Management Accounting System for Hospitals (MASH) Manual

October 2004

PHR*plus*

Partners for Health Reform*plus*

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- *Generation of new financing for health care, as well as more effective use of existing funds.*
- *Design and implementation of health information systems for disease surveillance.*
- *Delivery of quality services by health workers.*
- *Availability and appropriate use of health commodities.*

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The opinions stated in this document are solely those of the authors' and do not necessarily reflect the views of USAID.

Abstract

This manual introduces the Management Accounting System for Hospitals (MASH). MASH is a framework used for tracking and analyzing a health facility's services, resources, and costs. It provides the means for both routine management control and the initiation and management of change and is a useful tool for examining costs in connection with productive efficiency. MASH is built around 12 interrelated Excel spreadsheets. All the spreadsheets are structured by cost centers; four involve entering primary data and the other eight use that data to perform calculations and analysis. While MASH was designed primarily for hospitals, it is easily modified to suit any health care organization – its potential users are facility administrators and department heads, purchasers of care, regulators and auditors of performance, and financing and operations analysts. Its development grew out of work done by the Partners for Health Reform*plus* in the public hospital system in Jordan.

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Acronyms

FTE	Full-time Equivalent
ICU/CCU	Intensive Care Unit/Cardiac Care Unit
IT	Information Technology
LOS	Length of Stay
MASH	Management Accounting System for Hospitals
PHR	Partnerships for Health Reform
PHR*plus*	Partners for Health Reform*plus*
USAID	United States Agency for International Development

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This manual is the result of the efforts of many people around the world. The original costing methodology and Excel worksheets were developed by Alexander “Sasha” Telyukov based on hospital costing studies conducted in two Jordan hospitals by Dwayne Banks. The MASH application was refined by Steve Musau based on application of the tool in hospitals in Eritrea and inputs from Edward Chappy. The training manual is based on training sessions designed and delivered by Mary Paterson and Sasha Telyukov to hospital staff in Jordan. The manual’s visual layout and text were made more user-friendly through the editing talents of Margaret Philips. Linda Moll did the final edits and Maria Claudia De Valdenebro the final formatting to make the tool available by internet and CD. The efforts were coordinated by Catherine Connor, who provided technical guidance to the content as well as oversight to the production of the manual.

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1. Introduction

This manual introduces the Management Accounting System for Hospitals (MASH). MASH is a framework for tracking and analyzing a health facility's services, resources, and costs. It provides the means for both routine management control and the initiation and management of change and is a useful tool for examining costs in connection with productive efficiency. MASH helps make management of resources and services transparent and comprehensible for all parties involved.

1.1 MASH: Audience and Purpose

MASH has a wide potential audience that can employ it for a variety of purposes:

1. **Hospital managers**, who can use it for tasks such as:
   - setting realistic and competitive prices
   - negotiating contracts with purchasers of care
   - keeping clinical volume and capacity utilization at efficient levels
   - modeling the cost and revenue impact of structural change
   - demonstrating cost and productivity performance to customers, auditors, financing agencies, and regulators;
2. **Hospital department heads** who need to assess financial performance against budget targets, monitor cost structures, and track the impact of different care and management strategies on the department's efficiency and financial performance;
3. **Purchasers of care** who need to compare the performance of different hospitals and make decisions about national funding and selective contracting;
4. **Regulators or auditors** who have responsibility for evaluating hospital performance and need to assess hospitals according to internal and external norms;
5. **Health financing or operations analysts** who have responsibility for advising on policies of resource allocation, care purchasing or hospital management.

Which of these will be the primary beneficiaries of MASH will depend on the degree of centralization of the health system, the nature of financing arrangements, and other circumstances.

While MASH is designed primarily for hospitals, it is easily modified to suit any health care organization – ambulatory health care center, family practice association, or integrated health system – that is interested in managing its operations in cost-efficient ways.

1.2 How MASH Works

MASH is an Excel workbook built around 12 interrelated spreadsheets. Four of these involve entering primary data and the other eight use that data to perform calculations and analysis. All the spreadsheets are structured by cost centers – organizational units with distinct function, output, technologies, and management targets. (Chapter 4 deals with cost centers in more detail.) Cost centers are separated into those that produce services for which an organization is paid (final or revenue-earning cost centers) and those that provide support services (intermediate administrative and diagnostic centers). All the costs of the hospital are ultimately borne by the revenue-earning services.

MASH performs two important analytical procedures – variance analysis and break-even analysis (see Chapters 9 and 10) – which together assist managers in deciding how to reorganize the mix of services in the face of revenue losses or gains. They specify the amount of change in either activity volumes, costs, or reimbursement rates that cost centers might need to make to offset the shortfall of revenue in a given cost center.

MASH is a management accounting system. In contrast to traditional financial accounting, which is highly standardized and normally mandatory, management accounting is an optional tool that uses a variety of techniques designed to support managerial decision making. Management accounting systems are configured to meet the routine needs of managers by taking into account such things as how the facility is paid for its services, what financial information regulators and payers require, and what management or administrative units exist within the organization. MASH does have some of this flexibility (and future versions plan to have more)[1] but its current form reflects in large part a particular system – public hospitals in Jordan – where a considerable amount of field development and testing of MASH took place.

1.3 The Manual

This manual explains the principles underlying MASH and the steps that need to be taken to use it. Although the spreadsheets are the core of the tool, the manual has not been structured directly around them. The reason for this is that the basic concepts necessary to understand when implementing MASH do not fit neatly into a strict spreadsheet-by-spreadsheet approach. Some of the important principles do not link directly to any spreadsheet and others are crucial to all of them.

Instead, this manual is structured around three key procedures:

1. Establishing the framework of the cost accounting
    - cost definition
    - services and output
    - cost centers
2. Collecting and calculating costs

[1] The next version of MASH will be based on an Access database application that can interface with the user through attractively designed data entry screens, tabulated reports, and graphs. That version will adapt readily to country- and facility-specific settings including local accounting standards and organizational reality by allowing users to more easily choose their own cost centers and cost categories.

- principles of cost calculation
- procedures for costing of key cost categories (labor, supplies, equipment)

3. Analyzing the data

- fully loaded revenue-earning cost centers
- fixed and variable costs
- variance analysis
- break-even analysis

At the end of each chapter, there is a section entitled “Worksheets.” In this the reader is shown how the material discussed in the chapter relates to the spreadsheets. For the analytical chapters there are also case studies illustrating how the spreadsheets can be used and interpreted.

Since there is not a direct and unique relationship between the topic of each chapter and particular spreadsheet, the manual also includes, for ease of reference, an annex (Annex A) summarizing the content of each worksheet and showing how the 12 of them are related.

A second annex (Annex B) presents the results of field testing the system in the public hospital sector in Eritrea.

1.4 How to Get Started

Table 1 outlines the various steps involved in setting up and implementing MASH. The present manual focuses on explaining the data requirements and analytical possibilities of MASH. These are put into context in Table 1, which also highlights the activities involved in establishing and maintaining the system.

In all these steps, the user should bear in mind the important principle of customizing the cost accounting system to serve his managerial needs.

Table 1. MASH: Summary Implementation Guide

Reference*	Objectives	Steps
A	Prepare for MASH implementation	p Present MASH agenda to managers and staff p Set up a task force p Plan MASH implementation activities p Estimate resources required to implement MASH (staff, skills, time, information, financing) and determine need for external support including funds, training, and technical assistance p Obtain the necessary support to implement MASH
B Chapter 4 Exercises 1 & 2	Structure hospital by cost center	p Review cost center definition and criteria p Review hospital organization chart; as well as functions, activities, resources, products, costs, and management by organizational unit p Identify cost centers p Classify cost centers into final and intermediate ones
C Chapter 3 Exercise 3	Establish appropriate procedures for measuring service outputs	p Define clinical and logistical outputs (services or products) by cost center p Identify suitable volume indicators for those outputs p Modify the proposed list to minimize indicators not covered by reporting p Arrange for additional reporting if absolutely necessary p Ensure that data collection forms and data entry and processing are well designed and implemented
D Chapter 4 Exercise 4	Establish appropriate procedures for measuring costs and resources	p Review and modify human resource and labor cost accounting staff and payroll by category, work time, variable payments p Review and modify fixed asset and depreciation accounting: value of buildings, floor space by cost center, value of medical and other equipment by cost center; depreciation accounting rules and computations p Review and modify drug inventory and flow accounting by cost center p Review and modify accounting of hospital revenues and disbursements (e.g., billing for care and paying hospital bills)
E Chapter 5 & 6 Exercises 5 & 6	Select allocation statistics	p Select allocation statistics for indirect costing p Select allocation statistics for step-down cost allocation
F	Implement MASH database	p Install computers for centralized data entry and report production p Train IT (information technology) staff p Schedule submission of primary data for data entry p Schedule report updates and dissemination
G Exercises 7&10	Ensure sustainable use of MASH	p Train department-level staff on primary reporting p Conduct data audits p Establish standard procedures for the use of MASH data in hospital management p Determine the use of MASH to comply with Ministry of Health reporting requirements p Set up and gradually expand the facility to automate primary reporting and improve manager access to MASH database resources p Based on initial experience, determine additional resources required for MASH use (extra staffing, funding, space, computers)
	Phase in implementation	p Pre-test labor accounting and other tools, p Pilot them on a sample of facilities p Learn from promptly shared best practices

* Relevant manual chapters and training materials exercises

2. The Nature of Costs

Hospital **resources** are central to cost accounting. Resources used in the production of hospital services – as in any production effort – include labor (human resources), material and supplies, equipment, and other assets, including buildings and land. Knowing the quantity of resources is often an important first step in costing. Quantities of resources can also serve as proxy variables for allocating shared costs (see Chapter 5). Worksheets 1 and 2 record various resources.

Hospital cost accounting (otherwise named **"costing"** throughout this manual) **assigns monetary values to those resources** involved in the hospital operations. This "monetarization" of resources is a way of converting a mixed bag of inputs into a common measure, and this greatly facilitates planning and management.

The MASH approach focuses on the "production" costs of patient care – i.e., those costs that are directly relevant to the care of patients at a hospital. Costs that may be incurred by a hospital in its other, broader mandates, e.g., teaching and research, would only be included to the extent that they have a bearing on patient care. There are a number of different ways to categorize production costs. Resources that are similar in nature are grouped together: **"labor," "supplies," "equipment," "buildings," and "land" are common general categories** to one of which most individual resources could be unambiguously assigned.[2] Each of these categories can be further subdivided ("supplies" into, for example, "pharmaceuticals," and "office supplies") creating the possibility of a large number of different classification systems. Each country tends to have its own slightly different cost breakdown usually set out in public and general accounting standards or guidelines. The key feature of a good classification is that it is comprehensive and non-overlapping.[3] Worksheets 3, 5, 6, and 7 all explicitly use these cost categories in the structure of their spreadsheet.

Because costs are usually estimated over a defined one-year period, an important distinction needs to be made between those resources which are consumed within the year (recurrent) and those which are longer-lived (capital goods or fixed assets).

Recurrent costs include costs of labor, pharmaceuticals and medical supplies, meals, linen and clothing, utilities (water, gas, heat, electricity), maintenance and repair of buildings and equipment, laundry, cleaning, business travel, office supplies, communication, and transportation services. Annual accounting of recurrent costs is conceptually straightforward.

Capital costs include the costs of larger office equipment and medical equipment and vehicles that are usually incurred through a one-time payment even though the items are used over a considerably longer period. Annual accounting requires the transformation of these capital cost into a regular stream of equivalent annual or recurrent costs over the life of the asset. This is done by a

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2 "Other" is a useful, sometimes necessary, catch-all category for those costs that do not fit easily into defined groupings. However, the fewer the costs allocated to this miscellaneous category the better.

3 Services such as maintenance and activities such as training are often identified as cost categories because there is little to be gained from attempting to tease out the separate resource components. This causes few problems when these costs represent a relatively small proportion of overall costs.

process called “depreciation” that estimates how much of an asset is used up each year. An organization that annually puts aside the sum calculated through depreciation should have enough funds by the end of the asset’s useful life to be able to replace the worn out asset with a new one. Details on how to calculate depreciation are provided in Chapter 6.

There are other important ways of categorizing costs:

“Direct” and “indirect,” for example, refer to the way in which the costs have been attributed to or associated with a particular cost center (see Chapter 4 for more on cost centers). Costs that can be easily attributed to a particular cost center are termed “direct costs.” Some resources are shared between cost centers in a way that cannot be easily teased out. They can only be allocated (i.e., shared out) to a particular cost center *indirectly*, using some kind of proxy variable (or cost driver). Costs calculated in this way are termed “indirect costs.” The cost driver might be a measure of resources (e.g., number of staff, area covered) or of outputs (e.g., number of patients treated) or even of other costs (indirect costs are sometimes allocated in proportion to direct costs). The crucial feature of the cost driver is that it should mirror as closely as possible the amount of activity being costed indirectly. Chapter 5 and 6 describe this in more detail.

“Direct” and “indirect” refer to the way the costs are measured. **“Fixed” and “variable**” are terms that describe how costs vary when output increases or decreases. Costs that do not vary when output changes are termed “fixed”; those that do are termed “variable.” These terms are sometimes confused with the categories “capital” and “recurrent.” It *is* true that capital costs (involving one-off payments) are often fixed (and do not change with levels of output). An example would be building costs. And many recurrent costs (e.g., drug supplies) are variable. But recurrent costs can also be fixed. For example, building maintenance and most salary costs while made routinely are relatively constant and independent of output. Chapter 8 describes more about fixed and variable costs and the importance of the distinction when it comes to analysis.

