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TRIP REPORT

Costs and Effectiveness of Immunization Services in Moldova

Phase I: Preparation

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COSTS AND EFFECTIVENESS OF IMMUNIZATION SERVICES IN MOLDOVA

PHASE I: PREPARATION

24 January - 10 February, 1995

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GLOSSARY

Amb	Ambulatorio: Ambulatory Care Clinic (same as SVA)
BASICS	Basic Support for Institutionalizing Child Survival
BCG	Anti-TB vaccine
Cohort	Group of children with the same particular attribute.
CF	Railway SES (in Moldovan)
CIE	Centrul de Igiena si Epidemiologie (same as SES)
CRIE	Centrul Republican de Igiena si Epidemiologie (same as RSES)
CRS	Congenital Rubella Syndrome
Di	Diphtheria vaccine; not available from UNICEF
DPT or DTP	Diphtheria, Pertussis and Tetanus vaccine
DT	Diphtheria and Tetanus vaccine
DT-M	Russian description of Td: modified Diphtheria (reduced component) and Tetanus vaccine
EPI	Expanded Program on Immunization
EURO	WHO's Regional Office for Europe (in Copenhagen)
FAP	Feldsher and Patronage Nurse Station (same as PM)
FIC	Fully Immunized Child
Freeze Watch	A heat sensitive indicator which indicates temperatures below -4°C.
HepB	Hepatitis B vaccine
MMR	Mumps measles and rubella vaccine
NBC	Newborn Children
OPV	Oral Polio vaccine
Peri-urban	PMs or FAPs in the area around the raion which are supplied directly by the Raion SES, not by an SC or an Amb (cluster headquarters)
Policlinic	The largest out-patient facility
Primary doses	All immunizations given before the first dose for revaccination (booster dose)
Poli	Abbreviation for Policlinic
PIS	WHO/UNICEF Product Information Sheets
PM	Punct Medical (same as FAP): the smallest health facility staffed by a male paramedic and an obstetric nurse responsible for domicillary services. Some only have a Feldsher.
Raion	An administrative sub-division, equivalent to a District.
RSES	Republican Sanitary and Epidemiological Station (same as CRIE)
SC	Spital de Circumscriptie: rural hospital at sub-district level (same as SUB)
SES	Sanitary and Epidemiological Station (same as CIE) (the Public Health Headquarters)
SUB	Rural hospital at sub district level (same as SC)
SVA	Ambulatory Care Clinic (same as Amb)
TB	Tuberculosis
Td	Diphtheria (reduced component) and Tetanus vaccine
TT	Tetanus toxoid

GLOSSARY (continued)

UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

SUMMARY

Moldova's Plan of Operation for immunization services, developed with the Ministry of Health during November and December 1993, specified that a study of the costs of immunization services would be carried out. The purpose of this preliminary visit (24th January to 7th February 1995) was to make preparations for that study, and to identify suitable indicators of the quality of services. The work was carried out under the BASICS Project's Technical Directive Number MD 00 013. The visit overlapped with that of Anthony Battersby, on progress with implementing the Plan of Operation. This report should be read in conjunction with his report.

The planned study will compare cost-effectiveness at the level of facilities (micro-level) and raions or administrative areas (mid-level), so the main activity was to find out about the data that are available on EPI resources and on the level of outputs. It was important to establish the levels at which data could be obtained, the formats of records and reports, and completeness and uniformity of record keeping. We found that some essential data that could be obtained during field visits (e.g., number of under-1s in a facility's catchment area; children who have completed all scheduled immunizations on time) are not available at the central level. For other data there are no standard formats and procedures (e.g., stock management). The proposed approach is to base the cost estimates and output indicators on an operational assessment, which will also generate management indicators, such as number of children seen per session, session frequency, consumption of vaccine and syringes, and late doses. By comparing the best scenarios (high output at low cost) with the least desirable combination (low output at high cost), it is anticipated that the study's findings will provide examples of feasible ways to make the program more efficient and effective.

The study will also provide indicators of the quality of services such as vaccine handling, stock management, status of cold chain equipment, and technique for administering doses. In addition to the current diphtheria epidemic there were 3,400 cases of measles among children under 14 years old last year, so the study should link levels of output and the indirect measures of quality with the data on morbidity.

During the visit, staff at the Republican SES were finalizing the annual order for vaccines, for which the Government of Japan has provided $500,000 in 1995. Two estimates for 1995's vaccine requirements had already been prepared, but both were based on standard wastage rates. However, the information on the size of eligible populations collected during our field visits showed that a substantial proportion of facilities can expect to register no more than two newborns per month. The percentage of eligibles in such small catchment areas was 17% in Calarasi Raion, and 31% in Orhei Raion. These data indicate that for some antigens (especially Measles vaccine) wastage must be much higher than the standard rates, use of which would produce inadequate quantities of vaccine. Health staff said that they do not have enough vaccine, and have reported stock-outs to the Ministry of Health.

Two sets of wastage multipliers were prepared for Moldova, one based on the present frequency of sessions, and one assuming that small facilities would limit their sessions to one per month. In anticipation of WHO's new guidelines for the use of opened vials of toxoids, OPV and Hepatitis B vaccine (released on 22nd February 1995), the calculations assumed that opened

vials could not be kept for more than a few days. This assumption takes account of the frequent interruptions in the power supply and the state of cold chain equipment below the raion level. Analysis of the equipment inventories from a sample of raions showed that up to 39% of facilities have no working refrigerator.

The gross vaccine requirement for 1995 was revised to take account of the campaign to combat the diphtheria epidemic. The most economical trade-off between single dose and multidose vials for HepB and Measles vaccine was identified using updated prices from UNICEF Copenhagen; this saved an estimated $108,600. The final adjustment was to subtract existing stock to obtain a net quantity. The final estimates were faxed to the Republican SES on 10th February (see Appendix E).

Conclusions from this task are that vaccine wastage multipliers should always be based on local circumstances. Switching from single and two-dose to multidose vials calls for major adjustments in operating procedures. With a cold chain of uncertain quality, the frequency of sessions must be managed to bring vaccine consumption within affordable limits. The Republican SES has asked that the cost study look at alternative strategies for providing services to small groups of eligibles (e.g., outreach with cold boxes).

It is recommended that the Republican SES should prepare new guidelines for vaccine handling based on WHO's February policy statement. These should be used during in-service training, which should also cover procedures for requesting vaccine (taking vial size and session size into account) so that health workers know the constraints within which they must now work while handling the vaccine properly (i.e., no prefilled syringes). Technical assistance may be needed with the preparation of this training.

The method for estimating the annual vaccine requirement should be formalized and put into a spreadsheet for use by the EPI Unit. The assumptions upon which it is based need to be monitored and updated in light of experience. Health workers must understand, accept and abide by these assumptions at micro and macro levels.

Further technical assistance to unravel the epidemiology of the diphtheria outbreak should be provided, including colleagues from Romania, which has no cases of this disease. Explanations are also needed for the reported cases of other diseases which should be prevented by immunization.

The next visit for the cost study should be planned for June/July, depending on the availability of counterparts from the EPI Unit. Before then, the team of BASICS consultants providing technical assistance in Moldova should meet to share their findings in more detail and to coordinate their future work.

