The 1992 Beginning of Year Stock was not given in the data, but can be calculated by reversing the mathematical steps shown in the table: End of Year Stock *minus* Contraceptives Received or Scheduled *plus* Estimated Consumption equals the Beginning of Year Stock. This calculated figure should be checked against historical data if possible.

- *Sales or Distribution* figures are taken from the final forecast of Figure 18 for each year. *Loss or Disposal* figures are estimated as described above.

- *Received* and *Scheduled* shipments are taken from Figure 23.

- *End of Year Stock* figures are calculated by the formula embodied in the table: Beginning of Year Stock *minus* Estimated Consumption *plus* Additional Contraceptives Scheduled or Received equals the End of Year Stock. For the historical years, 1992 and 1993, this figure must equal the actual balances shown in Figure 22. For the forecast years, this balance can be augmented by procuring additional quantities, as the rest of the table shows.

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Figure 24
1994 Contraceptive Procurement Table

Country: Anyland	Prepared by: Richard C. Owens, Jr.
Program: MOH/Dept. of Family Planning	Prepared on: January 28, 1994
Contraceptive: Lo Femenal	

All Numbers in 1,000's

	1992	1993	1994	1995	1996
1. Beginning of Year Stock	1,419.9	1,146.2	1,283.4	2,149.7	2,357.3
MINUS					
2. Estimated Consumption					
a) Sales or Distribution	1,273.7	1,460.6	1,646.0	1,834.0	2,012.0
b) Loss or Disposal	0	0	12	10	10
c) Transfer or Adjustment	0	0	0	0	0
PLUS					
3. Additional Contraceptives Received or Scheduled					
a) Received	1,000.0	1,597.8	186.0		
b) Scheduled			376.8		
EQUALS					
4. End of Year Stock	1,146.2	1,283.4	188.2	305.7	
MINUS					
5. Desired End of Year Stock: 14 months			2,149.7	2,357.3	
EQUALS					
6. Net Supply Situation					
a) Surplus **OR**					
b) Quantity Needed			1,961.5	2,051.6	

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- *Desired End of Year Stock* is the quantity which the program wishes to have on hand at the beginning of the following year to meet that year's needs, plus any amounts expected to be lost or otherwise removed from the distribution system. This calculation is illustrated below.

As discussed above, the program wishes to maintain an average of 14 Months of Supply as its desired End of Year Stock. For 1994, this quantity is calculated based on expected consumption in *1995* (in thousands) as:

$$\begin{array}{c}\textit{Desired}\\ \textit{End of Year Stock}\\ \textit{for 1994}\end{array} = \left(\frac{\textit{Sales/Distribution for 1995}}{12}\right) \times \begin{array}{c}\textit{Desired}\\ \textit{Months of Supply}\end{array}$$

$$= \left(\frac{1{,}834}{12}\right) \times 14 = 2{,}139.7$$

To this the 10,000 cycles projected to lost are added, for a grand total of 2,149,700 cycles. The same calculation is used for the 1995 Desired End of Year Stock.

Finally, the calculated End of Year Stock and the Desired End of Year Stock are compared. If the Desired End of Year Stock is larger, as is the case here in both 1994 and 1995, additional product in the amount of the difference is needed to bring balances up to the desired levels.

Here, 1,961,500 additional cycles are needed in 1994, and the forecaster has assumed that this product will actually be procured or obtained from donors in 1994. Accordingly, the Beginning of Year Stock for 1995 is set to the *Desired* End of Year Stock level from 1994, and the same calculation is repeated for 1995 to give a requirement of 2,051,600 cycles for 1995 procurement. If program managers feel that it will not be possible to obtain the entire Quantity Needed in either year, then the Beginning of Year Stock in the following year should be reduced accordingly.

It is notable in this example that the desired balances in the forecast years are substantially larger than the balances in the historical years, and that the difference is much greater than could be accounted for by program growth alone. The implication of this finding is that the system has *not* in fact been operating at the average of the Max and Min levels specified in Figure 19, but rather at lower inventory levels. Since the data do not show frequent stockouts and program managers have not stated that stockouts are a problem, it may be desirable to review the Max and Min Stock Policies to decide whether they can be reduced, thus shortening the in-country pipeline and reducing the chance of product expiry.

This completes the forecast and requirements estimate for Anyland. Once program managers agree on the calculations and assumptions described here, the forecaster should assist in

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preparation of desired shipping schedules for the product which will be procured. As described in Chapter VII and Chapter XI, the resupply interval must be less than or equal to the difference between the Max Stock Policy and the Min Stock Policy if the Central Medical Store is to maintain balances between Max and Min. According to Figure 19, Anyland's deliveries should be scheduled at least quarterly.