Total costs reflect the entire costs of keeping a cost center in operation. They include direct costs – those unambiguously associated with the cost center – and a share of the assigned indirect costs: total direct costs plus total indirect costs equal total costs. Looked at from another angle, total costs are the sum of all capital and recurrent costs or the sum of all fixed and variable costs. MASH draws a distinction between these total costs and what are termed full costs. **Full costs** are really only relevant to so-called revenue-earning cost centers (see Chapter 4). They consist of the costs of the (revenue-earning) cost center itself, plus the allocated share of costs of the intermediate cost centers that precede it on the step-down allocation chart (see Chapter 7). Worksheet 4 calculates full (total) costs and Worksheets 8, 9, and 10 calculate full fixed, full variable, and full labor costs respectively.

Finally, there are a number of ways that costs can be put together with output variables to generate useful information about the behavior of costs. *Unit costs* are costs per unit of service or product. Two measures are used:

Average cost is the total cost of production divided by the number of units of service both measured over a specified accounting period. Average costs will tend to fall as the amount of activity or output increases. This is because fixed costs are shared out among more and more units. This phenomenon is called “economies of scale.” The higher the proportion of total costs that are fixed, the more pronounced this effect will be. The average *full* cost of revenue-earning centers represents the price that hospitals need to charge for their services in order to cover all the hospital’s costs.

Many different kinds of averages can be calculated using different kinds of outputs (e.g., Worksheets 4, 8, 9, and 10 calculate cost per patient visit, per patient discharge, per patient day and

per hospital bed) and different kinds of costs (e.g., Worksheet 7 uses full, total costs, Worksheet 8 full, fixed costs, Worksheet 9 full, variable costs, and Worksheet 10 full, salary costs).

Marginal cost is the cost of producing one *extra* unit of service. Because marginal costs are concerned with small changes, only variable costs are included (fixed costs are assumed to remain unchanged).

Costs are the consequence of utilizing resources to perform activities that lead to the provision of services. Services are therefore the outcome of the investment in resources (the cost). They play a pivotal role in cost accounting and analysis (you cannot calculate marginal costs or average costs without them) and are the topic of the next chapter.

3. Hospital Services – Outputs

Management accounting systems such as MASH are interested in costing out the various services offered by a facility. They start by identifying key hospital services and the associated functional units (cost centers) that generate those services and then measure the costs of those cost centers. Cost centers are the subject of Chapter 4, and Chapters 5 and 6 explain in detail the principles and procedures of estimating the costs of those centers.

But costs on their own are of limited value to managers. More powerful analysis is possible if those cost data can be linked in some way to outputs. The present chapter touches on the various output (or volume) measures of services that are possible and identifies those that the MASH system has employed. The final four chapters (7-10) describe various ways to use the cost and output data to determine full costs, identify fixed and variable costs, and analyze the hospital's financial position and management options.

3.1 Types of Services

A great many different activities are going on in a functioning hospital – everything ranging from surgical operations and antenatal classes to paying staff and cleaning the canteen. Any kind of management accounting system will need to simplify matters by conceptually grouping these disparate services in some way.

Hospitals generally have three main functions: **patient care, teaching,**[4] **and research.**[5] The most important of these, and the one on which MASH is focused, is patient care.[6] Patient care comprises all activities involving the provision of care to patients who arrive at the hospital or are treated elsewhere by the hospital staff.

Patient care itself has three main components – outpatient, day care and inpatient care. The essential difference between them is in the procedures and resources involved. **Outpatients** are treated without being hospitalized, **day care patients** stay in a hospital bed during the day (to recover from outpatient surgery, or invasive diagnostic or treatment procedures), and **inpatients** spend more than one day in hospital. Outpatient care includes services provided by the emergency department for non-admitted patients, various outpatient clinics and other areas on hospital premises, and outreach or community services (e.g., home visits, or mobile teams immunizing during the National Immunization Days). Inpatients may require immediate, short-term, acute care or longer, non-acute care (Table 2). Further subdivisions can be made according to clinical area (medical and surgical specialties and subspecialties).

[4] Teaching entails activities designed to transfer knowledge for clinical education and professional development. It may occur in classrooms or as on-the-job training or be self-directed.
[5] Research includes activities whose primary purpose to advance knowledge through observation, experiments, or other means that exceed the primary purpose of providing patient care.
[6] MASH in its current version would only consider teaching and research costs when they relate directly to a specified activity within patient care.

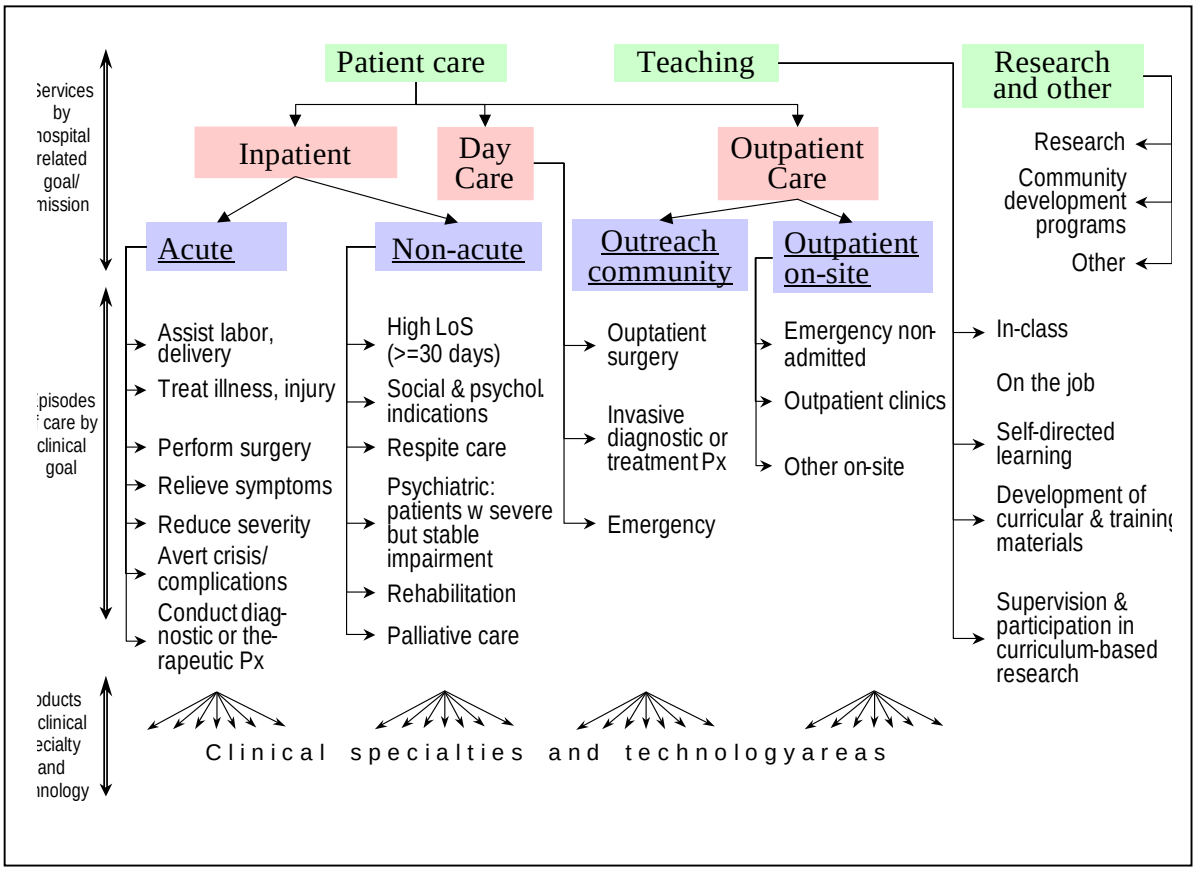
Table 2: Examples of Categories of Inpatient Care

Examples of acute inpatient care:
p Managing labor and child delivery
p Curing illness or providing definitive treatment of injury
p Performing surgery
p Relieving symptoms of illness or injury
p Reducing severity of illness or injury
p Averting crisis or complication of an illness or injury that could lead to a life-endangering or incapacitating condition
p Conducting diagnostic or therapeutic procedures
p Managing mental health problems
Examples of non-acute inpatient care:
p Respite care (because care, usually provided elsewhere, is temporarily unavailable)
p Management of psychiatric patients with severe but stable functional impairment who cannot function without extensive care and support and need care for an indefinite period
p Rehabilitation of those with a disability through participation in a multidisciplinary program aimed at improving functional capacity or facilitating psychosocial adaptation
p Palliative care, providing relief from suffering and enhancing the quality of life, for patients whose condition has progressed beyond the stage where curative treatment is appropriate
p Care for patients who would not normally require hospital care but cannot be discharged home because of social or psychological circumstances

Patient care services are supported by several important intermediary medical functions (notably pharmaceutics and diagnostic facilities). And patient care, research, and training all need the back-up of administrative and logistical support. Services such as laundry, catering, maintenance, transport, and personnel management are essential to the smooth running of the hospital. Some activities do not fit neatly into these categories[7] and some (such as the emergency department services) cut across all the subclasses. Figure 1 shows the breakdown into key hospital functions.

[7] Curriculum-based research, for example, could be classified as either teaching or research. MASH classifies it as teaching since the research category is intended to cover research designed to improve patient care more directly.

Figure 1: Classification of Hospital Services



LOS = length of stay

3.2 Measures of Service Output

Many different kinds of indicators can be used to measure the output or volume of services provided. They can be broad and general (e.g., number of patients admitted to hospital) or quite precise (e.g., the number of brain surgeries performed). The general indicators have the advantage that they can be used to measure the output from a number of different centers. The more precise indicators can be tailored to particular centers. Much depends on how detailed the costing exercise and management analysis is and whether comparisons between different centers are required.

Support services have outputs that can be measured. For example, “distance traveled” is a measure of output for transport services, “weight of clothes washed” could be a measure of output from a laundry, “number of meals served” a measure of output from a canteen, “diagnostic reports prepared” an indicator of activity of diagnostic services.

But the primary emphasis in MASH is on final patient care. These are the services for which hospitals are generally reimbursed and for which it is important to be able to measure outputs. The

emphasis is on the hospital as a whole and its productivity is measured in terms of the patient care it provides.[8]

There are three or four key output measures for both inpatient and outpatient services. Each one of them can be defined more precisely if desired (e.g., prenatal outpatient visits to hospital) though they are often more useful in their generic form (e.g., outpatient visit). Most simpler management systems will maintain a high level of aggregation.

The output of care provided to *inpatients*[9] may be measured in any one of several ways:

- ***Number of inpatients*** where an "inpatient" is defined as a patient admitted to a hospital ward for at least one night and counted as a bed occupant during a daily census at midnight.

  Patients admitted to intensive care/cardiac care units (ICU/CCUs) should be counted as inpatients regardless of whether they were subsequently transferred to a ward in one of hospital clinical departments. Neonates may be classified either as a separate episode of care (when the neonate is supported in a dedicated location such as a special care nursery) or a combined mother/child cases of maternal care (if roomed-in with his/her mother). In more complex management accounting systems, inpatients are differentiated into groups usually roughly according to cost of their treatment as reflected in such indicators as length of stay (LOS), presence of operating room surgery, or care in the ICU/CCU.

- ***Number of patient days*** where a "patient day" is defined as a completed day spent in hospital by an inpatient. Patient days are counted in the daily census of bed occupancy. The total number of patient days per inpatient admission to hospital is termed the "length of stay" and is a commonly used indicator for the purposes of cost analyses, pricing, and budget planning.

- ***Number of episodes of patient care*** where an "episode" is defined as a period of treatment in hospital corresponding with defined clinical intentions and treatment goals. When the clinical intent changes during the patient's stay in hospital, a new episode of care begins: the number of episodes may, therefore, exceed the number of inpatients. For example, a single inpatient case may shift over time from being acute to non-acute and experience two episodes of care. Sometimes the initiation of a new episode of care is accompanied by a physical transfer to another department ("administrative separation"). "Statistical separation" is an accounting procedure, by which a hospital closes an episode of care within one hospital stay, regardless of whether or not the patient was moved within the hospital. It is important that the accounting system (including billing procedures) is able to keep track of the patient irrespective of any changes in either the episode of illness they are experiencing or in their location (e.g., from acute care to non-acute care or from outpatient to inpatient).

  This indicator requires quite advanced data collection procedures but has the advantage of helping quantify and manage patient care in hospitals with amorphous clinical profiles, e.g., with short-term, sub-acute, rehabilitative, and long-term care represented in one facility.

[8] Putting aside for the moment any research or teaching functions the hospital may have.
[9] The volume of care provided to day care patients can be measured in the same ways. It is advisable to keep separate record for inpatients and day patients.

The output of care provided to *outpatients* is measured in any one of the following ways:

- ***Number of outpatient visits***, an indicator of contact between patients and outpatient staff either in an office or outreach (home or community) setting.