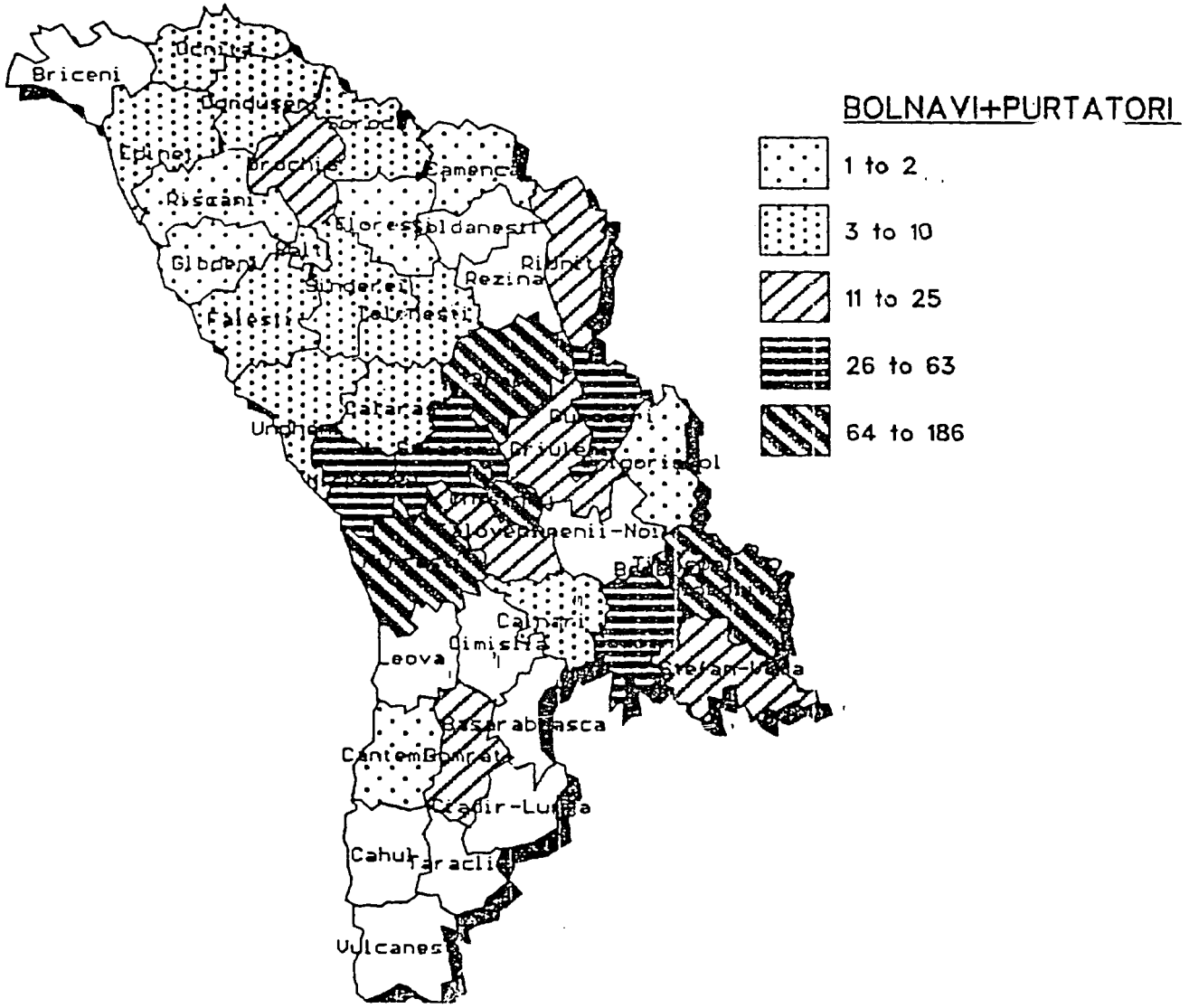
Figure 1

Map of Moldova showing Political and Administrative Boundaries

BOLNAVI SI PURTATORI DE DIFTERIE

CAZURI ABSOLUTE

MOLDOVA 1994



Costs and Effectiveness of Immunization Services in Moldova

Phase 1 - Preparation

January-February 1995

1. Purpose of Visit

The Plan of Operation for immunization services which was developed with the Ministry of Health during November and December 1993 specified that a cost study would be carried out (Battersby and Ion-Nedelcu, 1994). The purpose of this trip (January 24 to February 7, 1995) was to make preparations for a baseline study of the costs of immunization services in Moldova, and to identify suitable indicators of the quality of these services. The work was carried out under the BASICS Project's Technical Directive Number MD 00 013, and the visit overlapped with that of Anthony Battersby, on progress with implementing the Plan of Operation. This report should be read in conjunction with his report (Battersby, 1995).

2. Background

Moldova continues to experience rapid changes in its population and economy which are affecting the immunization program. Due to emigration and falling birth rates, the cohort of infants eligible for immunization is now only two-thirds as large as the level in 1987. Preliminary data indicate that in 1994 there were 59,754 under-1s. There has also been a substantial movement out of urban areas into the countryside. Comparing data for 1992 with 1994 indicates that the proportions of urban and rural have changed from 40% urban, 60% rural to 30%:70% in a sample of eight raions (administrative areas).

Further changes in catchment populations have occurred in the raions bordering those which chose to separate from the rest of Moldova in 1992. The facilities which were within the administrative boundaries of raions in Transdnistria but which were located on the right (south-west) bank of the River Dnister have been reallocated to raions on the right bank (see Figure 1). For example, in Orhei and Criuleni Raions the list of facilities and the eligible populations are not comparable with earlier years.

The separation of the "Left Bank" involved a costly war and the loss of Moldova's industries. The country is still recovering from the economic effects of this action. The health budget for 1995 was cut by 40% from the level allocated in 1994. The response of the implementing authorities to such deep budget cuts has been to defer all capital development projects for the time being, and to try to identify where improvements in efficiency could save resources. For example, the Republican SES (Hygiene and Epidemiology Center) is considering closing an underutilized maternity hospital in Chisinau.

Since October 1993, the Ministry of Health has received technical assistance from WHO and USAID in streamlining the immunization schedule, reducing the standard list of contraindications for immunizing a child, and planning operations within the new conditions. Cold chain equipment has been supplied and installed at the Republican SES as well as all raion vaccine stores and some facilities. Also, stock control software (CLM) has been demonstrated (Spanner, 1994). Vaccine and supplies were donated by USAID and the Government of Japan in

1993-1994, and most of the vaccine requirement for 1995 will be covered by a further donation of $500,000 from the Government of Japan. Assistance for vaccine procurement has also been provided (Woodle, 1994). In addition, representatives from Moldova's Ministry of Health have attended a series of conferences organized by WHO and UNICEF to develop a regional strategy for combating the diphtheria epidemic in the Commonwealth of Independent States. They have also attended the conference for Operation MECACAR (mass EPI campaigns in the Mediterranean, Caucasus and Central Asian Republics).

In these rapidly changing circumstances, it is crucial to choose a sensitive methodology for analyzing costs and effectiveness of immunization activities.

3. Findings

3.1 Administrative Structures for Immunization Activities

Preventive medicine is the responsibility of the Republican SES, which receives its own budget. The role of the Republican SES includes monitoring immunization coverage, following up on disease surveillance reports, and formulating policies (such as the immunization schedule and contraindications) with the relevant departments in the Ministry of Health. Since 1993 this role has expanded to include international vaccine procurement, management of the national vaccine store, and control of the quantities of supplies issued to raions.

Implementation of immunization services is the responsibility of the municipalities and raions, which receive budget allocations through local government financing mechanisms. This means that health is competing with education, roads and other sectors for the local budget. It also means that the Republican SES, which is responsible for technical supervision, has no control over financial decisions taken at the level of the raion. This arrangement suggests that the cost analysis should expect to encounter variations between raions in the resources used for immunization. A list of the municipalities and raions in Moldova (including the Left Bank and the "railway SES") is shown in Table 1, with the number of under-1s in 1994 (provisional data).

Within a raion, health facilities providing immunization are as follows:

Maternity (a hospital or a department within a hospital)

Policlinic or children's dispensary (in cities or at raion headquarters)

Local hospital (Spital de Circumscriptie=SC, or SUB in Russian)

Ambulatory clinic (Ambulatorio=Amb, or SVA in Russian)

Health post (Punct Medical=PM, or FAP in Russian)

Table 1: Cities and Raions in Moldova, showing Children Under 1 in 1994

Municipalities and Raions	Notes	Under-1s in 1994[a]	Mater-nities	Poli-clinic[b]	SCs, SUBs	Ambs, SVAs	PMs, FAPs
Chisinau	M	7,802	4	8	0	5	12
Balti	M	1,552	1	2	0	0	0
Bender	M	1,300	1	6	0	0	0
Tiraspol	M	2,125	1	4	0	0	0
Raions							
Anenii-Noi		1,138	1	1	8	4	24
Basarabeasca		628	1	1	3	3	5
Briceni		1,024	1	1	2	7	24
Cahul	C, √	1,217	1	1	5	2	23
Camenca		319	1	1	5	4	27
Cantemir		1,087	1	1	3	2	40
Cainari		793	1	1	3	4	23
Calarasi	√	1,367	1	1	6	4	29
Causeni		1,064	1	1	4	8	10
Ciadir-Lunga	√	1,040	1	1	4	3	2
Cimislia		1,062	1	1	2	4	25
Comrat		1,186	1	1	3	1	11
Cnuleni		1,486	1	1	5	8	31
Donduseni	√	866	1	1	4	9	24
Drochia	√	1,167	1	1	5	6	19
Dubasari	C	806	1	1	4	5	17
Edinet	√	1,110	1	1	9	4	28
Falesti		1,396	1	1	5	7	47
Floresti		1,545	1	1	6	3	39
Glodeni		1,026	1	1	5	3	21
Grigoriopol		719	1	1	4	5	15
Hincesti		2,044	1	1	7	8	31
Ialoveni		1,408	1	1	4	7	14
Leova		955	1	1	2	3	27
Nisporeni		1,271	1	1	7	4	26
Ocnita		639	1	1	3	4	23
Orhei	C, √	2,002	1	1	11	6	49
Rezina		901	1	1	4	2	28
Ribnita	C	1,292	1	1	3	5	24
Riscani	√	1,173	1	1	8	4	33
Singerei		1,614	1	1	5	7	42
Slobozia		1,600	1	1	4	8	7
Soroca	C	1,320	1	1	7	5	37
Straseni		1,457	1	1	8	4	20
Soldanesti		737	1	1	3	4	21
Stefan-Voda		1,320	1	1	5	6	16
Teraclia	√	739	1	1	5	0	20
Telenesti		1,364	1	1	7	2	36
Ungheni	C	1,760	1	1	9	7	55
Vulcanesti	√	884	1	1	4	1	13
Railway SES[c]		429	?	?	?	?	?
TOTAL		59,754	47	60	201	188	1,018

Sources: Under-1s is from *Numarul de copii si adolescenti aflati la evidenta in institutiile curativ-profilactice pe an. 1994 Formularul 6 Tabelul 1.* Republican SES (provisional data).
Number of facilities is from Battersby (1994), Table 10 and updated if marked √.

Notes: M=municipality;
C=Raion including a city population, sometimes reported as a separate entity;
√=data for facilities was updated in February 1995.

a Provisional data.
b Policlinic or Children's Dispensary.
c CIE a CF.

The PMs are organized into clusters around an SC or an Amb. In the lists of facilities prepared by the Raion SES, the cluster population is shown as well as the population of each facility. The main facility in each cluster is responsible for supplying vaccine and EPI syringes to the PMs, and its pediatricians travel to the PMs to screen eligible children before immunizations can be administered. PMs in villages around the raion's main town fall into a special category which can be described as peri-urban. They are listed separately by some raions but they are supplied directly from the Raion SES. Table 2 shows data for Orhei Raion, which has 17 rural clusters. They have been arranged by type of facility (SC or Amb) at the cluster headquarters, with the largest clusters listed first within each group.