- ***Number of finished episodes of outpatient care,*** an indicator of completed care. This may be determined by whether goals (e.g., recovery, remission or rehabilitation) have been achieved or clinical guidelines (delivery protocols) have been followed.

- ***Number of procedures***, an indicator of a specific activity, e.g., tests for the laboratories, surgeries for the operating room, kidney dialysis sessions for the kidney unit.

The best output measure is one that captures the key services produced by a center and which in practice is not too difficult to measure.

All these measures of output can serve two functions. One is as a vital ingredient in any calculation of efficiency (which is expressed in terms of cost per unit of output). The other is as a way of deciding how to allocate to different cost centers certain indirect costs which are shared in a way that is difficult to determine directly. (Chapters 5 and 6 describe in more detail what is involved).

3.3 Worksheets

Service output indicators should be recorded in Worksheet 1. At present this Worksheet distinguishes 20 hospital product or output indicators, of which four relate to final medical services, 14 to intermediate medical services, and two to logistical services. Table 3 presents the list of services matched to output indicators for a hospital in Jordan. The user is at liberty to change the services and corresponding output indicators.

Table 3: Services and Output Indicators

Services	Volume Indicators
Final medical services	
Beds	Number
Inpatients	Number
Patient days	Number
Outpatient visits	Number
Intermediate medical services	
Dietary services	Patients
Laboratory services	Patients
	Tests
Radiology	Patients
	Projections
Blood bank	Patients
	Units of blood dispensed
Emergency	Patients
Operating room	Surgeries
Ultrasound	Tests
ICU/CCU	Hospital admissions
	Other patients
Miscellaneous intermediate	Patients
	Units
Logistical services	
Transport	Km

4. Cost Centers

A *cost center* is a unit that creates one product or a range of similar services or products using common mixes of resources and production methods. The operating room is one example. The outpatient clinic, blood bank, clinical laboratory, and inpatient care department are others.

4.1 Principles for Identifying Cost Centers

There are no hard and fast rules about defining cost centers but there are some useful principles to bear in mind. A single classification system will require some compromise, because not all these principles can be addressed simultaneously.

The exercise should be **useful to managers and evaluators**. For this to be the case, cost centers should group together activities that have some kind of management autonomy and common inputs including designated staff and space.

Cost centers should be defined in such a way as to **capitalize on an existing sense of identify** among hospital workers. This makes it easier to generate a collaborative response to a cost-related problem and any proposed improvement plan. Similarly, taking account of the way the hospital is defined or identified by patients, the community, and payers, and the kind of services likely to attract the attention of any of these groups makes the management accounting system more responsive to issues that might arise.

Cost centers should be **associated with a single product or service**. This principle allows for an average cost per unit of service to be calculated in a given clinical department by dividing the full departmental costs by the total number of output units. More sophisticated versions of MASH (planned for the future) will allow for the possibility of cost centers having more than one kind of service output (i.e., multi-product accounting).[10]

Designing a classification that **reflects the way that management information** relevant to the accounting system (on inputs, costs, and outcomes) **is usually organized,** simplifies the data collection process.

Cost centers should usually **match an entity on the hospital organizational chart**. But if the hospital organizational structure integrates broad functions it may be necessary to split one department into several cost centers. In hospitals with narrowly partitioned organizational layout it may be appropriate to merge several units into one cost center.

[10] The new system will make a difference to the way research and training are handled. At present they are considered secondary to patient care and are only costed separately when they constitute the sole or main product of specific cost centers. Otherwise, all the costs of that center are assigned to patient care. Multi-product accounting would allow for teaching and research costs to be separated from the aggregate costs in a mixed cost center. By-product teaching and research would continue to be counted as patient care.

Increasing **the number of cost centers** in an individual hospital allows for more accurate accounting of services and costs. But it also requires additional time and effort. How detailed the breakdown into cost centers should be is a judgement that needs to be made based on how valuable additional detail might be and how costly. A large hospital with a highly disagreggated structure and database might justify a more detailed cost center breakdown.

Cost centers should be **classified broadly into either final or intermediate cost centers**. The terms "final" and "intermediate" have a very specific meaning here. The former are those cost centers directly involved in the production of services for which the hospital is budgeted or reimbursed. They are sometimes called revenue-earning cost centers. Intermediate cost centers provide support services for the final cost centers but are not, by definition, revenue-earning centers. This distinction is important because costs are handled differently. Final cost centers are reimbursed directly for their services. Intermediate cost centers have to cover their costs by allocating or mapping them appropriately among revenue-earning (or final) cost centers. Centers which offer support services and would normally be considered intermediate should be classified as final cost centers if their costs are reimbursed by paying customers or third-party payers.

Final cost centers are all medical in nature (reflecting the primary purpose of hospitals). They provide few, if any, services for internally referred patients. Outpatient clinics and inpatient clinical departments would generally be considered examples of final medical cost centers.[11] Intermediate cost centers can be usefully divided into intermediate medical and intermediate non-medical cost centers. **Intermediate medical cost centers** provide medical support services. They may serve patients directly (e.g., radiology, operating room) or indirectly (e.g., blood bank). Diagnostic services are usually intermediate cost centers.[12] **Intermediate non-medical cost centers,** sometimes called *administrative and logistical cost centers,* are those centers providing overhead services to the entire hospital or large areas within the hospital. Examples include general administration, housekeeping and maintenance services.

If a single cost center both provides services to internally referred patients *and* bills for services to external patients it should be classified according to the relative importance of direct charges in its overall funding. For example, some hospitals occasionally sell their administrative and logistical support services (e.g., a piece of software or well-equipped conference space). Because this practice is usually incidental to their predominantly internal support function, these centers would continue to be classified as intermediate.

4.2 Procedures for Identifying Cost Centers

The following process is designed to assist in generating a suitable list of cost centers for a particular hospital or group of hospitals.

1. Take, as a starting point, Tables 4, 5, and 6 (in next section), which give examples that would commonly appear in lists of final, intermediate medical, and intermediate non-medical cost centers respectively.

[11] On the other hand, if an outpatient clinic does not see many external patients but provides pre-admission diagnostics, it should be considered an intermediate (support) medical center.
[12] But if, for example, a hospital set up a radiology office in an outpatient building to provide services directly to paying outpatients, that radiology office would be considered a final cost center.

2. Customize these lists – breaking down, aggregating, adding, removing, or rearranging cost center titles according to management needs. To do this consult:

    - National cost accounting guidelines (where available). These may include a standard list of cost centers to which every hospital would be required to map its organizational structure;
    - The organizational structure of the hospitals of interest; and
    - The format in which relevant input, cost and output data are available. For example, you could add to the list of cost centers any others that are present in the organizational structure of your hospitals, or group together narrow subspecialties that share management, staff, wards, and beds, and are not clearly distinguished.

Whatever changes you do make, preserve the three basic categories of final medical, intermediate medical, and intermediate non-medical.

3. Use a common structure of cost centers for each hospital in the set of hospitals that are of interest so that inter-hospital comparisons can be made.

4. Accommodate differences in the following ways:

    - Add several discretionary lines for each hospital to fill with cost center titles that reflect its particular clinical and organizational uniqueness. These may be pre-grouped under such titles as “Other inpatient care,” “Other operating rooms,” “Other pathology,” and “Other pharmacy.”
    - Have several levels of aggregation to make the resulting list more adaptable to variable organizational structures of hospitals. For example, a composite cost center such as “General and specialty surgery” could aggregate a set of lower-level, more detailed specialized surgical cost centers. A general community hospital would probably use the broader composite cost center and most hospitals’ clinical departments would be organized by broadly defined specialties (e.g., medicine, surgery, obstetrics and gynecology). Specialized tertiary care clinics would have use for the detailed list. Disaggregation allows for the hospitals to have cost center lists that are different but compatible and at some level comparable.

5. Validate and standardize the resulting lists of cost centers using a representative hospital sample.

6. Guide hospitals toward matching their medical services to the adopted list. This may involve anything from re-naming some cost centers to changes in the organizational chart in order to provide meaningful analyses for decision making.

4.3 Worksheets

Cost centers are the common structural element of all the worksheets. The list that emerged from the study in Jordan includes 15 administrative and logistical centers, nine intermediate medical, and 17 final medical cost centers – 41 cost centers in total, and these are the cost centers that currently appear in the worksheets. But all the worksheets also have empty lines (hidden) for up to an extra 10 administrative, 20 intermediate medical, and 20 final medical cost centers that can be used to accommodate differences in hospital organizational structure.

Table 4. Sample List of Clinical Specialties to Identify Final Medical Cost Centers

Dermatology	Neonatal care	Pediatric surgery
Endocrinology	Nephrology	Plastic & reconstructive surgery
Gastroenterology	Neurology	Psychiatry
General medicine	Obstetrics	Pulmonology
General surgery	Oncology	Renal dialysis
Gynecology	Ophthalmology	Thoracic surgery
Hematology	Orthopedic surgery	Urology
Infectious diseases	Otolaryngology	Vascular surgery
Internal medicine	Pediatric medicine	

Table 5. Sample List of Intermediate Medical Cost Centers*

Anesthesia	Immunology (Lab)	Physiology lab
Angiography	Lung function lab	Prostheses
Autopsy	Mammography	Radiology
Clinical biochemistry	Microbiology	Radiotherapy suites
Computer tomography	Morgue	Recovery rooms
Cytology	MRI	Respiratory labs
Day surgery suite	Non-invasive cardiac labs (Echo labs)	Toxicology
Echocardiography	Nuclear medicine	Transfusion services (incl. blood bank)
Endoscopy	Operating rooms	Ultrasound
Forensic medicine	Pathology	
ICU/CCU	Pharmacy	

*Although ICU and CCU have many features of final cost centers, it is recommended that they be classified as intermediate medical cost centers. For patients referred from, and transferred to inpatient departments, the cost of their stay in ICU and CCU will pass on to respective final cost centers.

Table 6. Sample List of Intermediate Non-medical Cost Centers

Cleaning services	Mailroom
Clerical services	Maintenance and repair
Computing (data processing) services	Medical management & admin
Document transmission and storage	Nursing management & admin
Executive services (general administration)	Occupational health & safety
Financial administration	Payroll management
Food services (patients)	Printing and copying services
General hotel services	Public relations and marketing
Grounds and gardens	Quality assurance
Hospital staff catering	Security
Human resource management	Staff accommodation
Insurance	Staff development
Interpreter services	Telecommunication services
Legal services	Transport of patients
Library services	Transport of personnel
Linen and laundry services	Warehouses

5. Calculation of Costs – General Principles

Costs are a function of the number of resources and their unit value. There are many different ways to calculate costs. For example, you might have access to expenditure records that have exactly the costs you are looking for. Or you may need to combine data on quantities of resources and their prices. You may have access to an average (or typical) cost and have to employ it to estimate the costs of more units. The resource may have a simple, single cost or a variety of different elements (e.g., labor costs include allowances of various sorts). The way you perform the calculations will depend on how the available data is organized and the extent to which you have the capacity to collect additional primary data yourself.

Whatever procedure is used to calculate costs, there are some important principles that must be followed.

5.1 Costing Should Be Comprehensive

All costs incurred should be accurately accounted for, even though, for example, a specific budgeting agency may be willing to ignore the costs that the hospital recovers from other purchasers of care.

All costs should be included even if money doesn't change hands. This is because the cost being measured should be **the value of the resources used** in the production of the service and not, if it is different, the cash paid. In other words, MASH uses accrual accounting, not cash accounting. The advantage of accrual accounting is that it directly reflects the activity levels that generate output. This makes it a more reliable management tool, particularly in chronically underfinanced health care systems and generally poor business environments where deferred payments are common and may distort the real picture of costs. In practice, cash and accrual accounting often diverge – costs and payments frequently occur at different times (e.g., with capital assets) and sometimes there is a cost with no associated cash payment (e.g., voluntary contributions of time and services and equipment). The value of such donations should be included particularly if replacement of these products or services is likely to be the responsibility of the hospital or the Ministry of Health.[13]

5.2 Costs Should Be Attributed as Precisely as Possible to Specific Cost Centers

Where possible, costs should be traced directly to a specific cost center. The higher the proportion of costs that are so allocated (i.e., are direct costs – see Chapter 2), the more accurate the costing will be.

[13] If voluntary support does not play a particularly important role and does not vary much over time, and its value is hard to estimate, an alternative approach is to offset the contribution against services that it generates and ignore them both.

What makes a cost direct or indirect is not intrinsic to the resource itself but is a function of how you choose to measure it. Taking the effort to tease out and disaggregate summary data that have amalgamated costs from different cost centers may be all that is required to allocate costs directly. Improved cost reporting and tracking techniques can increase the proportion of costs that are direct.

The more substantial the cost, the more worthwhile it is to invest in approaches to increase the accuracy with which it is allocated to specific cost centers. Cost accounting systems and rules should guide the hospitals toward direct accounting of conspicuous costs, i.e., those of high volume, intimately related to the nature of hospital patient care.

Generally speaking, direct assignment of costs to cost centers should be possible for most labor, pharmaceuticals, medical supplies, and medical equipment costs in a well-run cost accounting system. Other costs such as for linen and clothing, business travel, and some utilities can also become direct costs if sufficient appropriately disaggregated records are available (e.g., if there are electricity meters in cost centers).