Table 2: Clusters in Orhei Raion, showing Under-1s at the Main Facility and in the Puncts Medical Supplied by each Cluster HQ

Cluster	Type of cluster	Number of under-1s: in HQ	Number of under-1s: in PMs	% of <1s in PMs	No. of PMs	Under-1s per PM
Dispens. de Copii	Poli	451	451		? sectors	
around Orhei	Peri-urban	101	0	18%	6	17
Susleni	SC	175	74	58%	5	20
Chiperceni	SC	162	41	75%	7	17
Peresecina	SC	142	142	0%	0	
Isacova	SC	135	28	79%	4	27
Morozeni	SC	121	18	85%	7	15
Fora de Fos	SC	77	49	36%	2	14
Molovata TD	SC	70	54	23%	1	16
Piatra	SC	68	43	37%	1	25
Ciocilteni	SC	67	27	60%	2	20
Cucuruzeni	SC	56	27	52%	4	7
Ghetlova	SC	34	20	41%	1	14
Pelivan	Amb	105	37	65%	2	34
Telesau	Amb	59	18	69%	3	14
Bulaesti	Amb	59	41	31%	2	9
Oxintea TD	Amb	53	53	0%	0	
Braviceni	Amb	47	32	32%	2	8
Podgoreni	Amb	20	20	0%	0	
Casa internat	Casa					

SCs are generally in bigger towns than Ambs, and PMs are in the smallest communities. However, Table 2 illustrates that no assumptions can be made about the relative sizes of eligible populations. For example, the size of clusters around SCs varies by a factor of six (compare Susleni with Ghetlova), and the number of PMs within each cluster varies between zero and seven. Due to population movements over time, some cluster headquarters are smaller than their largest PMs. The average number of under-1s per PM varies between seven (Cucuruzeni cluster) and 34 (Pelivan cluster, centered on an Amb). The size of eligible populations is discussed in more detail in Section 3.4.2.

Preventive medicine, based in the Centers of Hygiene and Epidemiology (SESs), is separated from curative medicine at the national and local level. For example, although there were almost 5,000 cases of rubella last year, the SESs never reported any cases of congenital rubella syndrome (which is on their reporting form) because the epidemiologists' remit does not extend to reporting on cases from the maternity hospital. However, in order to provide immunization services, the SESs work through the hospital sector. The first doses of Hepatitis B vaccine and BCG are administered in maternity hospitals.

Supplies for preventive services come through the SES, whereas curative supplies come via the hospital. This means that EPI syringes and vaccine have a parallel distribution system. Yet when staff are asked what happens when they run short of syringes for immunization, they say that they obtain these items from the hospital (curative sector).

The administrative arrangements for procuring, requisitioning, and distributing vaccine have altered fundamentally in the last two years. Since the Russian sources of supply became unreliable, Moldovafarm, the parastatal procurement and distribution agency, is no longer the main supplier of vaccine. First, Moldovafarm has no expertise in international procurement. Second, it charges a fee of 50% of the value of the product it supplies. In 1994 the Republican SES purchased vaccine for the first time, using the World Bank loan, but this source of funding is intended for investment projects and will not be used for consumables in the future.

These changes have three major implications:

(a) Vaccine is now an expensive component of the immunization program, and it must be procured from international sources and paid for in hard currency;

(b) The Republican SES now manages the national vaccine store and distributes vaccine according to availability and need;

(c) Most antigens from international sources are only available in multidose presentations. Even allowing for keeping opened vials of toxoids, OPV, and Hepatitis B as allowed in the new WHO guidelines (see Appendix D), the session sizes found in Moldova will still entail very high wastage rates. This issue is discussed further in Section 3.4.4 and Section 5.1.

Health facilities are supplied by their local Raion SESs, either directly or through their cluster headquarters. In the past, with single dose and two-dose vials, wastage was low, vaccine was cheap, and estimates of vaccine requirements were made independently of any cost considerations. Even at the smallest facilities, immunization sessions were offered every two weeks. This practice has not changed in spite of the different circumstances introduced by multidose vials and relatively expensive vaccine. The need to offer immunization every two

weeks is perpetuated in the immunization schedule, in which the interval for DPT2 and DPT3 is six weeks (not one month).

Now the system is genuinely short of vaccine (see Section 5.1). Some health facilities complain that they have run out of vaccine. Others have tried to avoid this predicament by taking extraordinary measures to ensure that their limited allocation of vials is utilized to the full. For example, we were told that a cluster headquarters is holding all immunization sessions on the same day throughout the cluster, and prefilling syringes for the PMs which it supplies with the antigens required during each PM's session. The staff from the PMs collect the prefilled syringes and transport them in vaccine carriers as quickly as possible back to their own facility. Other rules for correct handling of vaccine were being rigorously observed. For example, the staff were clear on the fact that reconstituted vaccines had to be used within strict time limits. A notable side-effect of this strategy is that the pediatrician, who has to screen eligibles for contraindications, cannot possibly be present in every PM on immunization day. Therefore, the screening is being done up to eight days before the session. The diagnosis for temporary contra-indications is likely to be out of date by the day of the session. Thus the cluster's strategy to extend the availability of vaccine appears to be reducing the availability of safe, effective immunizations.

The Raion SES had already advised the SC staff not to pursue this strategy of prefilling syringes, and we suggested reducing the frequency of sessions to gather more eligibles to each session and reduce vaccine wastage in that way. However, the pediatricians resist any perceived reduction in services. Their primary interest seems to be curative medicine and their decisions take precedence over those of the nurse at facility level. Thus the administrative structures involve a discontinuity between the SESs' objectives for immunization activities and the decisions of staff with responsibility for the curative elements of the health service.

The trade-offs between frequency of sessions, level of contraindications, and coming to terms with multidose vials as a binding constraint were discussed with staff from all levels of the health service. Some adjustments have been made. For example, hepatitis B vaccine is recognized as being expensive so it is offered less frequently, producing larger session sizes to minimize wastage. Many staff in the preventive health service are well aware of the need to adjust working practices in the delivery of immunization services. However, they can only implement changes through the staff at health facilities, who are also supervised from the curative sector. Any initiatives to introduce improvements in cost-effectiveness must be accepted by the curative staff if they are to succeed.

3.2 Level of Resource Allocation

The state of Moldova's economy has forced the Government to limit its spending until the benefits of the economic reform program (begun in 1993) are felt. Some observers expect that public sector finances will be subject to tight constraints until 1998. The health budget for 1995 is 315 million Lei, a reduction of 40% from the level allocated in 1994. For 1995 this represents annual expenditure of $16 per capita. The response of the implementing authorities to such deep

budget cuts has been to defer all capital development projects, cut maintenance expenditure, and identify underutilized facilities which could be closed.

The budget cuts have affected the immunization program in several ways. Discussing funds for vaccine procurement, Woodle wrote in March 1994: "The SES finds that getting money from the Government to purchase vaccines is their biggest problem." The crisis has been solved by a mixture of donations, loans and procurement from Russia, but funding for 1996 and 1997 will still have to be obtained. Staff morale is adversely affected by late payment of salaries, of which the real value is falling. This makes it more difficult to introduce changes which would improve efficiency and effectiveness if these require changes in health workers' operating procedures. If alternative strategies would require additional consumable resources (e.g., fuel or fares), it may prove impossible to implement them until the necessary funding becomes available. It should be emphasized that funding for such expenditure at the level of the health facility must be allocated from the local government (raion) budget.

During one of the field trips we discussed the processes by which the raion officials decide how much should be allocated to different sectors. The SES epidemiologist had asked the local officials to explain how the level of allocation to preventive medicine was determined, but had been unable to obtain an explanation. The analysis of costs and effectiveness of the immunization program may contribute to discussions of this type, especially if the costs of treating illness from preventable diseases are included.

3.3 Sources of Data for Analyzing Costs

Resources used to provide immunization services are usually described in the categories shown in Table 3, which is divided into recurrent costs and capital costs.

Table 3: Components of EPI Costs

Recurrent or Operating Costs		Capital Costs	
Personnel		Buildings	
Materials and supplies:	vaccine needles syringes stationery cotton wool	Equipment:	refrigerators freezers cold boxes vaccine carriers steam sterilizers
Transportation (fuel, fares)		Vehicles	
Maintenance			
In-service training, workshops		Basic, start-up training	
Other		Other	

The share of costs consumed by these categories is influenced by many variables, including the chosen strategies for providing immunization, the schedule, the frequency of services, and the number of eligibles per session. Thus any cost analysis must gather information about the way in which immunization services are provided, to ascertain the quantities of resources used in achieving the reported levels of activity or coverage.

3.3.1 Staff

The share of time spent on immunization activities will be multiplied by the appropriate salary to calculate the cost of personnel. The general pattern of work in ambulatory facilities is that eligibles are notified by a personal invitation (house visit) when their next immunization will be due. Then the pediatrician screens the child to make sure that there are no contraindications. If none is identified, the child receives the relevant doses. The field visits indicate that the following patterns of work may be expected.

Table 4: Usual Frequency of Sessions by Type of Facility

Urban:	City policlinic	daily sessions
	Children's dispensary	two sessions per week
Rural:	SC or SUB	once or twice per week
	Amb or SVA	once or twice per week
	PM or FAP	once every two weeks

In urban areas the eligibles are assigned to sectors according to their place of residence. Each sector is cared for by a particular pediatrician who may arrange for all "their" children to come for immunizations on a particular day of the week. This practice is less efficient than having all eligible children invited for the same session. In rural areas pediatricians are based at the cluster headquarters (SC or Amb) and travel out to the PMs in order to screen the eligibles.

In addition, staff members spend time recording, reporting, disinfecting, and disassembling the used disposable syringes and repacking the plastic components for recycling. (See Battersby, 1995 for recommendations that this practice should be stopped immediately.) In the children's dispensary in Orhei city the nurse responsible for immunization invited the eligibles on Mondays and Tuesdays, ran sessions on Wednesdays and Thursdays, and spent Fridays working on the reports and rearranging Form 63 in the pigeon-hole filing system (based on when each child was due for its next visit).

3.3.2 Vaccine

The number of doses of each antigen which every eligible person should receive is indicated by the immunization schedule, which was revised in 1994 and circulated in Order Number 100. The schedule is now as shown in Table 5.

The Republican SES works on the assumption that about 5% of eligible children will be contraindicated for Pertussis vaccine. Instead of Diphtheria, Pertussis, and Tetanus vaccine (DPT), these children will be given two doses of Diphtheria and Tetanus vaccine (DT), plus a booster of DT at 22-24 months.