5.3 Allocation of Indirect Costs Should Be Done in a Way that Reflects as Closely as Possible the True Incidence of Those Costs

Some resources are shared in a way that makes it impossible or impractical to measure directly how much of the resource is used in a particular cost center. For example, hospitals are often billed for the total hospital-wide cost of utilities such as water or for contracted maintenance services. Office supplies, communications, cleaning, laundry, routine maintenance, and transportation services are other costs that are often impossible to attribute directly to specific cost centers.

With these costs it becomes necessary to use an indirect approach (sometimes also called an allocation or apportionment process) to distribute them among cost centers. This involves identifying some kind of indicator that reflects approximately the distribution of those costs - an easily measured variable of which the cost is a function. For example, if you want to know how much of the cost of cleaning agents should be allocated to the hospital's outpatient clinic (given a centralized cleaning service), you might calculate the percentage of floor space of the hospital occupied by the outpatient clinic. The assumption is that the more space there is, the more cleaning agents will be required. If the relationship is assumed to be linear and the outpatient clinic occupies one-tenth of the hospital's space, then one-tenth of the hospital's cleaning material costs can be allocated to outpatients. Indicators (such as "floor space" in this example) are termed *allocation statistics, allocation bases, apportionment statistics, or* ***cost-drivers***.

Cost drivers are variables that approximate the level of activity taking place in a specific cost center. Sometimes these cost drivers can be resources (e.g., the percentage of the hospital's medical staff working in each cost center or the percentage of the hospital's floor space occupied by each cost center). The former might be a good approximation of the relative amount of training done in each center; the latter might approximate the percentage of cleaning costs associated with each center. But cost drivers can also be outputs, either clinical ones (e.g., number of patients treated) or administrative or logistical ones (e.g., "distance traveled"). Cost drivers can even be other costs – e.g., the "proportion of all direct costs" is used in the top-down allocation of some cost centers (see Chapter 7 and Worksheet 4).

There is often more than one cost driver that can be used for any given cost. For example, it would not be unreasonable to assume that the amount of cleaning agent used was some function of the number of cleaning staff assigned to each cost center or possibly also some function of the

number of patients treated. “Floor space,” “time of cleaning staff,” “number of patients” are all possible cost drivers for cleaning material costs. The one that should be chosen is that which:

- Accurately describes demand for the resource for which it is acting as proxy and
- Is readily available and accurately measurable.

How much effort should be put into the process of allocation depends on how much more accurate it will make the overall costing. This in turn will depend on how large that specific cost is as a proportion of the total.

Table 7 gives examples of allocation statistics that could be used to allocate different costs.

Table 7. Sample List of Costs and Matching Allocation Statistics

Costs	Allocation statistics
Buildings	Space in square meters
Equipment	Procedures performed
Labor	Procedures performed
Heat	Space, cubic meters
Electricity	Space, cubic meters
Water	Direct costs
Building maintenance	Space, cubic meters
Office supplies	Direct costs
Telephone communications	Number of phone sets
Miscellaneous contracted services	Direct costs
Cleaning	Surface, square meters
Security	Depreciation of fixed assets
Television	Number of TV sets or patient days
Workplace security	Staff number

5.4 Costs Incurred by One Service Should Never Be Attributed to Another Service

Quite frequently hospitals will decide to charge for one service more than its cost in order to subsidize another service. Inexpensive, non-vital procedures will often be “over-priced” so that expensive, lifesaving ones can be made more financially accessible.

This cross-subsidization is a legitimate pricing strategy but care should be taken not to carry over the same thinking to assessing the *costs* of different services. Costs incurred by one service should never be attributed to another service. This is important even if the *price setting* mechanism does involve cross-subsidization. You may choose to charge less than cost for one service and, to compensate, charge more than cost for another, but you need to know what the cost of each service actually is.

6. Procedures for Measuring the Costs of Each Cost Center

In measuring costs it is useful to start by consulting expenditure records. Usually this will not be enough either because data are insufficiently disaggregated or because expenditure is not equivalent to annual costs (e.g., with equipment and buildings) and it will be necessary also to collect information on the quantity and cost per unit of resources. Sometimes the *cost per unit* is a relatively straightforward measure (e.g., for pharmaceuticals), and sometimes it is a complex set of different elements (e.g., in the case of labor where allowances, bonuses, and compensations of different kinds complicate the picture). It is important to collect data on the *quantity of resources*, not only because it can be used (together with unit prices) to calculate costs but also because they can function as cost drivers. Human resources (e.g., numbers of staff) and physical plant (e.g., square meters of space) both serve as important cost drivers for indirect costing (see Chapter 5) and for step-down allocation of costs to revenue-earning cost centers (see Chapter 7).

The following sections take each major distinct category of cost – labor, supplies, equipment and buildings, utilities, and services – and describe for each case which resources to measure, how to cost them, and how to deal with any costs that are shared between cost centers.

6.1 Labor

6.1.1 Calculating Costs

1. Identify all the staff employed in the hospital. Include:

    - *clinical staff* such as physicians, dentists, pharmacologists, nurses, midwives, or pharmacists; and
    - *non-clinical staff* such as engineers and technicians, administrative personnel, office/clerical and other administrative personnel, or ancillary medical and technical staff.

2. Classify these staff into full-time and part-time workers. For those who work part time estimate annual work hours or workdays. These estimates can be later translated into full-time equivalent (FTE) labor.

3. Consider classifying hospital staff by qualification and other categories to provide additional information for hospital resource management and analyses. (Some hospital units such as the ICU and CCU will be sensitive to the functional or clinical specializations of staff, age, and other personal and work-related characteristics).

4. For each staff member or group of staff whose labor is being costed, track down **all** the different elements that contribute to the cost of that person or group of persons. These

elements, whose records are often kept somewhat separately, include:[14]

- Standard wages and salaries
- Additional compensation for such things as extra-hours and night shifts; work in, or visits to, remote (e.g., rural) areas
- Work-related allowances (e.g., commuter subsidies, car allowances)
- Cash and in-kind income supplementation (e.g., housing and utility allowances, heating fuel, food baskets)
- Vacations, sick leave, and other off-time payments
- Educational stipends
- Performance bonuses and miscellaneous rewards
- Workers' compensation (or a country-specific equivalent for workplace injury and professional disease compensation)
- Severance packages
- Labor surcharges, such as payroll taxes[15]

5. Identify the cost center to which staff are attached. Note that non-clinical staff will often work in medical departments and clinical staff can be associated with support services.

6.1.2 Allocating Shared Costs

While some staff work exclusively in activities that are unambiguously associated with one cost center, many others divide their time in some way among multiple cost centers. Since most labor costs are a function of time, the best way to allocate these labor costs is by looking at the proportion of time staff spend in different cost centers activities. Labor costs measured in this way are "direct costs."

Most hospitals should be able to allocate labor costs directly (though crudely) to cost centers, based on the knowledge of their staffing schedule, salaries by staff category and, possibly, personalized accounting of discretionary compensations. More accurate tracking of labor costs requires a system of work time accounting to track time for each category of personnel and each cost center. This can be facilitated by introducing a template for labor accounting with standardized personnel classification, coding rules, worksheet design, and licensed database software.

Sometimes it might be necessary to use a proxy to allocate time costs. For example, if a staff member performs one main task (e.g., some particular treatment procedure) but does this in several different cost centers, it may be appropriate to use those tasks as a proxy for time. Labor costs allocated according to the percentage of tasks performed at each cost center would be "indirect costs."

[14] You may find that data sources have amalgamated different elements. This is not a problem since there is no need to preserve all the separate categories unless you plan to do a detailed analysis specifically of staff costs. As described later in Chapter 8, it can be useful to separate those cost elements that are variable (e.g., performance bonuses) from those that are fixed (e.g., severance packages). However they are packaged, it is important that all cost elements are included.

[15] Sometimes these appear as a separate item on the cost classification lists of some countries; they should be attributed to cost centers as a direct cost, because they are part of the "gross" remuneration paid to staff.

Accurate direct costing is to be preferred since labor usually represents the largest single cost item in a hospital's budget.

6.2 Equipment and Buildings

6.2.1 Calculating Costs

Any equipment with a useful life of more than one year and with a purchase value that is not trivial[16] and all buildings should be treated as a fixed asset or capital cost. Outlays for these resources occur irregularly and need to be spread out over their lifetime in some way so as to generate an annual cost.

1. Make or consult an inventory of the stock of equipment being used – medical equipment, furniture, vehicles, and administration-related equipment. Include equipment that has been leased or donated as well as that which has been purchased. It is particularly important to include donated goods when it is not certain that donors will replace the once-donated fixed asset.

2. Identify the buildings that comprise the hospital.

3. If the equipment or buildings have been leased rather than purchased, use the annual or annualized lease payments. Otherwise follow the procedure in steps 4 to 7.

4. Determine the replacement cost of each item. You might get this information from expenditure or purchasing records (which will give you the book value or acquisition cost) or, especially for equipment that has been donated, from supplier brochures or building valuers.

5. If the value you have relates to a year different from the one for which you are doing the costing, make adjustments to take account of general price growth (inflation) or advances in technology that might make replacement costs higher or lower.

6. Determine the "useful life" of each piece or category of equipment or type of building using accounting guidelines or user manual.

7. Calculate the annualized cost of that equipment or building. The simplest way to do this is the so-called straight-line method of depreciation where the current value of a fixed asset is divided by the number of years of the asset's useful life. For a more accurate estimation,[17] the replacement cost should be:

    - Reduced by the asset salvage value, i.e., the amount expected to be recovered from disposing of the asset at the end of its useful life;
    - Increased by the value of asset improvement (e.g., refitting, remodeling, repair, renovation) with a lasting effect (say, two years or more) on the asset's durability and productivity;

[16] The value threshold that separates capital assets from recurrent inputs differs by country and is regulated by national accounting laws. In the absence of such local guidance, take $100 as the threshold.
[17] Use available accounting standards or guidelines to decide how much of these refinements to take on board.

- Discounted for the net present value of future investments. If depreciation funds can generate an investment income while waiting to be invested in the new fixed asset, the depreciation basis should be reduced by the amount of expected income.

6.2.2 Allocating Shared Costs

Equipment is often shared between different cost centers. Various measures can be used to divide total costs among various cost centers:

- How frequently, or for how long, different centers utilized the machine
- Numbers of procedures performed (for diagnostic equipment)
- Number of trips or distance traveled (for shared vehicles)
- Floor space in square meters (for allocating building costs among centers)

Table 8 indicates the information required on each piece of equipment to enable the calculation of the cost per cost center.

Table 8: Information Required on Each Piece of Equipment

Asset title	
Year of acquisition	
Replacement cost	
Useful life	
Date and cost of capital improvements	
Inflation rate since purchased	
Present interest rate	
Cost center to which initially assigned	
Assigned to (cost center and date)	
Assigned to (cost center and date)	
Assigned to (cost center and date)	

6.3 Pharmaceuticals and Other Supplies

6.3.1 Calculating Costs

Pharmaceuticals represent the single most important group of supplies in a hospital setting. They consume a very significant proportion of the entire hospital budget. They are the focus of this section though much of what is said could be applied to supplies more broadly.

Unlike labor (which involves a large set of cost components of which salaries is only one) and equipment (which requires manipulation through depreciation to establish its annual cost), pharmaceutics are relatively easy to cost. Expenditure records will usually provide the relevant

information on annual pharmaceutical costs quite straightforwardly and finding out the annual costs of a particular drug is also unlikely to be difficult.

6.3.2 Allocating Shared Costs

The problem with this category of cost lies in working out which costs belong to which cost center. Obviously pharmaceutics are used only by medical cost centers and not by administrative or overhead centers, and that simplifies matters somewhat. But most pharmaceuticals are unlikely to be used by only one medical cost center. Because pharmaceutics are such a large cost component it is important that allocation to costs centers is done as precisely as possible.

Direct accounting presents a challenge. A drug inventory and flow control system supported by a database is essential. It should record the drug name and classification code, presentation,[18] acquisition price per pack, date on which it was dispensed, number of dispensed packs, name of the cost center ordering it, and total cost per record.

A basic system could involve the pharmacy recording the unit price on each shelved box and, when compiling a weekly lot for a specific cost center, entering the essential information in the ledger, which would be separated into cost center-specific sections. At the end of, say, each two-month period, the pharmacy record keeper could provide the summary cost of drugs dispensed to each medical cost center. A more sophisticated system would involve computerized data bases, scannable orders from the cost centers, and bar-coded boxes. Well-organized storage space and rational stock management standard procedures and competent staff are important conditions for efficient and accurate accounting of pharmaceutical costs.[19]

6.4 Utilities and Contracted Services

In some cases, labor, supplies, and equipment come in an entangled package of services or utilities, and it is much easier to treat them as a package. Examples include heat, electricity, water, and telecommunications services, building maintenance, and miscellaneous contracted services. Information on the total costs for the hospital for these services and utilities is generally available in expenditure records. Deciding how much to allocate to each cost center is more problematic. There is seldom any way to allocate these costs directly. The resources in this group share the common characteristic of being clearly “indirect” costs.

There are a variety of cost drivers that one could consider for allocating these shared costs among cost centers. Most of these costs are, to a large extent, a function of the space occupied by the cost center (heat, electricity, and building maintenance probably fall into this category), and square meters is probably a suitable allocation variable (or cost driver) to use. This might also apply to water, although water use may be better allocated according to the number of faucets. Staff numbers or perhaps the total cost of labor, equipment, and supplies might be other suitable allocation variables for these utilities and services.

[18] Number of pills per the lowest-priced pack or smallest number of doses per ampoule or vial is termed “presentation.”

[19] A more advanced system (using standard patient encounter forms and discharge summary forms) would detail drug consumption and prices to the level of prescription. This would enable drug costs to be matched to patient data and could form part of a multi-functional database tracking patients, services, and resources.

6.5 Worksheets

All the worksheets except the first will require data on resources and costs. The key worksheets are numbers 2 and 3.

For each cost center, worksheet 2 requires the user to enter:

- FTE hospital personnel by three occupational categories: physicians, nursing/midwife, and non-medical. These staff numbers are transformed by the software into FTE workdays, based on the realistically assessed numbers of hours worked annually and daily. The worksheet (based on Jordan data) currently assumes that “physicians” work 2,392 hours per year and “other personnel” work 1,872 hours per year, but these values can be modified by users for each category of personnel.

- Acquisition (or purchase) value for three categories of fixed assets – buildings and structures, equipment and furniture, and vehicles. (The values currently inserted from Jordan include imputed prices of the donated equipment but do not take into account capital improvements to fixed assets)

- Three in-kind indicators of usage of fixed assets – floor space in square meters, number of telephone sets, and number of outlets for medical gases – all of which serve as allocation statistics.

Worksheet 3 requires users to enter the costs of each cost center by cost category.

7. Estimating the Full Costs of Revenue-Earning Cost Centers

The previous chapters have provided guidance on how to calculate the cost of each cost center in the hospital. This chapter builds on the important distinction made earlier (Chapter 4) between those cost centers whose services are paid or budgeted for (i.e., the final or revenue-earning cost centers) and those whose services are not (intermediate medical and administrative cost centers). It explains how to allocate the total costs of the non-revenue-earning cost centers to the final cost centers so that the latter, between them, bear the full costs of the hospital. Each final cost center's costs would include all their own costs and some portion of the other intermediate and administrative costs. This amount would represent the charges that would need to be made by the revenue-earning cost centers for their services if they were to cover all the costs of the hospital and not simply their own.

This process, known as the *step-down (or top down) cost allocation*, maps the costs of intermediate cost centers to those of the final cost centers and results in so-called "full absorption of costs." It is done as described below.

7.1 Description

1. Cost centers are assigned to different "levels." Centers at the top "supply" centers below them with some kind of service, and they in turn do the same for the centers below them. The assumption is that a cost center is either a supplier *or* a customer to another cost center. It cannot be both.[20]

2. The bottom rank contains only revenue-earning final cost centers. Immediately above them are placed any intermediate cost centers that provide specialized services directly to one or more of the final cost centers. Those cost centers whose functions are most universal (e.g., switchboard, general administration) are placed on top.

3. The allocation process starts at the top. The higher the intermediary cost center is on the list, the more cost centers it will have as its "customers" in the step-down resource allocation process. The uppermost cost center will allocate its costs to all the cost centers.

4. Of two or several equally universal services, the one with the highest volume of total costs is placed on top so as to minimize the inaccuracies resulting from unidirectional nature of the step-down allocation process.

5. Final cost centers do not allocate costs to each other.

[20] Clearly, this is a simplification. Many pairs are likely in fact to be bi-directional with one cost center being both a supplier and a customer of another cost center ("general administration" and "transportation services" are good examples). The unidirectional convention does not, however, lead to big distortions in the cost distribution under a properly ordered list of the cost centers

6. The allocation of costs from one cost center to a number of others is done using allocation statistics (or cost drivers). The principles (and sometimes the statistics themselves) are the same as when allocating indirect costs (see Chapter 5). The only difference is that in the first case, one is dividing up the cost of a specific cost category (e.g., labor) and in the second it is the cost of a set of activities (a cost center).

7. The chosen allocation statistic should reflect, approximately, the extent to which the centers below them use the intermediate cost center's services. There is sometimes more than one cost driver that can be used to allocate the cost of intermediate cost centers. Choose the one that best meets the following criteria:

   - △ Accurately describing demand for which the resource is acting as proxy; and
   - △ Being readily available and accurately measurable.

8. As a minimum, the allocation statistic chosen should ensure that all those cost centers that are consumers of an intermediate cost center's services are allocated at least some proportion of the costs. In other words, the allocation statistics should have non-zero values in all the cost centers that are consumers of the respective service. For example, if inpatient outputs such as "inpatient days," or "admissions," or "occupied bed days," are selected as the allocation basis for medical records, the outpatient clinics will not absorb any of the medical records costs even though they benefit from the medical record-keeping services. As a result, the full costs of outpatient clinics will be underestimated while the full costs of inpatient departments will be inflated.

Table 9 presents an illustrative list of allocation statistics for different cost centers:

Table 9: Sample List of Allocation Statistics for Step-down Cost Allocation Process

Intermediate Cost Centers	Allocation Statistics (optional or composite)
Administrative and logistical services	
Cleaning services	Floor space, weighted by frequency of cleaning; unweighted floor space; general ledger
Computing	Number of computer ports in use
Financial management	General ledger (itemized accounting, e.g., by work order); staff – FTE; staff – headcount
Food services (patients)	Meals dispensed; patient days; inpatient discharges
Hospital administration	Staff – headcount; staff – FTE
Human resource management	Staff – headcount; staff – FTE; wages & salaries
Infectious control	Medical staff – FTE; general ledger; inpatient admissions
Laundry	Weight of laundry used, kg; patient days + personnel days; patient days
Legal services	Staff – headcount; staff – FTE; general ledger
Linen	Linen costs; patient days + personnel days
Maintenance and engineering – buildings	Volume, cubic meters; floor space, square meters; general ledger
Maintenance and repair – equipment	Asset book value; general ledger
Medical management and administration	Medical staff – FTE; medical staff – headcount; medical salaries
Medical records	Outpatient visits + inpatient admissions; outpatient primary visits + patient days
Miscellaneous	Total costs

Intermediate Cost Centers	Allocation Statistics (optional or composite)
Patient administration	Inpatient admissions; inpatient discharges; patient days
Security	Asset book value; floor space; staff – headcount
Telecommunications	Invoiced phone costs; number of telephone lines; staff – headcount
Transport – patients	Inpatient admissions; inpatient discharges
Transport – personnel	Staff – headcount; staff – FTE; wages & salaries
Intermediate medical services	
EEG	Requests
Occupation therapy	Sessions
Operating theater	Time in use
Optical services	Direct to ophthalmology
Pathology	Weighted requests
Pharmacy	Value of dispensed drugs; requests
Physiotherapy	Duration of sessions; number of sessions; referrals
Radiology	Weighted requests
Radiotherapy	Exposures
X-ray diagnostics	Weighted projections
Speech therapy	Sessions
ECG	Weighted referrals

7.2 Worksheets

Four cost aggregates are processed through the step-down allocation algorithm – total costs, labor costs, fixed costs, and variable costs. The last two are discussed in the next chapter and feature in Worksheet 8 (fixed costs) and Worksheet 9 (variable costs).

Total costs feature in Worksheet 4, which generates the key results of the entire MASH algorithm, i.e., final production costs by revenue-earning cost centers and unit costs of an outpatient visit, patient-discharge, patient-day, and hospital bed in each final (i.e., revenue-earning) clinical department of the hospital. These indicators inform a wide range of management tasks including cost-based pricing and budgeting, comparative assessments of hospital performance, structural modernization planning cross-subsidization policies, and others. They feed into the analysis that is described in more detail in the following chapters.

7.3 Case Study

Figure 2 shows the cost structure of a hospital that consists of eight cost centers. The first two – hospital administration and building maintenance – represent administrative and logistical services; another two – radiology and operating room – represent supporting medical services, and the last four– outpatient internal medicine, outpatient pediatrics, inpatient medicine, and inpatient surgery – represent final medical services.

Cost centers 1-4 are intermediate cost centers. Their total costs have to be included in the costs of the final cost centers (5-8) in order to be budgeted or reimbursed to the hospital. The hospital administration total cost of 800 (fourth column from the left) is allocated downward to each of the cost centers below using “hospital direct costs” as the cost driver. The assumption is that direct costs

reflect the level of activity, and that those cost centers that are more active have a higher dependence on the services of hospital administration. The resulting allocation adds a fraction of the hospital administration costs to each cost center's total costs (fifth column from the left). Similarly, the costs of cost center 2 (building maintenance), which now total 550 (i.e., 500 + 50 allocated from the hospital administration cost center), are allocated to the cost centers below it proportionately to the space they occupy.

The costs of cost center 3 "radiology" are then allocated downwards proportionately to weighted tests (number of tests that each medical cost center ordered, weighted by the resource intensity of each type of tests). Finally the costs of cost center 4 "operating room" are allocated proportionately to the number of surgeries and are naturally loaded to the final costs of the inpatient surgery.

The rightmost column features the resulting final costs of the revenue-earning cost centers. Each revenue-earning cost center's final cost includes its own total cost and a portion of total costs of each intermediate cost center that contributed to its clinical output. Hospital-wide total costs (see the bottom line of the table) equal the hospital-wide final costs (7,700). This means that the revenue-earning cost centers have fully absorbed all hospital costs.

Figure 2: Illustration of Step-down Cost Allocation

				CC 1				
Cost centers (CCs)	**Direct costs**	**Indirect costs**	**Total costs**	**By direct cost**	CC2			
1. Hospital administration	500	300	**800**	*800*	By sq.m	CC3		
2. Building maintenance	300	200	**500**	50	*550*	By weighted tests	CC4	
3. Radiology	600	300	**900**	100	50	*1050*	By No. of surgeries	
4. Operating room	900	400	**1300**	150	100	0	*1550*	**Final costs**
5. Outpatient internal medicine	600	200	**800**	100	20	150	0	**1070**
6. Outpatient pediatrics	600	300	**900**	100	30	100	0	**1130**
7. Inpatient medicine	1200	500	**1700**	200	150	300	0	**2350**
8. Inpatient surgery	600	200	**800**	100	200	500	1550	**3150**
TOTAL	5300	2400	**7700**					**7700**

8. Fixed and Variable Costs

8.1 Description

Purchasing and regulating agencies and hospitals will all want to know the pace at which different costs change in response to changing service outputs: the former because they may wish to base their pricing and resource allocation decisions on a certain "mandated" share of variable costs[21]; the latter because such decisions will have unpredictable financial consequences for them unless they have a clear view of their cost structure and behavior.

Those costs that change in proportion to the volume of activity are termed v*ariable costs*. If the number of patients being treated in a certain unit increases by 50 percent so too, roughly, will associated pharmaceuticals and medical supplies and meals. These are all examples of variable costs. Those costs that remain constant over the analyzed period of time, regardless of changes in the volume of hospital services, are termed f*ixed costs.* A facility lease is an example of a fixed cost. It would generally stay constant for the duration of a multi-year contract, absorbing moderate fluctuations in capacity utilization and clinical outputs.

Many costs cannot be termed either strictly variable or fixed. Some costs that do vary do not do so in linear proportion to outputs and are "conditionally variable." Most costs that are fixed over a range of outputs will eventually increase once output reaches a certain point. For example, a building may be big enough to accommodate from one to 5,000 patients but beyond that a new facility would need to be purchased or leased. Over a sufficiently large range of outputs, facility costs would have to be described as "semi-variable." Semi-variable costs do not change in a smooth fashion, but step up periodically. Salaries of the general management staff tend to follow the semi-variable growth pattern.

Capacity is an important determinant of cost behavior. If a hospital operates at 95 percent capacity, a slight increase in occupancy may trigger the deployment of additional beds and the expansion of diagnostic and operating room facilities. These normally fixed costs would be added in lumps and thus transformed into semi-variable costs. Similarly, if capacity utilization rates are at the lower threshold of the relevant range, a moderate decline in occupancy can precipitate the reduction of bed capacity with across-the-board cutbacks in administrative and clinical support resources, services, and costs.

[21] For example, governments that purchase services from hospitals might agree to reimburse hospitals a specified percentage of the relevant variable costs (either total hospital or department-specific variable costs). This percentage would be specified in the purchaser (government)/provider (hospital) contract. The hospital might well benefit from knowing what portion of each cost is variable as it could use this information to argue for increased levels of reimbursement especially if costs that would otherwise have been treated as fixed (e.g., staff) can be shown to be variable.

What determines whether a cost is variable or fixed is, therefore, not simply in the nature of the resource itself but also relates to how close to capacity the hospital or cost center is operating. There are other factors too that can influence whether a cost is fixed or variable:

- The basis on which costs are paid: Labor costs would be a "perfectly" fixed cost in hospitals where staff are all permanently employed and paid according to set remuneration packages. In those hospitals where temporary personnel are employed in response to changing workloads and paid performance-based (i.e., variable) bonuses that reflect worker and hospital productivity, labor costs would be variable. Most hospitals do both and should identify those labor cost components that are fixed (e.g., base salaries of permanent staff) from those that are variable (salaries of temporary staff and bonuses assuming the hospital has a nimble response to variations in the workload).

- Whether costs are for in-house or out-sourced services: Contracted (outsourced) services are easier to adjust to changing hospital needs, and their associated costs would behave in a variable or conditionally variable manner. Take, for example, car maintenance and repair services. A hospital-owned garage implies substantial levels of fixed costs whereas purchasing these same services from an outside source would mean that the costs would respond to the hospital's changing transport needs.