Table 5: The Immunization Schedule

0-24 hours	hepB. 1					
4-7 days		BCG				
1 month	hepB. 2					
3 months			DPT 1	OPV 1		
4.5 months			DPT 2	OPV 2		
6 months	hepB. 3		DPT 3	OPV 3		
12 months					measles	
22-24 months			DPT 4	OPV 4		
6-7 years		BCG		OPV 5		Td
14-15 years						Td
20-40 years				every 5 years		Td
>40 years				every 10 years		Td
Total doses	3	2	4	5	1	10

The analysis of vaccine costs must be based on quantities of vaccine actually consumed (rather than on calculations based on coverage), for three main reasons. First, in any immunization program there is the possibility of losses in transit or in storage due to cold chain failures. Second, if multidose vials are used there will be unavoidable wastage, which will vary widely between facilities with large sessions and those with small sessions. Third, a comparison of actual vaccine consumption in different clusters and different raions makes it possible to identify where resources could be used more effectively, using local experience. Some methodologies for estimating vaccine costs use coverage data, but that approach has been shown to produce serious underestimates of the costs to the program (Feilden, 1990). In this analysis we will use the more accurate approach of discovering the amount of vaccine actually used.

Stock records - showing receipts, issues, balances and losses in storage - can provide a source of information from which to estimate vaccine consumption. However, Moldova's immunization program does not yet have a system for recording stock receipts and issues at raion stores and facilities. For example, one storekeeper at a cluster headquarters showed us a careful record of all issues to PMs in his area, but the record was not in doses or vials but in liters (the convention used by the Russian Mechnikov Institute and Ufa in Moscow for toxoids). His record was also rather difficult to follow as it was not arranged in columns. There is no official format specifying the headings, layout and units for stock keeping, and the storekeeper was congratulated for using his initiative in obtaining a ledger (formatted for recording agricultural cargo) from the farm.

The first time that the Republican SES knew the balance in stock at all the raions was January 1, 1995. This information was essential in order to assess which raions were holding relatively generous safety stocks, and which were about to run out of vaccine. This provides a starting point for the cost study to trace stock movements and consumption at the level of the raion.

Two factors make vaccine consumption a central issue for the Moldovan immunization program. First, there are large numbers of facilities with tiny catchment populations (fewer than one newborn per month) where wastage from multidose vials must be very high if vaccine is handled

correctly. The distribution of eligibles is discussed in Section 3.4.2, and a study to find out how services can be rationalized is discussed in Battersby (1995). Second, the proportion of small facilities to large facilities varies widely between raions. So a standard formula for issuing vaccine according to population is totally inappropriate and will result in stock-outs (or mishandling) of vaccine at facilities with small populations of eligibles. The implications for Moldova's vaccine requirements are discussed in Section 5.1. We anticipate that a comparison of actual vaccine consumption between raions will highlight crucial aspects of the quality of services. These are discussed in Section 3.4.4.

3.3.3 Needles and Syringes

Since 1993, disposable syringes and autodestruct syringes have replaced the glass and metal sterilizable syringes in the immunization program. As with vaccine, it has not been standard practice for raions or facilities to keep stock records of the needles and syringes received and issued (or used). Analysis of the number of syringes that the Raion SES in Orhei was intending to issue in February and March 1995 shows that on average, the 25 clusters and facilities would receive enough stock to give them a two-month surplus. However, the amount of the surplus varied widely (see Appendix C). One peri-urban facility would receive enough syringes to give it six months' surplus, yet two places would not receive enough to cover their immunization activities in February and March. Reasons for these variations were not discussed during the field visit, but could include special campaign activities, or using data other than the number of eligibles to estimate syringe requirements, or use of EPI syringes for curative injections. Whatever the reason, these data suggest that no assumptions about standard formulae can be applied when estimating the quantity of syringes used. The implications for assessing quality of services are discussed in Section 3.4.6.

The assessment of Orhei Raion's plans for syringe distribution assumes that oral polio vaccine (OPV) will be administered using the plastic droppers supplied (free) with the vials or tubes of vaccine. However, staff at one cluster headquarters said that they administered OPV using a syringe. The dose was said to be 0.2 ml (the vials of OPV in use do not state the volume on the label). The procedure was not observed, so the accuracy of dosing could not be assessed. Staff from the Republican SES told me that the inserts with the Russian OPV advised that this vaccine could be administered using a syringe as a dropper. When we asked the facility staff about the plastic droppers, they said that they had not received any. This point needs to be followed up through all the levels of supply. The extent to which health workers (and storekeepers) consider syringes as an appropriate method of administering OPV should be assessed, and the cost should be identified.

Although each raion has been supplied with one "demonstration" steam sterilizer, these are not in use. Some staff say that they have used them and would use them (perhaps for campaigns or booster doses). A comparison of the costs of disposable syringes with reusable syringes will be included in the cost analysis.

3.3.4 Stationery

Immunization services are facing shortages of stationery, so invoices of expenditure will underestimate the resources needed. In addition, the information system lacks several elements which would make it easier to manage and monitor immunization activities. For example, there is no parent-held record, no stock record, and no monthly report showing all doses administered vaccine (vials) consumed and syringes used. On the other hand, Form 63 (or at smaller facilitie the ledger, or register, of eligibles) makes it possible to map the doses administered, the interval between doses, the rate of contraindicating, movement of the eligibles, and session frequency. The progress report on the Plan of Operation recommends that financial support should be provided to enable the Ministry of Health to print and distribute the necessary supplies of records, reporting formats, and other stationery (Batters by, 1995).

3.3.5 Transportation

Transport is needed for collecting or delivering supplies, and for pediatricians to reach the PMs in their cluster. Moldova does not use dedicated EPI vehicles, so it will be difficult to identify the share of transport costs which should be allocated to immunization. When asked, staff said that they used a car that was making the trip anyway, or that they found a lift. In the present circumstances of budgetary stringency the supervisors cannot be sure that they have enough fuel to visit rural clusters as often as they would wish. Data on the interval since the last (or last two supervisory visits would document this problem.

The issue of transportation for nurses when they visit eligibles, inviting them to come for immunization, also needs to be included in the cost study. Parents' transportation arrangements should also be addressed, as those whose children have temporary contraindications have to visi the facility at least twice before their child can receive the immunizations that are due.

3.3.6 Maintenance

(Colleagues in Romania say that their language has no word for "maintenance.")

This cost category covers the maintenance of buildings, equipment, and vehicles. In the budget codes, maintenance of buildings might be covered by item 3 (running expenses), and maintenance of equipment and vehicles might be covered by item 12 (purchases of equipment and inventory). This will need to be checked. During the current financial year, line item 12 has been cut in order to cover more essential expenditures from the reduced budget allocation.

The extent of the need for maintenance of cold chain equipment is indicated by the audit of equipment carried out as part of the Plan of Operations (see Section 3.3.9). In the sample of seven raions shown in Table 6, four have more than 10% of their refrigerators needing repair. In Drochia, 25% were reported to need repair.

The task of making the repairs is probably made more complicated by the large variety of refrigerators in use. In addition to the Vestfrost, Codru, and Iarna shown in Table 6, the following were listed in the inventories: Alit, Asperon, Cinar, Cristal, Dniepr, Fort, Ghiocel, Inei, Iuriuzani, Minsc, Morozca, Nega, Nistru, Oca, Ocean, Orsc, Pamir, Saratov, Smolensc, Snejinca, Sviaga, Vega. Some of these models are no longer manufactured (e.g., the Pamir, made in Tajikistan). Full analysis of the equipment audit will show which models are more likely to need repair or replacement, and it will indicate the magnitude of the problem of spare parts for the existing inventory of equipment.

3.3.7 Other Recurrent Costs

Utilities: There are three major considerations when estimating the resources consumed by electricity for running cold chain equipment and other fuel for disinfecting or sterilizing syringes and needles. First, it will be difficult to ascertain the fuel consumption of cold chain equipment because utility bills cover other uses (e.g., lighting, heat), so this cost will have to be estimated from kilowatts and the unit cost of electricity. Second, it will be important to establish the energy cost of providing 365 days per year of refrigeration, especially for facilities with tiny catchment populations. This will contribute to the discussion of making service delivery more cost-effective. Third, shortages of energy have made power cuts a regular occurrence. At one PM the health worker described a schedule of times when power was on and off throughout the day and night. In the absence of data from cold chain monitor cards (CCMs) or Freezewatch indicators, it is difficult to assess the effects upon the quality of vaccine stored in domestic refrigerators when the power supply is frequently interrupted for hours at a time.

In-Service Training: No information was collected on this category of expenditure. However refresher training or workshops will be required to reorient supervisors and health workers to developments in the strategies for providing immunization services.

3.3.8 Buildings

Norms based on population and distance govern the type and number of health facilities permitted. Within these norms a network of facilities has been established, making basic health services available even in small villages of 300 people. With falling birth rates, a surprising number of PMs now have fewer than one newborn per month (see Section 3.4.2). The buildings need to be staffed, equipped, heated in winter, supervised, and supplied. The decision to rationalize the provision and location of the most peripheral facilities is beyond the control of the Republican SES, but the cost study can contribute to the discussion of alternative strategies for providing preventive services to small and scattered populations.

3.3.9 Equipment

The Plan of Operation specified that the Republican SES would carry out a full audit of all immunization equipment (see EQPTAUD1 in Battersby and Ion-Nedelcu, 1994). Collection of data has been completed by most of the raions and the EPI Unit will soon begin the analysis. Selected data from seven raions are shown in Table 6.