- What the accounting rules are: For example, if calendar time serves as the basis for depreciation accounting, depreciation will be a fixed cost. If, instead, depreciation is done on the basis of the output that a piece of equipment has produced over the year (e.g., the number of tests or the percent of full capacity utilization) then depreciation will become a variable cost.

Unless data are sufficient for an econometric study of cost variability in relation to output, hospital managers and analysts will have to make educated guesses regarding the appropriate split of each cost category between the fixed and variable parts. Table 10 summarizes the split used in the analysis of Jordan's hospital costs (and presented in Worksheet 5).

8.2 Worksheets

Worksheet 5 is a table of the percentage of costs that are variable by cost category and cost center. The figures in the Worksheet are for the most part notional ones – educated guesses – except in the case of food service, laundry, and textiles/linen, where the variable share was actually calculated from Jordanian data.

Only pharmaceuticals and medical gases are assumed to be "100-percent" variable costs and only "depreciation of buildings and structure" is considered a completely fixed cost. All other costs are positioned at various points along the "fixed/variable continuum."

For most cost categories, the split between fixed and variable changes depending on the cost center. The variable part is assumed to be higher in medical services, particularly in final medical services, than in administrative services.

Managers are encouraged to substitute values that reflect more closely the situation in their own hospitals. The fixed/variable cost split should be subject to ongoing statistical testing in the process of MASH application. A review of trends in major costs over time compared with changes in output can help to determine the variability of the cost.

Table 10. Percentage of Costs that Are Variable by Cost Category and Type of Cost Center

Cost categories	Type of cost center		
	Administrative and logistical services	Intermediate medical services	Final medical services
Direct costs			
Labor – Salaries	5	10	15
Labor – Incentives	5	10	15
Labor – Commute allowance	5	10	15
Pharmaceuticals	N/A	100	100
Medical supplies	90	90	90
Depreciation – Equipment & furniture	5	50	50
Depreciation – Vehicles	10	20	50
Indirect costs			
Heating fuel	0	20	20
Butane gas	0	20	20
Electricity	5	50	50
Water	5	70	70
Gasoline and lubricants	10	20	50
Telephone services	5	10	20
Building maintenance	5	10	15
Equipment maintenance & supplies	5	50	50
Housing for clinical staff	5	10	15
Medical gases	100	100	100
Food services (patients and staff)	5	15	25-40
Cleaning and washing	5	10	30
Laundry	5	15	25-40
Miscellaneous contracted services (security, procurement)	5-10	10	10
Stationery	5	10	10
Textiles and linen	5	15	25-40
Other indirect costs	5	15	25
Depreciation of buildings and structures	0	0	0

9. Variance Analysis

9.1 Description

Variance analysis is a management accounting technique that enables close examination of the difference between budgeted and actual (or projected) information.

The analysis starts from the assumption that each final cost center and the hospital as a whole start at the break-even point (see Chapter 10 on break-even analysis). With price or output changes, department and hospital revenues diverge from costs, and this has implications for the financial status of individual cost centers and the entire facility. Variance analysis enables managers to predict or measure what those implications will be and then to play with alternative scenarios for responding to them.

A growth in outputs or an increase in price will generate a surplus of revenue over cost. Variance analysis calculates how much the hospital would have to spend on additional projects or could afford to lose by, for example, taking some beds out of operation for a structural modernization of the hospital. Similarly, if the department-level and/or cumulative hospital-wide effects are negative, leading to a shortfall of revenues compared to costs, variance analysis can show managers how effectively alternatives such as slashing operating costs or raising output targets for growth areas will address the financing gap.

9.2 Worksheets

Worksheet 11 provides a programmed interactive tool for estimating the impact of changed clinical outputs or prices (in final cost centers) on costs and revenues. For each revenue-earning cost center it is possible to have up to seven different scenarios for the percentage change of output or price or the cumulative effect of both. The worksheet is pre-programmed for percent changes of -25 percent, -15 percent, -5 percent, 10 percent, 20 percent, 30 percent, 40 percent but the user can simply replace these numbers in the shaded cells with alternative values, if needed, and the scenario-specific line will recalculate itself. If changes in output/price are expected to occur in several cost centers, Scenario 1 lines should be activated for each of those cost centers. Numbers in the shaded cells corresponding to cost centers whose price/output parameters remain unchanged should be erased. If a multi-scenario simulation is required, Scenario 2, Scenario 3, etc. should be activated by entering parameters of change for each cost center involved (while clearing any other numbers from the shaded cells). Based on these inputs in the shaded cells, the worksheet calculates all other cells, using cost and other information already recorded in previous worksheets.

For each scenario of change the worksheet produces the following results for each cost center and for the hospital overall:

1. The changed number of visits (for an outpatient clinic) or patient discharges (for an inpatient department), equivalent to the entered price or output percent change;

2. Percent and value of the cost change;

3. Percent and value of the change in revenue;

4. Revenue/cost gap or surplus both in absolute value and as a percent of new costs.

The numbers at the end of the worksheet (in bold) reflect the cumulative hospital-wide change resulting from same-scenario changes in all cost centers.

9.3 Case Study

A hospital (budgeted per outpatient visit and inpatient discharge) is asked by the Ministry of Health to showcase a transition from inpatient to outpatient surgery. The hospital's response is described below and illustrated in Figure 3, an extract from Worksheet 11.

The hospital analyzes its surgical case mix (patients' ages, principal diagnoses, and co-morbidities in surgical cases, and planned and performed operating room procedures) and concludes that, with the skills of its surgeons, 25 percent of last year's surgical patients could be operated on in the outpatient setting. However, capacity of the outpatient surgical facility is limited so the hospital makes a commitment to move only 15 percent of its inpatient surgical cases to the outpatient surgery. This number is entered in cell *D4* of Table 11 and results in the reduction of the number of inpatient surgical cases by 22 (*F4*). The hospital estimates that one episode of outpatient surgical care would require an average of three visits to the "outpatient surgery" department whose own workload would then increase by 66 visits (11.5 percent – entered into cell *C3*) over the previous year.

Figure 3. Variance Analysis: Extract from Worksheet 11

	A	B	C	D	E	F	G	H	I	J	K	L
1	Clinical Departments	Scenario Number	Change in the N of visits or discharges, or reimbursement/ budgeting rates				Change in costs		Change in revenue		Revenue/cost gap (-) or surplus (+) in % of new cost	
2			% visits or price change	% discharges or prices	N visits	N discharges	%	Value, JD	%	Value, JD	%	Value, JD
3	Outpatient general & specialty surgery	1	11.5		66		5.7	9818	11.5	19716	5.2	9898
4	Inpatient surgery	1		-15		-22	-4.8	-18155	-15	-56228	-11.9	-38073
5	TOTAL/AVERAGE	1	0.5	-3.9	66	-22	-0.3	-8337	-1.4	-36512	-1.1	-28174

p Since only variable costs will respond to these changes in output, outpatient surgery costs will increase by only 5.7 percent (*G3*). Assuming that the Ministry of Health continues to budget the hospital at the same rate per outpatient visit as before, then revenue will increase by the same 11.5 percent (*I3*) as the workload. That rate will reimburse the department for both variable costs (actually borne) and fixed costs (not borne). As a result, the revenues of the outpatient surgery will exceed its costs by 5.2 percent (*K3*).

- Inpatient surgery will lose 15 percent of its caseload (*D4*) and, correspondingly, 15 percent of its revenue (*I4*) to outpatient surgeries. Costs, on the other hand, will decline only by 4.8 percent (*G4*), since fixed costs will not go down despite reduced number of inpatients. The inpatient surgery will end up with a shortfall of revenue of -11.9 percent over costs (*K4*).

- At the hospital level, the number of outpatient visits will grow by 0.5 percent (*C5*) (66 in absolute terms (*E5*)), while the number of inpatient discharges will decline by 3.9 percent (*D5*) or 22 cases (*F5*). The interplay of department-level cost behaviors under the existing fixed/variable mix will lead to a hospital-wide decline of costs by 0.3 percent (*G5*), accompanied by the reduction of revenue by 1.4 percent (*I5*), to produce the revenue/cost gap of -1.1 percent (*K5*).

Given this prediction of a financial loss, the hospital director would probably have to ask the Ministry of Health for an upward revision in the budgeting rates in order to compensate the hospital for the expected budget deficit of -1.1 percent. The Ministry might react in any of the following ways:

- Compensate the hospital in full for the projected shortfall of revenue but request that the hospital invest 1.1 percent of its gross revenue, or JD 28,174 (*L5*) (freed from the reduced clinical output in inpatient surgery), to refit its outpatient operating room in order to increase its productivity.

- Compensate the hospital for 50 percent of the projected next year's shortfall but warn them that the hospital would then be on its own in balancing its budget. This arrangement gives the hospital a partially funded year in which to make cost-saving structural changes such as reducing fixed costs by closing a surgical ward.

- Leave the hospital with the 1.1 percent budget deficit and advise the management to cut back its operating expenses or to increase cost recovery by marketing to paying customers.

The analysis described in the next section provides guidance for hospital managers on how to rearrange hospital resources and costs to keep costs and revenues in balance.

10. Break-even Analysis

10.1 Description

The concluding part of MASH continues the analysis initiated in the previous chapter to address the question "What if a final *cost center A* is to lose or gain 1 percent of its clinical output, production capacity, or revenue?" Break-even analysis determines the service output at which total revenue will equal the total costs of an organization.

Assuming that the output of services is "x" and the price is "p," then total revenue is "xp." If fixed costs are "'a," and "b" is the variable cost per unit of service then the total costs are "a + bx." The algebraic expression of the break-even condition (total costs equal total revenues) will then be:

$$xp = a + bx \qquad (1)$$

And the break-even *point*, i.e., the service output at which costs and revenues are equal, can be determined as:

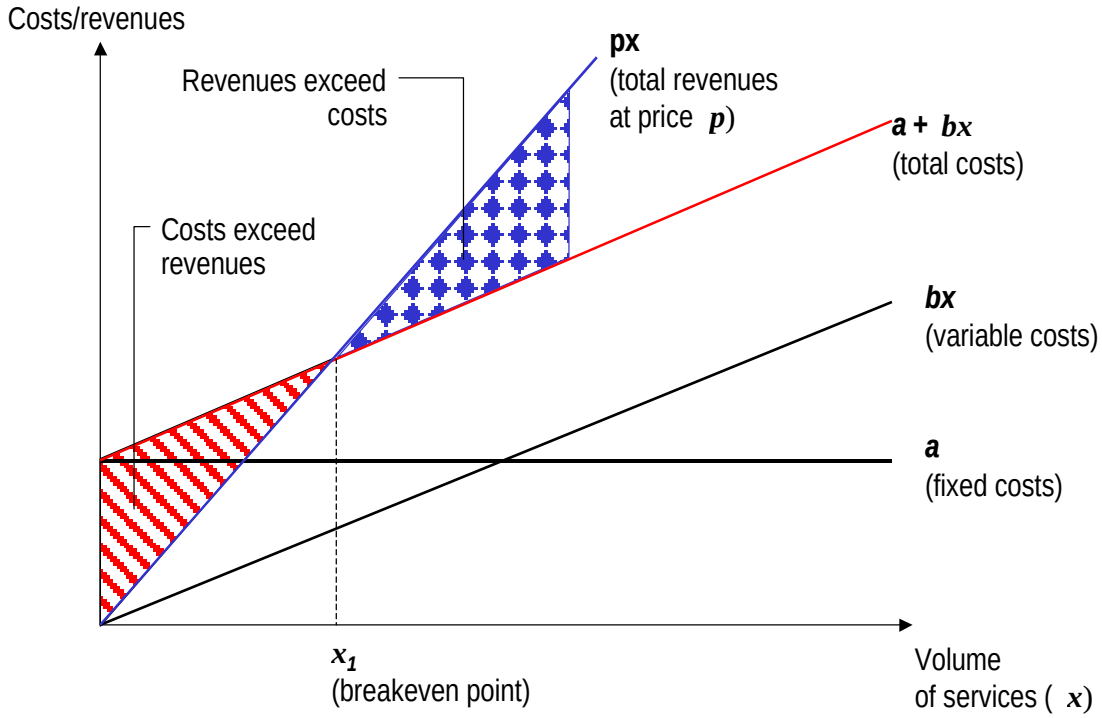
$$x = a/(p-b) \qquad (2)$$

Equations (1) and (2) hold true within the service output range for which the fixed costs and unit variable costs remain constant.

As long as "p" is somewhat bigger than "b" (i.e., the price is higher than the variable unit cost), so that at least some element of fixed costs is being covered, then, with each additional unit of service, the hospital makes a step toward its break-even point. It will take the sale of a certain number of units of service to recover fixed costs. Beyond that number, each additional unit of service sold will generate a surplus of revenue over cost. Figure 4 provides a graphical illustration of the break-even condition and point.

The hospital is a multi-product organization. Sustainable performance above the break-even point depends on the sum of performances across many services and cost centers. Decline in the output of services in one clinical department will cause a shortfall of revenue that throws the facility left of the break-even point and into deficit (see Figure 4). The hospital will have to close the gap either by increasing reimbursable or budgeted activities in other revenue-earning cost centers, or by reducing costs in the intermediate cost centers (taking care not to jeopardize the quality of patient care). The break-even analysis shows the percent by which price and outputs should be increased in each final cost center (or costs should be reduced in each intermediate cost center) in order to restore the hospital to its break-even point, for each percent revenue shortfall in a given revenue-earning cost center.

Figure 4. Break-even Analysis



10.2 Worksheets

Worksheet 12 gives a comprehensive response to the question: how can a 1 percent shortfall of revenue in *cost center A* be compensated for by cost reductions in the intermediate cost centers or increased funded outputs in other revenue-earning cost centers? Or, conversely, how can the hospital take advantage of the 1 percent net revenue (surplus in the budget) of *cost center A* to temporarily reduce activities in other cost centers[22] while keeping the hospital total costs balanced against its total revenues (i.e., in the break-even point)?

For each final cost center, Worksheet 12 lists the percent change rates for clinical output, production capacity, and revenues in all other cost centers that either:

- Would be *required* to compensate for the 1 percent loss of clinical output, production capacity, or revenues in the given cost center; or

[22] It may, for example, want to move beds between clinical specialties or renovate a diagnostic service.

- Would be *available* to those cost centers if the given cost center produced a 1 percent excess of revenue over costs.

Put another way, the worksheet shows what changes are necessary to restore the hospital to its break-even point after it has been disturbed by changes in a given final cost center.

These calculations are made automatically once data on costs and outputs have been entered into Worksheets 1, 2, 3, and 4.

10.3 Case Study

An inpatient surgery department expects to lose 15 percent of its revenue when the hospital moves from inpatient to outpatient surgery (see the case study introduced in Chapter 9). Figure 5, abstracted from Worksheet 12, illustrates how this situation can be analyzed using variance analysis.

The rightmost column of the figure depicts how an expected 1 percent loss of revenue in inpatient surgery can be offset by the reduction of operating expenditure in other cost centers. The fact that most of the figures in this column are greater than 1.00 reflects the substantial financial size of the inpatient surgery department. A small percentage change in inpatient surgery revenues is still a relatively large sum and would require a larger percentage change in most other cost centers to compensate. For example, to recoup a one-percent loss of revenue in inpatient surgery would require a more than 5 percent reduction in any one of most of the administrative services costs and up to 22.86 percent in personnel. Streamlining low-cost administrative and logistical services is not, in other words, an easy way to make up for the inpatient surgery shortfall.

Intermediate medical services cost centers would not need to reduce their expenditure by quite the same higher percentage (indeed laboratory costs need only fall about the same percentage as inpatient surgery losses). Most final clinical departments would have to increase their revenues by 2 to 3 percentage points in order to compensate for the 1 percent decline in the inpatient surgery revenue. The figure is much higher (41 and 17 percent) for, respectively, newborn care (which is probably a relatively small volume service) and dermatological care (which is probably a relatively low unit cost service).

The other four columns express the break-even analysis in non-value terms. They show, for example, that the number of visits made to outpatient obstetrics and gynecology clinic would have to increase by 12.31 percent in order to earn revenue equivalent to one inpatient day in inpatient surgery. Inpatient medicine departments would have to produce an addition 0.63 inpatient days to compensate for the decline of clinical volume by one patient day in inpatient surgery.

Figure 5. Break-even Analysis

The change in percentage points in the amount of activity (costs) in other cost centers necessary to compensate for a change in inpatient surgery by one visit and 1 percent operating expenditure.

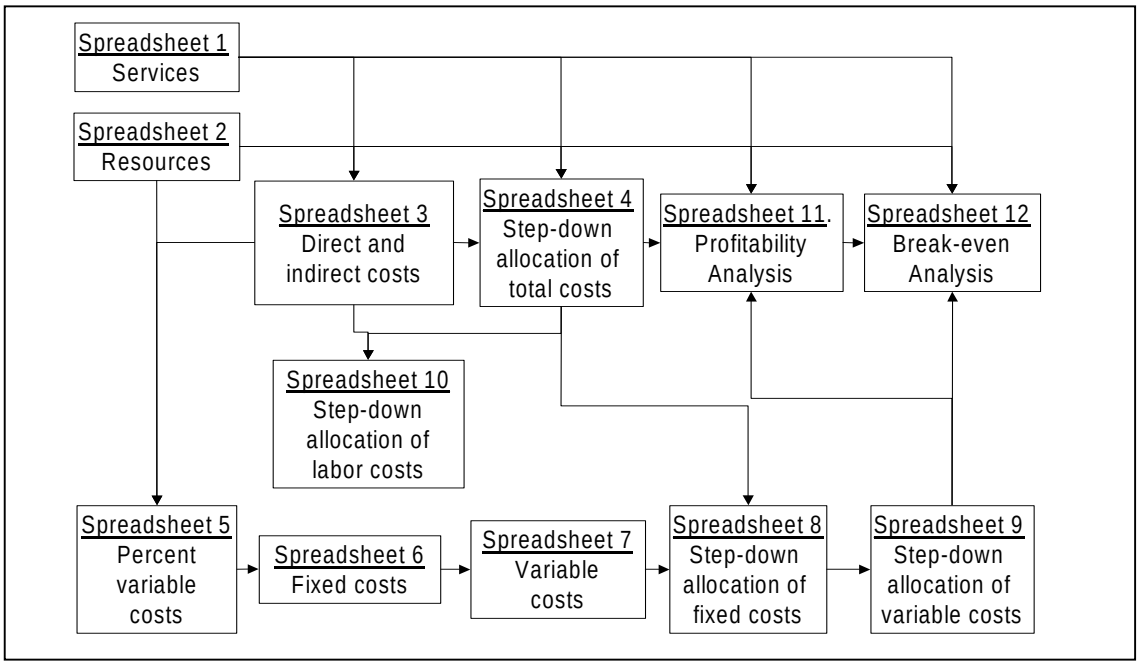
Cost centers	Indicators of output				
	Outpatient visits/patient days	Beds	Patient days	Patient discharges	Operating expenditure, %
Administrative Services and Logistics					
Switchboard					8.47
General administration					8.13
Transport					5.77
Personnel					22.86
Financing and accounting					12.25
Building maintenance					3.44
Intermediate Medical Services					
Pharmacy					6.58
Laboratory					0.99
Radiology					1.97
Final Medical Services					
Outpatient general and specialty Surgery	4.11				2.19
Outpatient internal medicine	11.35				2.68
Outpatient obstetrics and gynecology	12.31				3.29
Outpatient dermatology	60.33				41.29
Obstetrics/gynecology		1.00	1.49	1.81	0.92
Inpatient pediatrics		1.76	1.02	0.87	1.76
Newborn care		5.14	2.06	1.33	16.70
Inpatient medicine		1.00	0.63	0.32	1.09
Inpatient surgery		1.00	1.00	1.00	1.00

Annex A. Worksheet Summary

MASH comprises 12 worksheets, the first three of which are the primary data worksheets. The important procedure of step-down allocation of total costs to revenue earning cost centers is performed in Worksheet 4, which also calculates unit costs. Similar step-down allocations are performed on fixed, variable, and salary costs (Worksheets 8, 9, and 10) using data on fixed and variable costs from Worksheets 5, 6, and 7. Worksheet 11 performs variance analysis. Worksheet 12 is programmed for break-even analysis.

The relationship between the spreadsheets is illustrated in the figure below.

Figure A1. MASH Flow Chart



Before filling in the relevant data in the worksheets (in the shaded cells) it is important to decide which cost centers you wish to use and modify the existing list if necessary. Note that some worksheets express the data in terms of monthly costs and some are annualized. For those worksheets using monthly data you will need to check whether you should be entering in monthly figures or whether the spreadsheet is programmed to convert annual figures to monthly ones. A brief description of each worksheet is given below explaining what data need to be entered and what procedures the worksheet will automatically perform.

Worksheet 1 – Services

The figures recorded in this worksheet serve two important purposes. One is to function as cost drivers in allocating indirect costs to cost centers (Worksheet 3) and to allocate costs from intermediate cost centers to final cost centers (Worksheet 4). The second is to provide the output measures that allow calculation of unit costs of different cost centers (Worksheets 4).

Record in the spreadsheet all the relevant outputs (numbers of inpatients, beds, patient days, outpatient visits, laboratory tests, blood bank units, kilometers traveled, etc.) for each cost center. Focus particularly on identifying outputs for the final medical services.

Worksheet 2 – Human resources and physical plant

The figures in this worksheet (except for equipment, vehicle, and building values) are used mostly as cost drivers to allocate hospital-wide costs among cost centers (Worksheet 3) and to allocate costs from intermediate cost centers to final cost centers (Worksheet 4).

Enter the full-time equivalent (FTE) number of staff for each main category (physicians, nurses/midwives, and non-medical) for each cost center. Also record the number of hours worked per FTE and the number of hours per day (row 4). The spreadsheet will then automatically translate FTE into FTE days.

Enter the estimated useful life for buildings, equipment, and vehicles (row 4). Enter the value of equipment and vehicles for each cost center. For buildings, enter the total value of all buildings (S108) and also, for each cost center, the number of square meters it occupies. The spreadsheet will then automatically calculate an allocated value of building costs to each cost center using space as the cost driver.

Record the number of telephone sets and outlets for medical gases for each cost center.

Worksheet 3 – Direct and indirect monthly costs

This worksheet presents the basic calculation of costs in the hospital by cost center and cost category.

Enter monthly figures on salary, incentives, and commute allowances and the value of monthly expenditure on pharmaceuticals and medical supplies for each cost center. The worksheet will automatically calculate monthly equivalent value of equipment and vehicles using the total cost of each asset and its useful life (both from Worksheet 2) and dividing by 12.

Enter also the total monthly expenditure on the 18 “indirect costs” – electricity, water, etc. in row 5. The worksheet will use the cost drivers specified in row 4 (whose values are found in Worksheet 2) to allocate the total costs to each cost center.

Worksheet 4 – Final total costs by cost center, annualized

This worksheet takes the total costs from Worksheet 3 and performs the step-down allocation of all intermediate cost center costs to final cost centers.

There is no need to feed in any new data to Worksheet 4. This worksheet automatically takes the data on total costs for each cost center from Worksheet 3 and annualizes it (multiplies the monthly figures from Worksheet 3 by 12). It then allocates all the costs from the intermediate non-medical and intermediate medical cost centers to the final medical cost centers using cost drivers specified in cells E4, F5, G6, etc. Some of these cost drivers appear in Worksheet 1 (e.g., kilometers), some in Worksheet 2 (e.g., phone units and FTE staff) and some in 3 (e.g., direct costs). The calculated full costs of the final medical cost centers are then divided by suitable output measures (from Worksheet 1) to calculate full unit costs.

Worksheet 5 – Percent variable costs

This worksheet presents the estimated percentage of costs that are variable for each cost category in each cost center.

Enter in any data you have on the percentage of costs that are variable in your hospitals. In the absence of data specific to your hospitals consider, in the first instance, using the data already recorded in this worksheet. Initiate studies to look more closely at the variable/fixed breakdown of costs in your hospitals.

Worksheets 6 and 7 – Fixed costs and variable costs, monthly

These two worksheets apply the percentage of costs that are variable (Worksheet 5) to the cost figures in Worksheet 3 to calculate the value of fixed costs for each cost category and cost center (Worksheet 6) and the value of variable costs for each cost category and cost center. These calculations are done automatically using data from Worksheets 3 and 5.

Worksheets 8, 9, and 10 – Final fixed costs, final variable costs, and final salary costs by cost center, annualized

These three worksheets perform the same operation as Worksheet 4, allocating in a step-down fashion the costs of intermediate cost centers to final medical cost centers. The difference is that instead of doing this to the total costs, the procedure is applied to fixed costs from Worksheet 6 (to derive Worksheet 8), to variable costs from Worksheet 7 (to derive Worksheet 9), and to salary costs from Worksheet 3 (to derive Worksheet 10). There is no need to enter any new data in these worksheets.

Worksheet 11 – Impact of changed clinical volumes on revenues and costs

This worksheet uses data on the output of services (Worksheet 1) and the value of full (stepped-down) total costs (Worksheet 4) and full (stepped-down) variable costs (Worksheet 7) to calculate the net revenue or cost gap from specified changes in output or prices. The only values the user enters are the percentage changes in the number of visits or in the prices charged for each final cost center. The worksheet does the rest.

Worksheet 12 – Breakdown ratios for structural change planning

This final worksheet uses data from Worksheet 4 to estimate how much change would have to occur in other cost centers to balance a 1 visit or 1 percent change in operating expenditure in any other given cost center. This worksheet takes data from Worksheet 4. There is no need to enter any additional data.

Annex B. Worked Example from Eritrea

Introduction

In 2002, the MASH costing methodology was applied in Eritrea in three pilot hospitals, each chosen from a different level of the health system – national referral, regional, and community. The cost analysis was part of a technical assistance package to the Ministry of Health, Eritrea, to strengthen management systems in selected facilities and in their respective regional health management teams. The preliminary cost analysis provided information to the hospitals and to the Ministry on the costs of running a typical hospital at each level, information that would assist the Ministry's planning for new hospitals. Differences in efficiency of service delivery were also evident from the results, motivating the Ministry to make improvements.