Table 6: Refrigerators in Health Facilities

	Brand name of equipment				Total excluding SES	Facilities in which fridge needs repair	Facilities in need of fridge replace-ment	Facilities with no fridge
Raion	Vest-frost	Codru	Iarna	Other				
Cahul	2	13	4	12	31	2	1	0
Calarasi	6	11	8	11	36	4	1	2
Ciadir-Lunga	5	1		4	10	0	0	0
Donduseni		18	8	7	33	5	7	6
Drochia		8	10	10	28	7	0	2
Edinet		12	8	16	36	5	0	6
Riscani	7	33		6	46	2	0	0

The data reported by the raions illustrate several important points. Three of the seven have not reported any Vestfrost equipment at health facilities (Table 6 does not include the Raion SES store) yet the Republican SES has records that Vestfrost refrigerators for facilities have been distributed. The number of refrigerators varies widely between raions, due to differences in the number of facilities. Four of the seven raions reported that some of their facilities are not equipped with any refrigerator. Combining absence of any equipment with equipment that is broken beyond repair (needs to be replaced), the raions' experience varies from having no facilities in this state (Ciadir-Lunga and Riscani) to 39% (Donduseni). In this sample, only Ciadir-Lunga reported that all its facilities are equipped with working refrigerators which do not need any repairs. It may be no coincidence that Ciadir-Lunga also has by far the smallest number of facilities with equipment to maintain.

This data also indicates that the cost-effectiveness analysis must gather operational data on the strategies for providing immunization at facilities which have no refrigerator. Experience from these places may provide valuable examples of how services can be provided to small, scattered groups of eligibles without the expense of providing active refrigeration for 365 days per year. The findings will be used in the study of how health service provision can be rationalized (Battersby, 1995).

The inventories sent in by the raions listed individual facilities. Comparisons with other sources of data showed that the inventories should not be used as the definitive list of facilities. The best sources of this information are the lists held by the Raion SESs, which show the clusters and the number of under-1s per cluster and per facility.

3.3.10 Vehicles

No information was collected about vehicles. During field visits, staff in the raions said that one reason for not returning used disposable syringes to Medtechnica (see Section 3.4.6) was expense. The syringes are so bulky that they could not be fitted into the vehicle that might be going to Chisinau for other reasons, and a special vehicle had to be used. The immunization

services' share of the annual amortized cost of vehicles will be estimated, with particular reference to collection and delivery of supplies, supervisory visits, and the pediatricians' outreach visits to PMs.

3.4 Sources of Data for Effectiveness and Quality

The usual approach taken in studies of costs and effectiveness is to choose an indicator of output which incorporates some elements of quality. This indicator has frequently been the fully immunized child. The preventive health service in Moldova reports very high immunization coverage and at the same time is reporting morbidity from diseases which should be prevented by immunization. Therefore, this study needs to incorporate indicators which will reflect the quality of services in order to accurately identify the conditions and practices leading to truly effective, low cost, high quality immunization.

3.4.1 Fully Immunized, On Time

In Moldova, immunization coverage is calculated in a different way from that used for cost-effectiveness analysis. The reports at the end of each year (e.g., in Form 6) show the immunization status of children according to their age at the end of that calendar year (December 31). Thus if a child was born in August 1993 and received its third dose of DPT in March 1994 (at seven months of age), this dose is counted in the cohort of children aged 12-23 months (i.e., they were at least one year old but under two) on December 31, 1994. This method produces lower coverage figures than the method employed for WHO's coverage surveys, which is based on the child's age when it received a particular dose. Thus WHO's methodology measures the percentage of children who were within a specified age range (e.g., under one, or under 18 months) when they completed the relevant portion of the immunization schedule.

The information system's Form 6 shows the number of children who have completed the primary series (e.g., third dose for DPT and OPV) in each cohort. But when children receive a booster dose they are subtracted from the column which indicates completion of the primary series, and added to the booster column. In the 1994 data this occurs four times for BCG, although the schedule has now been revised. Table 7 shows selected data for 1994 to illustrate this approach to reporting the number of immunizations.

The WHO definition of a fully immunized child is one who has received all the doses specified in the immunization schedule. This information is not reported in Moldova. To be fully immunized on time, the specified doses must be received before the child reaches a stated age (e.g., 12 months, 15 months or 18 months, depending on the schedule). As shown in Table 4 of Battersby and Ion-Nedelcu's report (1994), the information is available in Form 63 at policlinics and children's dispensaries, and in the child registers at SCs, Ambs and PMs, but it takes some time to extract it. These sources also indicate the frequency of contraindicating by the pediatrician; children who are assessed as being sensitive to Pertussis vaccine are given DT, and our field visits indicate that contraindicating for this reason varies widely between clusters.

Table 7: Preliminary Coverage Data for 1994, from Form 6, showing Completed Primary Immunization and Booster Doses

Age in compl-eted years	Eligible children	Diphtheria (and Tetanus)			Pertussis 3 doses + B 1	OBV		Measles
		DT 3	+B 1	+B 2		OBV. 3	+any Bs[a]	1+B[b]
0	59,754	19,825			19,188	20,270		0
1	63,655	56,869	1,915		54,573	57,022	2,957	53,791
2	67,132	30,411	35,461		57,916	17,474	47,958	63,698
3	68,449	5,016	62,637		63,083	2,761	63,482	67,036
4	73,062	1,762	70,747		67,847	892	71,773	71,677
5	76,764	766	75,586			311	74,741	74,785
6	81,605	459	67,379	13456		152	81,454	80,386
7	86,061	279	12,729	72691		63	85,595	84.550

a For OPV the first booster (to children aged 12-23 months) is followed by a second booster, usually at age 6-7 but a small number of children received it earlier(1% during third year, 5% during fourth year and 5% during fifth year). In Table 7 these have all been rolled into one number which indicates children who received their three primary doses of OPV and at least one booster.

b The schedule for Measles is one dose but a booster dose ("revaccinati") is reported on Form 6 for children aged 6-10 years. By 11 years of age about two-thirds of the cohort had received a booster dose.

The drop-out rate reflects parents' uptake or satisfaction with the quality of services, and monitoring this early indication of problems would enable managers to intervene, prevent late doses, and increase the proportion of eligibles fully immunized on time. It is not possible to obtain this indicator from the present reporting system, but drop-outs and late doses can be identified from Form 63 and the child register. Comparing the experience from a sample of facilities should make it possible to identify the causes of problems (such as non-attentance, or contraindicating, or stock-outs of essential supplies). This micro-level analysis will form the basis for discussion about how to overcome the problems and improve the quality of services.

The potential bias of using facilities' records for estimating the completeness and timeliness of coverage is that it will only include children who are registered. Those who are not registered and those who move will be under-represented, although the frequency with which registered under-1s leave a cluster can be identified. Data from a rigorously-conducted coverage survey using the household interview approach (30 clusters of seven eligibles) developed by WHO would make it possible to assess the extent of unregistered eligibles (see COVERAGE in the Plan of Operation). However, the absence of a parent held record means that respondents are unlikely to be able to provide precise data on the dates when doses were administered. A partial coverage survey was carried out in Constanta, Romania during a training workshop in February

1995. In the analysis, data from the parents has been compared with data extracted from the dispensary records (N. Beldescu, personal communication). This experience may be useful for Moldova.

3.4.2 The Number of Eligibles

a) Eligibles by cohort

In the immunization schedule (Table 5), there are five age groups who are eligible for immunization. Table 8 shows the number of eligibles in each group using provisional data for 1994 provided by the Republican SES.

Table 8: Number of Children, Adolescents, and Adults Eligible for Immunization

Age group	Primary series or Boosters	Number of eligibles
Children from birth to 12 months of age	primary series	60,000
Children aged 22-24 months of age	DPT4 and OPV4	64,000
Children aged 6-7 years	boosters of BCG, OBV. and Td	84,000[a]
Adolescents aged 14-15 years	1 booster of Td	73,000[a]
Adults at 5 year intervals (20,25,30,35,40) Adults at 10 year intervals (50,60,70)	8 boosters of Td	480,000[b]

Source: Form 6, Table 1. Republican SES. Provisional data for 1994, rounded to the nearest 1000.

a Data for two age-groups has been averaged to give a single cohort.

b Total of 8 boosters between 20 and 70 years of age, assuming 60,000 per age group.

The cohort born in 1986 was the largest in recent years and now contains 89,000 children. Since then, birth rates have fallen substantially, as indicated by the figures in Table 8. The number of under-1s expected in 1995 is 60,000 (two-thirds of the peak nine years ago).

Accurate denominators are needed for forecasting the quantities of supplies and for monitoring coverage. The Plan of Operation compared six sources of data on the number of births, and found large differences in the data in some raions (Battersby and Ion-Nedelcu, 1994, Table 9). Differences may arise because births are not in the family's usual place of residence, and because births are registered late.

The problem of establishing accurate denominators is made worse by movement of families. A comparison of data for 1992 with 1994 from a sample of eight raions indicates that there has been a shift from 40% urban and 60% rural to 30% urban and 70% rural. The shift is by no means constant in all raions. Tracking the movement of eligibles, especially during their first year when they are due for primary immunizations, is important to prevent doses from being late or missed. Data collected for estimating output indicators for the cost study will include children who move out of or into the surveyed clusters. However, this will only give an incomplete picture of the extent to which movers are re-registered at their new place of residence. The most reliable method for measuring unregistered eligibles would be through a coverage

survey using the WHO methodology, as recommended in the Plan of Operation.

b) Eligibles per facility

Data on the number of under-1s in the catchment area of each facility is available at the facility itself and at the Raion SES. It is not available to the Republican SES through the Ministry of Health's reporting system, or through the Bureau of Medical Statistics, which can provide data on the total population in each facility's catchment area. However, with birth rates changing as rapidly as they have in recent years, estimates of births using aggregated birth rates (CBR) applied to the total population are bound to be inaccurate. It has proved very straightforward to obtain data on under-1s at the level of the raion and below. This is what we propose to do.

The size of eligible groups per facility varies widely. In Table 9 some descriptive statistics referring to eligibles per facility are summarized from the data collected in two raions (see Appendix B for the full list of eligibles per facility). These data illustrate the wide range in the number of under-1s per facility. For example, in Calarasi the SCs vary by a factor of five and in Orhei by a factor of eight.