All the worksheets were used except for the profitability analysis (Worksheet 11) and break-even analysis (Worksheet 12). On the other hand, a number of additional worksheets were created which, to distinguish them from the original worksheets, have been labeled as "tables." Table 1 gives a snapshot view of the results, cost recovery rates, and the cost profile of the hospitals. Tables 2 and 3 are supplementary worksheets on, respectively, staff time and the allocation of drugs and supplies. Table 4 gives an overview of the key data for each hospital for purposes of interpreting the cost results and Table 5 shows a summary of costs per unit. Costs are all expressed in local currency (1 Nakfa = 13.5$US)

Table 1: "Summary"

The summary worksheet Table 1 "Revenue and Expenditure Report" is intended to give managers a quick overview of the total revenue generated from user fees and the operating expenditure of the hospital as a whole and also by cost center. The percentage of costs funded from user fees (i.e., total user-fee revenue divided by total operating costs) shows the overall cost recovery percentage for the hospital. The percentage of non-wage expenditure funded from user fees gives an indication of the proportion of non-staff costs that is paid for by user fees. These non-staff costs are usually within the control of hospital managers who can increase that percentage through improved cost efficiency.

Eritrea Table 1, Hospital Revenue and Expenditure Report

REVENUE AND EXPENDITURE REPORT 2001			
Internally generated Revenue		**Nakfa**	**Nakfa**
Pharmacy (sale of drugs)		627,639	
Treatment (all other patient fees)		308,674	
			936,313
EXPENDITURE			
	Cost Profile		
Salaries	47.4%	2,246,106	
Drugs and medical supplies	29.6%	1,405,155	
Electricity and water	7.5%	354,630	
Food Services	9.2%	438,000	
Other Indirect Costs	6.2%	295,860	
Total expenditure	**100.0%**		4,739,751
Net costs of running hospital			**(3,803,438)**
Percentage funded from user-fees			**20%**
Percentage of non-wage expenditure funded from user-fees			**38%**

Worksheet 1 – "Services"

The services' worksheet was used to collect data on service volumes and the usage of those services by different cost centers. The only adaptations to this worksheet from the basic template were in the number and names of cost centers and services; unwanted rows and columns are only hidden rather than deleted in order to preserve the links and formulae in other parts of the spreadsheet. The health management information systems in Eritrea were not well developed and some of the data on services was not readily available. The process of gathering this data served as an opportunity to highlight the areas that needed strengthening in the collection and reporting of hospital service data.

Figure A2. Eritrea Worksheet 1, Services

		Final Medical Services			Intermediate Medical Services						Logistics
	Beds	Inpatient discharges	Patient days	Outpatient visits	Laboratory services		Radiology		Emergency	Operating room	Transport
	Number	Number	Number	Number	Patients	Tests	Patients	Projections	Patients	Surgeries	Km
Administrative Services and Logistics											
General administration											
Transport											0
Building maintenance											
Kitchen											
Laundry and sewing											
Intermediate Medical Services											
Pharmacy											0
Laboratory											
Radiology											
Operating room											
Final Medical Services											
Outpatient general				26298	6336	7607	3157	3743		136	
Outpatient dental				1077							
Emergency (outpatient)				8523			315.7	374.3	10		
Physiotherapy (outpatient)				504							
Inpatient obstetrics/gynecology	30	1511	3580.7		453	543.4	0	0			0
Inpatient pediatrics	38	2723	8740.9		905	1087	315.7	374.3			0
Inpatient ophthalmic	30	657.5	4562.9		0	0	0	0			
Inpatient medicine	44	2141	13963		905	1087	315.7	374.3			0
Inpatient surgery	40	1263	15369		453	543.4	631.5	748.7	3	930	0
TOTAL	182	8296	46216	36402	9052	10867	4736	5615	13	1066	0

Table 2: "Staff Time"

This new worksheet was developed to record staff costs and allocate them to cost centers. The accounting systems in Eritrea hospitals do not have a cost center structure: costs are accounted for by "line item" without any reference to cost centers. Data to make the allocations were obtained from the Personnel Department (which provided a list of all staff and their designation and remuneration), the Matron (who provided work schedules for nursing staff), and the Medical Director (who provided work schedules for doctors). On the basis of the total basic salaries obtained from the Personnel Department for each cost center, the total (actual) expenditure on staff was allocated.

Worksheet 2: "Human Resource and Physical Plant"

This worksheet was used without any changes except to revise the names of the cost centers. Fixed assets' book values were not available and nominal ($1) amounts were entered in order to keep the formulae from returning a #DIV/0 error message. The hospitals do not keep records of the cost of fixed assets in their fixed asset registers; depreciation is not calculated in public institutions in Eritrea.

Table 3: "Drugs and Supplies Allocation"

The Eritrea hospitals do not keep detailed records of the distribution of drugs and medical supplies. It was necessary, therefore, to allocate the total cost of drugs and medical supplies to cost centers by studying a sample of issues from the pharmacy store. It was assumed that the number of drugs and other medical supplies issued from pharmacy stores was equivalent to consumption in the recipient cost centers. (There are no records of actual consumption in the cost centers, except for the outpatient pharmacy).

Figure A3. Eritrea Table 3. Drugs and Supplies Allocation

	Drugs & medical supplies Est. annual based on 30-day sample		
	Pharmaceuticals	Medical Supplies	Drugs & medical supplies
Cost Drivers	**30-day survey**	**30-day survey**	**Allocation of actual**
Administrative Services and Logistics			
General administration			-
Transport			
Building maintenance			
Kitchen			-
Security			-
Laundry and sewing			-
Intermediate Medical Services			-
Pharmacy			-
Laboratory		25,759	25,759
Radiology		91,229	91,229
Operating Room	93,025		94,104

Final Medical Services			
Outpatient general	617,100		512,599
Outpatient dental	54,488		45,261
Emergency (outpatient)	74,340		61,751
Physiotherapy (outpatient)			
Inpatient MCH	164,511		166,418
Inpatient pediatrics	104,454		105,665
Inpatient opthalmic	26,198		26,502
Inpatient medicine	124,020		125,458
Inpatient surgery	148,686		150,410
TOTAL	1,406,822	116,988	1,405,155

Worksheet 3: "Direct and Indirect Costs"

This worksheet was used without modification. This worksheet differs from the hospital's financial reports only in the amount of drugs and medical supplies; an adjustment was made to reflect goods received that had been recorded in the store but not in the accounting records. This is a common problem with the public accounting systems in Eritrea and has not yet been resolved.

Telephone costs were included in "other indirect costs" because there was no appropriate cost driver to use as an allocation base. The number of telephone sets, as used in the template, would have been misleading.

Figure A4. Eritrea Worksheet 3

	Salaries	Drugs & medical supplies	Total Direct Cost	Electricity and water	Gasoline and lubricants	Telephone services	Building maintenance	Food services	Other contracted services (Security, procurement...)	Stationeries	Other indirect costs	Total indirect costs	Total costs
Cost Drivers		**30-day survey**		**Floor space, m2**	**Transport, Km**	**Phone sets**	**Book value of buildings**	**Patient days**	**Direct costs**	**Staff, FTE**	**Direct costs**		
TOTAL	**2,246,106**	**1,405,155**	**3,651,261**	**354,630**	**104,880**	**21,560**	**75,260**	**438,000**	**59,520**	**17,600**	**17,040**	**1,088,490**	**4,739,751**
Admin. services and logistics													
General administration	219,567	-	**219,567**	40,919	37,457	5,390	8,684	-	3,579	2,029	1,025	**99,083**	**318,650**
Transport	31,180	-	**31,180**	-	-	-	-	-	508	274	146	**927**	**32,108**
Building maintenance	122,296	-	**122,296**	-	-	-	-	-	1,994	3,556	571	**6,121**	**128,417**
Kitchen	73,943	-	**73,944**	-	-	-	-	-	1,205	1,277	345	**2,827**	**76,771**
Laundry and sewing	67,557	-	**67,557**	-	-	-	-	-	1,101	1,185	315	**2,602**	**70,159**

Intermediate Medical Services								-				**-**	**-**
Pharmacy	28,455	-	**28,455**	40,919	37,457	1,348	8,684	-	464	182	133	**89,186**	**117,641**
Laboratory	96,982	25,759	**122,741**	13,640	-	1,348	2,895	-	2,001	456	573	**20,911**	**143,652**
Radiology	50,743	91,229	**141,972**	13,640	-	1,348	2,895	-	2,314	274	663	**21,132**	**163,104**
Operating room	318,136	94,104	**412,240**	40,919	-	-	8,684	-	6,720	1,819	1,924	**60,066**	**472,306**
Final Medical Services		-						-				**-**	**-**
Outpatient general	150,919	512,599	**663,518**	13,640	-	1,348	2,895	-	10,816	287	3,097	**32,082**	**695,600**
Outpatient dental	53,104	45,261	**98,365**	27,279	-	1,348	5,789	-	1,603	274	459	**36,752**	**135,117**
Emergency (outpatient)	100,368	61,751	**162,119**	13,640	-	1,348	2,895	-	2,643	730	757	**22,011**	**184,130**
Physio-therapy	50,743	-	**50,743**	13,640	-	1,348	2,895	-	827	274	237	**19,219**	**69,962**
Inpatient Obs/Gynae	206,332	166,418	**372,750**	27,279	7,491	1,348	5,789	33,934	6,076	1,154	1,740	**84,811**	**457,561**
Inpatient pediatrics	159,068	105,665	**264,732**	27,279	7,491	1,348	5,789	82,839	4,315	912	1,235	**131,209**	**395,941**
Inpatient opthalmic	142,675	26,502	**169,177**	27,279	7,491	1,348	5,789	43,243	2,758	748	790	**89,445**	**258,622**
Inpatient medicine	179,141	125,458	**304,600**	27,279	7,491	1,348	5,789	132,325	4,965	1,003	1,422	**181,623**	**486,223**
Inpatient surgery	194,896	150,410	**345,306**	27,279	-	1,348	5,789	145,658	5,629	1,076	1,612	**188,391**	**533,697**
TOTAL	2,246,106	1,405,155	**3,651,261**	354,630	104,880	21,560	75,260	438,000	59,520	17,600	17,040	1,088,490	4,739,751
Discrepancy	-	-	0	0	0	-	0	-	0	-	-	-	0

Worksheets 4-10: "Step-down allocation of costs"

The step-down cost allocations were performed with little modification to the MASH templates. The following tables summarize the results of the analysis for the three hospitals. Table 4 gives an overview of the key data for each hospital for purposes of interpreting the cost results and Table 5 shows a summary of costs per unit.

Figure A5. Eritrea Table 4, Key Data for Hospitals

Hospital Name	M/Hiwet Ped. Hosp.	Keren Hospital	Dekemhare Hospital
Level	**Referral**	**Regional**	**Community**
	Nakfa (Annual) 2001	**Nakfa (Annual) 2002**	**Nakfa (9 months) 2002**
REVENUE (user-fees)	1,133,432	936,313	317,073
EXPENDITURE	6,237,737	4,739,751	2,252,545
Net funding from Ministry of Finance	(5,104,305)	(3,803,438)	(1,935,472)
Overall cost recovery	18%	20%	14%
Cost recovery non-wage expenditure	32%	38%	27%
Hospital Workload			
No. of beds	191	182	60
Occupied bed days	54788	46216	6122
Bed occupancy	79%	70%	37%
No. of outpatient visits	26487	36402	16337
Hospital Staffing			
No. of doctors	11	12	4
No. of nurses	74	81	34
Other staff	99	100	52

Figure A6. Eritrea Table 5, Summary of Costs per Unit

	Mekane Hiwet Pediatric Hospital			**Keren Hospital**			**Dekemhare Hospital**		
	National referral			**Regional**			**Community**		
	Fixed	**Var.**	**Total**	**Fixed**	**Var.**	**Total**	**Fixed**	**Var.**	**Total**
SERVICE									
Outpatient	19.6	27.0	46.5	24.8	19.7	44.6	34.5	37.0	71.5
Inpatient	44.2	47.1	91.3	43.0	24.4	67.4	50.4	126.6	177.0

Uses of the cost analysis results

The cost analysis of the three hospitals provided useful insights to both the Ministry of Health and to the Hospital Management Teams in areas of budgeting and planning, cost control and efficiency, and training.

The Ministry of Health is particularly interested in the results of these cost analyses because it is preparing for decentralization of some level of decision-making authority to the hospital level. The application of MASH has given them a more accurate picture of what it costs, at current levels of

quality, to provide hospital-based care, information that will feed into the planning of resource allocations to hospitals.

A comparison of unit costs in the three hospitals has also led to discussions within the Ministry of ways to improve the efficiency of hospitals. This is an important goal with implications for overall financing of health care in the country since it can lead to a freeing of resources for much needed primary health care.

The process of analyzing costs by department gave Hospital Management Teams a good idea about how their hospital is organized from a cost point of view. They have already used the results to prepare better hospital budgets and recognize its potential value in negotiating more reasonable budget allocations with the Ministry of Health and the Ministry of Finance. Information on unit costs in each area of the hospital has provoked discussion about the possibility of producing services for less cost without compromising unduly on quality. Hospital training courses on financial management have used the results of cost analysis to show how better use could be made of this information to deliver services more efficiently. The next step for hospitals is to consider placing responsibility for costs and revenues on the managers of each cost center, a strategy that is likely to lead to improvements in efficiency.

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