Table 9: Eligibles per Facility: Data from Orhei and Calarasi Raions

Raions	Calarasi			Orhei		
Level of service	Nbr	Under-1s n=1,367	% of <1s	Nbr	Under-1s n=2,002	% of <1s
Children's Dispensary	1	285	21%	1	451	23%
Number of clusters[a]	11	1,082	79%	18	1,551	77%
Average per cluster		98			86	
Range (min...max)		43...155			34...175	
SCs /SUBs	6	381	28%	11	523	26%
Average per SC		64			48	
Range (min...max)		25...123			18...142	
Ambs /SVAs	4	109	8%	6	201	10%
Average per Amb		27			34	
Range (min...max)		13...57			18...53	
PMs./FAPs	28	592	43%	49	827	%
Average per PM		21			17	
Range (min...max)		2...48			3...40	
Facilities with fewer than 24 newborn children per year	18	230	17%	44	613	31%

a The peri-urban group of PMs which are supplied directly from the Raion SES have been counted as one cluster and are included here.

The Ambs have smaller catchment populations but still vary by a factor of three to four. With such wide variations it would be unwise to rely on generalizations about the number of eligible children per type of facility.

The last row of Table 9 shows the number of facilities which have fewer than 24 newborns (under-1s) per year in their catchment area. Facilities in this category are mostly PMs but include Ambs, and in Orhei there are two SCs with such small populations (see Appendix B).

The figure of 24 under-1s per year translates into an average of two new under-1s per month. The monthly workload in such circumstances is summarised in Table 10. Our field visits confirmed that sessions are still held once every two weeks, even at the smallest facilities. The last column of Table 10 shows the average number of doses of each vaccine that will be administered per session and number of children attending under this regime.

Table 10: Average Monthly Workload for Immunization of Children up to 2 Years of Age* at a Facility with 24 Under-1s Registered in 1995

Antigen	Age of eligible children in months						Total doses if:	
	1	3	4.5	6	12	22-24	1 session / month	2 sessions / month
Hep B	2			2			4	2
DPT		2	2	2		2	8	4
OPV*		2	2	2		2	8	4
Measles					2		2	1
Children 1-24 months	2	2	2	2	2	2	12 children	6 children

* Omits BCG booster at 6-7 years, OPV booster at 6-7 years, and Td boosters starting at the same age. It is assumed that these would be organized as a campaign (one session per year for the entire cohort, at school).

Data from the two raions in Table 9 show that 7 PMs in Calarasi and 15 PMs in Orhei have half as many under-1s in their catchment population (i.e., fewer than 1 new child registered per month). With an immunization session every two weeks, the session sizes will be half the size (or less) of those shown in the last column of Table 10.

There are two main implications for the quality of immunization services. First, a large proportion of facilities have workloads that are so low that informing staff of new policies and procedures, up-dating staff skills, resupply, monitoring and on-site supervision are expensive when considered as input per eligible child.

Second, the unavoidable wastage of vaccine supplied in multidose vials presents a huge cost to the health service. For example, Measles vaccine which must be reconstituted and cannot be kept for more than a few hours comes in a 10-dose vial, and a significant proportion of facilities cannot avoid discarding 90% of this vaccine. From the two raions shown in Table 9 we see that 17% of eligibles in Calarasi and 31% in Orhei are immunized in facilities with this level of wastage. Translated into wastage multipliers, these figures imply that the Republican SES would have to order:

10 times more Measles vaccine than the number of eligibles where wastage is 90%;

5 times more Measles vaccine than the number of eligibles where wastage is 80%.

The present levels of vaccine wastage and the steps that were taken during the visit to reduce tl expense of this wastage are discussed in Section 5.1. Further intervention will be needed to persuade health workers that the frequency of sessions must be adjusted to fit the number of eligibles and the constraints of multidose vials. The larger issue of location of facilities will be addressed in the study of four raions (Calarasi, Orhei, Rezina and Telenesti) proposed in Battersby (1995), and it is anticipated that findings from the cost study will contribute to that discussion.

3.4.3 The Rate of Contraindication

Contraindicated children are still shown on the reports (e.g., Form 6), but staff in the Republic SES said that these children are no longer subtracted from the denominator when estimating coverage. Order Number 100 (June 1, August 3, 1994) contains updated guidelines for contrai dications; see Battersby (1994), Appendix A. Data collected for the cost study will enable us t identify any pattern of late doses and the proportion of children given DT instead of DPT in a sample of catchment areas. The staff concerned will be asked their reasons for temporary or long-term contraindication, and the rates of contraindicating will be compared.

3.4.4 Vaccine Handling

This aspect of the quality of immunization services includes observing the instructions concern ing the amount of time that opened vials of toxoids, hepatitis B vaccine and OPV, and reconsti tuted vials of BCG and Measles vaccine, can be kept. It also includes maintaining the cold cha at correct temperatures for vaccine in storage, in transit, and during immunization sessions.

We should be able to assess whether enough vials of vaccine are being consumed to carry out t reported amount of work in the number of sessions held, by using the data that will be collecte for estimating vaccine costs. If the supply of vials has not been sufficient to complete the recorded workload with correct vaccine handling, then this may be explained in two ways: eit extraordinary measures (such as prefilling vials or keeping opened vials beyond the recommended interval) are being adopted to solve the constraints posed by multidose vials; or the recorded work has not been carried out.

Frozen toxoids are likely to be a problem in Moldova because of the use of domestic refrigerat and the winter temperatures inside facilities. These circumstances are broadly similar to the situation in Hungary where a study of the cold chain found that 38% of DPT was frozen in win (Lugosi and Battersby, 1990). Health workers' knowledge of correct vaccine handling can be assessed using a series of questions to discover whether they know (a) how to recognise toxoic that have been damaged, (b) what causes the damage, and (c) how to use a cold chain monitor card and a Freeze Watch indicator. Other indicators of the quality of vaccine handling are: refrigerators running at the correct temperature, presence of working thermometers, use of temperature records, an awareness of managing stock according to earliest expiry date, inspection of how vaccines are stored in the refrigerator, presence of ice-packs and vaccine carriers. These indicators can be collected by direct observation and questions during visits to the locations sampled for this study.

3.4.5 Technique for Administering Doses

A series of questions can be used to assess whether health workers are using appropriate techniques (subcutaneous, intradermal, intramuscular) and correct doses for each antigen. We

have found that it is best to observe technique, but if this is not possible then staff should explain what they do - showing the equipment and supplies used in the process. The use of syringes instead of droppers for administering OPV has already been identified as an avoidable cost. The accuracy of dosing by those using this technique needs to be assessed.

The frequency with which BCG primary immunization is repeated due to scar failure provides an indicator of the skill of those who administer this vaccine. During the preliminary visit we did not assess whether such data could be obtained from the reporting system.

3.4.6 Safety of Injections

The study will combine an inventory of equipment and supplies with reported technique to see whether the number of injections administered could have been given safely (i.e., with a sterile needle and a sterile syringe for every dose). Staff practices for handling used syringes will also be covered, including the time spent in cleaning, disinfecting, disassembling, packing and transporting the components destined for recycling at Medtecnica.

The accompanying report by Battersby (1995) contains a discussion of injection policy (Section 8) and of the risks which health staff face when handling disposable syringes in this way.

3.4.7 Morbidity from Diseases which Immunization Should Prevent

Preliminary data for 1994 indicate that there is significant morbidity for several of the diseases that should be prevented by immunization. Table 11 shows both the level of morbidity and the change in incidence between 1993 and 1994. The diseases are shown in the same order as in the immunization schedule.

Table 11: Number of Cases, Morbidity per 100 000 and Change in Morbidity between 1993 and 1994, for Selected Diseases

Disease	Number of cases				Morbidity per 100,000		Change from 1993 to 1994[e]
	Total		Children 0-14				
	1993	1994	1993	1994	1993	1994	
Hepatitis B	2,065	2,168	639	680	47.56	49.92	104.9%
Tuberculosis[a]	1,666	1,918	26	42	38.37	41.86	109.1%
Diphtheria	35	373	17	219	0.80	8.58	10.65 times
Pertussis[b]	831	872	810	852	19.14	20.07	104.9%
Tetanus	2	0	1	0	0.04	0	-0.05 cases
Polio (acute)	1	0	1	0	0.02	0	-0.02 cases
Measles	866	3,952	649	3,373	19.94	91.00	4.56 times
Mumps[c]	1,460	2,036	1,278	1,772	33.63	46.88	139.4%
Rubella[c,d]	1,614	4,845	1,544	4,604	37.17	111.56	3.00 times

Source: Buletinul Epidemiologic al Bolilor Infectioase in Republica Moldova pe Ianuarie-Decembrie (a.a. 1993/1994). Centrul Republican de Igiena si Epidemiologie.

a Pulmonary tuberculosis.
b Whooping cough (including Parapertusis).
c The immunization schedule does not include this vaccine at present.
d Listed separately from congenital rubella syndrome, for which no cases are reported.
e Change between 1993 and 1994 (in %, cases or number of times).

Table 11 shows that incidence in 1994 was lower than in 1993 only for poliomyelitis and tetanus. For the other diseases which immunization can prevent, some of the increases in incidence are dramatic (see diphtheria and measles), and the levels of chronic disease (see hepatitis B and tuberculosis) give cause for great concern. The relative importance given to morbidity from each disease is summarized in the Ministry of Health's Order Number 584 ("About the Approval of the National Programme on Immunisation"). The targets for the epidemiological situation, the level of morbidity, and operational targets for each disease (except rubella) are summarized in Table 12.

Table 12: Morbidity Targets for Moldova, from Order 584

Disease	Seq u-ence[a]	Epidemiological situation	Morbidity target	Operational target (coverage)
Hepatitis B	8	Tense; antigen transmission level is the highest in the world	Reduce the number of carriers and morbidity from viral hep.B and D, chronic hepatitis and primary liver cancer	Start in 1994. 98% of under-1s to have 3 doses
Tuberculosis	7	Complex with multiple factors; now serious	Prevent the disease among children	98% of under-1s (primary dose, at birth)
Diphtheria	2	99% reduction[b]; as a result of epidemic in Russia and Ukraine, situation in Moldova is considered to be pre-epidemic.	Elimination of local diphtheria by 2000	From 1995, 95% of under-1s with three doses of DPT, under-3s with fourth dose, Td boosters as per schedule
Pertussis	3	97% reduction[b]	From 1995, 3% lower than pre-immunization levels	From 1995, 95% of under-1s with three doses of DPT, under-3s with fourth dose
Tetanus	4	Neonatal T. has been eliminated. Isolated cases occur among adults	Preserve the current situation	same as for Diphtheria
Poliomyelitis	1	95% reduction[b]	By 1997, elimination of morbidity caused by the local wild strain	From 1995, at least 95% of under-1s with three doses
Measles	5	85% reduction[b]	By 2000, no deaths from acute measles; morbidity <5% of pre-immunization level; average long term rate <40-50 per 100 000.	From 1995, 98% of under-2s (one dose)
Mumps[c]	6	73% reduction[b]	<5% of pre-immunization rates by 2000; will not exceed average long term indices	Start in 1995. 98% of under-2s (one dose)
Rubella[c]	0	not included		

Source: Order 584, About the Approval of the National Programme on Immunisation. For the full text see the translation in Battersby (1995), Appendix C.

a Sequence in which morbidity targets are presented in Order 584.
b Reduction from pre-immunization levels.
c The immunization schedule does not include this vaccine at present.

Since this order was issued, morbidity from diphtheria has moved from "pre-epidemic" to epidemic status. Follow-up of the diphtheria cases has identified a variety of problems leading to low quality of immunization services. Additional measures are being taken during 1995 to contain and prevent outbreaks (see Appendix E). It is hoped that further epidemiological investigations will take into account all operational factors that might have contributed to the present situation, so that a more effective service can be provided.

In order to gain some insight into how there could be nearly 4,000 measles cases last year, we visited a cluster which had reported several cases. The health staff said that the cases were among school children and were so mild that the parents had not kept these children home from school. The features of the measles outbreaks also require further epidemiological investigation.

Failures in any aspect of the quality of immunization services mean that the resources spent to provide the service have been wasted. The cost study will use morbidity data as an indicator of the quality and effectiveness of implementation.

4. Suggested Approach

The methodological approach to the cost study is determined by three basic considerations, which have become clear from this preliminary visit.

First, the large number of raions means that there is great scope for variation within Moldova's immunization program. We have visited two raions and looked at data for another eight, and have identified wide differences (e.g., in the eligible population per facility) which will strongly influence cost-effeciveness, other things being equal. Therefore, the study should include enough raions to enable these differences to be represented.

Second, the absence of standard formats for stock control means that data on consumption of vaccines and syringes will take more time to collect. At present these supplies put a heavy financial burden on the program, so it is especially necessary to collect reliable, accurate data on the amounts used and the way in which they are used.

Third, the reported levels of morbidity make it essential to include indicators of quality which go beyond the usual denominators (i.e., fully-immunized children and doses administered). Composite measures indicating the quality of cold chain, vaccine handling, and injection technique can be obtained from observation of facilities' equipment and supplies and discussion with health staff.

Thus the proposed approach is to carry out an operational assessment which focuses on the quality and effectiveness of resource use. Translating the resources into costs provides the common currency. Linking them to the quality of outputs will enable us to identify the variables and features which are associated with effective services provided at relatively low cost.

The assessment should be carried out in the four raions which have been identified for the special study (see Battersby, 1995) and in a sample chosen from the northern and southern raions listed below.

Special study area	North	South
Calarasi	Donduseni	Cahul
Orhei Drochia	Ciadir-Lunga	
Rezina	Edinet	Taraclia
Telenesti	Riscani	Vulcanesti

The size of the sample will depend on constraints of time and budget. Urban policlinics and children's dispensaries must be adequately represented, as well as cluster headquarters and PMs. If enough prior information is available the study should include clusters where immunization is being provided without active refrigeration at small facilities, and where mobile outreach strategies are in use. Experience from these sites will be useful in assessing whether alternative strategies are feasible and suitable for other locations.

By the end of the study we should be able to complete the cost/output matrix for Moldova's immunization program. The details of attributes associated with high or low costs and better or worse performance will be quantified by the study. Table 13 shows a matrix with illustrative data for health facilities in rural towns. The worst combination is Case 2, and the best combination is Case 3.

Table 13: Example of a Cost/Output Matrix for Health Facilities

	LOW COST	HIGH COST
LOW OUT-PUT	CASE 1 Minimal equipment Small staff, few sessions Resupply by public transport or lifts Low utilization by target groups Passive follow-up of children who do not attend or who drop out	CASE 2 Cold chain equipment is out of order Large staff, under-occupied Resupply with EPI/health vehicle Frequent sessions, poorly attended Time is spent on follow up and social mobilisation, but is ineffective
HIGH OUT-PUT	CASE 3 Easy access to the point of resupply Minimal equipment Small staff Resupply by public transport or lifts Few sessions, well attended High utilization by target groups Effective community based health promotion, registration and follow-up of eligibles	CASE 4 Equipment at facility provides continuous cold chain Large, active staff Resupply uses EPI/health vehicle Frequent sessions are well attended High utilization by target groups Staff spend much time on identifying eligibles and following up defaulters and drop-outs

Source: Use of Cost-Effectiveness Analysis in Three Countries (Feilden, 1991)

5. Additional Activities

5.1 Moldova's Vaccine Requirements

During this visit we were shown two estimates of vaccine requirements for 1995. One was prepared by Spanner during his consultancy in November/December 1994. The other was prepared in Berlin by Bruno Martin (UNICEF Geneva) at the conference to discuss control of diphtheria in the region (January 1995), and given to the Deputy Minister, who gave it to staff at the Republican SES. The second estimate caused some confusion as it did not take account of Moldova's immunization schedule. Moreover, the staff from the Republican SES, who had not attended the conference, were puzzled why a target population of 90,000 newborns had been used when the earlier estimate had applied the more realistic figure of 60,000. I was asked to prepare an updated estimate of the quantity of vaccine needed for 1995 (see Appendix E).

The approach taken is based on the fundamental constraint that vials cannot be split. Applying this constraint to the present frequency of sessions and the sample of facilities from two raions, I estimated what wastage rates must be if opened vials of toxoids, OPV and Hepatitis B vaccine could be kept for one week. This is slightly more rigorous than the new guidelines released in late February by WHO Geneva. The new guidelines allow opened vials of OPV, DPT, TT, DT, (Td) and Hepatitis B vaccine to be used in subsequent immunization sessions as long as they are kept under correct cold chain conditions and have not passed their expiry date. Opened vials of Measles and BCG vaccines must be discarded at the end of each session. Appendix D contains the full text of the new guidelines.

Wastage multipliers were calculated for each individual facility, according to its usual frequency of sessions and its average session size, calculated from the facility's eligible population. Wastage was far higher than the assumptions used in the two earlier estimates, which used the standard multipliers cited by WHO/EPI.

A second set of wastage multipliers was calculated assuming that the frequency of sessions in policlinics and children's dispensaries would be reduced to one, two, or three days per week (depending on size), and in SCs, Ambs and PMs there would be one session per month unless the workload merited more frequent services. The three sets of wastage multipliers are shown in Table 14.

[Note: The relationship between percent wasted and wastage multipliers is as follows. If wastage is 40%, then in a 10-dose vial, six doses are administered and four are thrown away. The multiplier is calculated as (Vial size / Doses administered).

With wastage of 40% from a 10-dose vial, the multiplier is 10/6=1.67.

With wastage of 25% from a 20-dose vial, the multiplier is 20/15=1.33.

The multiplier is the factor by which the number of doses to be administered (based on number of eligibles) must be multiplied when ordering vaccine to ensure that the program has enough vaccine to cover its normal wastage.]

Table 14: Comparison of Three Sets of Wastage Multipliers

Antigen	Dose	Doses from one vial[a]	Place of service	Wastage multipliers			
				WHO[b]	Calarasi	Orhei	Revised
Hepatitis B	first	9 / 10	Maternity	1.5[c]	1.11[h]	1.11[h]	1.11
BCG	first	17 / 20	Maternity	2.0[d]	2.3[j]	1.6[j]	2.50
Hepatitis B	second, third	9 / 10	Facility	1.5[c]	2.2	2.6	2.50
OPV	all five	10 / 10	Facility	1.3[e]	2.1	2.4	1.3
DPT	all four	9 / 10	Facility	1.3[e]	2.6	2.9	1.5
Measles	one	9 / 10	Facility	2.0[f]	7.3	8.1	5.0
BCG	booster	8 / 10	Facility	1.2[d,g]	3.6	4.3	1.57
Td	boost-ers	17 / 20	Facility	1.2[g]	2.2	2.5	1.2

a The maximum number of doses it is possible to administer from one vial.
b The Cold Chain: Product Information Sheets, 1993/1994. EPI Technical Series.
c PIS does not give wastage for Hepatitis B vaccine; Spanner used this multiplier.
d Spanner and Martin used a multiplier of 3.0 for BCG.
e PIS gives wastage of 40% (wastage multiplier of 1.67) for vial of 20 doses; Spanner and Martin used a multiplier of 1.3 for 10-dose vials.
f PIS gives wastage of 40% for Measles (multiplier of 1.67); in many countries, 2 doses are given which reduces wastage. Spanner and Martin used a multiplier of 2.0.
g PIS figure is for a 20-dose vial, given at school entry (i.e., minimal wastage).
h Assuming the vaccine is available daily and opened vials are kept until used.
j BCG offered Monday, Wednesday and Friday in the Maternity hospital.

The quantities of vaccine needed under the present session frequency and a revised session frequency were discussed with staff in the Republican SES. We then counted the stock in the national vaccine store and subtracted this from the annual requirement. This step was essential to avoid procuring inappropriate quantities of vaccine that was already in stock (e.g., Hepatitis B).

Two further revisions were made. The first took account of the planned activities to stop the diphtheria epidemic (see Appendix E, Paragraph 2). The second adjustment was to find the session size at which single dose vials of Hepatitis B and Measles would be cheaper than 10-dose vials. Using updated prices obtained from UNICEF Copenhagen (after leaving Moldova), we found that single-dose vials of Hepatitis B vaccine are cheaper than 10-dose vials for facilities with fewer than 43 under-1s per year. The distribution of facilities by size of eligible population indicates that about half of the under-1s should receive their second and third doses from a single-dose vial. For Measles vaccine, single-dose vials should be provided to any facility with fewer than 60 newborns per year (i.e., fewer than five children per month); this represents most of the rural facilities and covers about two-thirds of the eligibles.

These adjustments cut the cost of the annual requirement by 22% for Hepatitis B and 26% for Measles. The total saving amounted to $108,600. The final version of Moldova's annual vaccine requirement and the net quantities of each antigen, by vial size, was faxed to Chisinau on 10th February. This is shown in Appendix E, with an explanation of the assumptions upon which it is based.

Follow-up will be needed to ensure that all staff involved in requesting and issuing stock are aware of the relationships between session frequency, session size and vaccine quantities. If sessions continue to be held at the present frequency, facilities will either run out of vaccine or handle it inappropriately.

5.2 The Information System

The present system of recording and reporting has some very good features. For example, Form 63 at the policlinics and the child registers at smaller facilities make it straightforward to track an individual child's immunization history. However, the system also has gaps. There has never been a parent-held record showing the child's immunization history. The absence of both formats and standard procedures for recording stock movements (receipts and issues) and the stock balance makes it virtually impossible to track supplies. Both vaccine and syringes are now precious and expensive, and require active management.

Records and reports are now being drawn up in Moldovan (Romanian) and/or Russian. The need to make provision for both languages adds considerably to the problems of designing and printing the formats. For example, we discussed the proportions of parent held records that should be printed in each language and how to ensure that parents were offered a card in their preferred language.

Staff at the Republican SES and some Raion SESs have seen examples of parent held records used in a pilot project in Dolj, Romania. There are some fundamental problems with that format, mainly that it assumes that all antigens that are due according to the schedule will be given at the same time. The parent held record must provide space for recording the date when each dose of every antigen was administered as a separate item. During the visit at six months, HepB 3, DPT 3, and OPV 3 must each be recorded in its own space on the card.

We discussed how an information system could be used to monitor levels of activity, drop-outs and late doses, and consumption of vaccine and syringes on a monthly basis. The status of cold chain equipment can also be included in these formats. Moldova's immunization program has no experience of such applications, and the staff in the EPI Unit expressed interest in seeing examples of formats from information systems which do provide the data needed for managing these aspects of performance. The team of BASICS consultants should identify appropriate examples of formats which they have seen working well in other settings, as input to this component (RECS/RPS) in the Plan of Operation.

6. Recommendations

The cost study will produce many operational recommendations for choosing and implementing strategies which maximize efficiency within the available level of resources. However, without waiting for the study to be completed, a fundamental change must be introduced to avoid running out of vaccine and to ensure that the available vaccine is handled correctly.

1 The new WHO policy statement, *The Use of Opened Vials in Subsequent Immunisation Sessions* (22 February 1995) should be translated. The EPI Unit should take Part C, *Implications for EPI Programme Managers*, and prepare a memorandum for distribution to all health staff who handle vaccine.

2 Given the state of the power supply, the use of domestic refrigerators for EPI, and the proportion of facilities without working refrigerators, it will be essential to put strict time limits on the period over which opened vials of OPV, DPT, DT, Td and Hepatitis B vaccine can continue to be used for vaccine without vial monitors (i.e., the existing stock). If the new supply of vaccine from UNICEF has the individual vial monitors (time/temperature indicators), staff will need training in how to use them.

3 The safest approach is to orientate staff to provide sessions at a frequency appropriate to the workload. This will address the problem of wasting Measles vaccine in multidose vials at facilities of intermediate size.

4 Therefore it is recommended that the EPI Unit prepares a training package which covers the new guidelines on use of opened vials, including maintenance of cold chain, and at the same time informs all staff using multidose vials that their supply is finite, and that they must organize their sessions to fit within the constraints of vaccine availability. Correct handling of vaccines (i.e., no prefilling of syringes, all reconstituted vaccines discarded at the end of the session) must be stressed. The message is that there is enough vaccine **if session frequency fits the workload**. Informing staff at small facilities how much vaccine they will get during the year should help to instill awareness of the constraints within which they must now operate.

5 The corollary of this is that the Republican SES must issue vaccine to raions according to the number of **vials** needed in order for all the facilities within a raion to work within the assumptions used when the vaccine was ordered. Vaccine should not be issued according to population; this will leave small, rural facilities out of stock, or encourage them to mishandle vaccine.

6 The method for estimating 1995 vaccine requirements - based on indivisible multidose vials, variable vial sizes, and individual facilities' eligible populations - should be formalized and put into a spreadsheet. The underlying assumptions should be reassessed when more operational data are available from raions and facility level (e.g., from the cost study). Global wastage multipliers are inappropriate for Moldova and should not be used.

7 The guidelines for staff should make it clear that OPV vaccine is to be administered using the plastic droppers supplied free with this vaccine. The use of syringes as an alternative mode of administering OPV drops is a complete waste of valuable resources, and should cease immediately. This message must also be communicated clearly to raion staff with responsibility for issuing supplies.

8 Further detailed investigation of the diphtheria epidemic should include operational factors, and should answer the question why there are no diphtheria cases across the western border in Romania. The expertise of Romanian epidemiologists would be invaluable in this task.

9 Support should be provided for purchase of reagents which are needed to confirm clinical diagnosis of suspected diphtheria cases with laboratory tests. There is also a need for other consumables such as antiserum and antibiotics for prophylaxis and treatment. The specialists carrying out the epidemiological investigation should quantify these needs.

10 Epidemiologists' skills are also needed to identify whether any programmatic changes in strategy are needed in response to the reported incidence of measles and rubella. In particular, is it possible that there can be almost 5,000 cases of rubella but no case of congenital rubella syndrome, or is this a feature of the reporting system rather than an epidemiological reality?

11 The coverage survey in the Plan of Operation should include questions which will identify whether the sampled children have moved into their present place of residence since birth, and details of their birth registration. This will help to calibrate the health service's denominators and explain the noted discrepancies. The experience from Constanta should be used when preparing for this survey.

12 The team of BASICS consultants should identify appropriate examples of formats which they have seen working well in other settings, and provide examples as input to revising the information system (RECS/RPS in the Plan of Operation).

7. Follow-Up Action Required

The next phase of the cost study is to prepare drafts of formats for collecting the necessary data using the proposed approach of operational assessment. Field testing must be done in Moldova during my next visit, when details of sample selection will also be finalized. It is hoped that this visit can be in June/July. The timing must be agreed with the Republican SES to ensure that counterparts from the EPI Unit will be available.

I will send a copy of WHO/EPI's new guidelines on use of opened vials to the Republican SES, and arrangements must be made through BASICS to get this document translated. Technical assistance with preparing the guideline for vaccine handling and with fitting session frequency to the size of the workload may be required. This should take place before the supply of single-dose vials for Hepatitis B and Measles start to be issued.

The forthcoming consultancy by Soren Spanner should include an assessment of whether spare parts are available for the refrigerators needing repair. (The plethora of brand names listed may be mostly the same model with different names). This task should build upon the EPI Unit's analysis of the raions' equipment audit, which was originally due to be completed by mid-April 1995. The cost implications of repair or replacement can then be included in the cost study. The team of BASICS consultants should meet to discuss past and future work before the next visit.

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Appendices

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Appendix A: Schedule of Meetings and Visits

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Schedule of Meetings and Visits

25 January	Arrival in Chisinau; briefing from A. Battersby
26 January	Introduction to V.V. Sohotski and staff at the Republican SES
	Meeting with Accounting Department
27 January	Visit to Chisinau SES's cold store, and Policlinic Number 7
	Battersby's debriefing with Dr. Magdei, Deputy Minister
	Meeting with S. Sutton, USAID
30 January	Meeting at Ministry of Health, Planning Department
31 January	Visit to Orhei Raion SES and an SC cluster
1 February	in RSES: issues of equipment and supplies, shipping costs of vaccine
2 February	Visit to Calarasi Raion SES, children's dispensary, an SC and a PM.
3 February	Visit to Bureau of Medical Statistics and the sub-section responsible for data on catchment populations of facilities
4-5 February	Calculation of wastage multipliers
6 February	Discussion of vaccine requirements; count of stock in cold store
	Debriefing with Dr. Magdei and Dr. Stasi
	Telephone conversation with R. Steinglass
7 February	Incorporating EPI Unit's estimates of cohorts to be covered in the campaign to stop the diphtheria epidemic; telephone call to UNICEF Copenhagen.
	Meeting with S. Sutton, USAID
	Departure from Chisinau to Bucharest
8-10 February	Obtained updated prices from UNICEF Copenhagen. Spoke to WHO/EURO and Dr. Dittman about Di, DT and Td vaccines. Worked out the breakeven points for single-dose and multidose vials for HepB and Measles. Sent fax to Dr Sohotski at the Republican SES with revised estimates of vaccine requirements.
14 February	Call to Dr. Sohotski to check that fax was received and clear.

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Appendix B: Under-1s per Facility in 1995: Data from Two Raions

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Under-1s per Facility in 1995: Data from Two Raions

CALARASI

Facility	Type	NBC/yr
Dereneu3	PM	2
Pitusca3	PM	3
Calarasi7	City	4
Pirjolteni5	PM	8
Hirjauca2	PM	9
Bravicea2	PM	11
Oniscani2	PM	11
Hirjauca3	PM	12
Hirjauca1	Amb	13
Pirjolteni3	PM	13
Dereneu1	Amb	14
Sipoteni3	PM	15
Hirjauca4	PM	15
Sipoteni2	PM	17
Calarasi2	City	17
Calarasi4	City	20
Tibirica2	PM	23
Calarasi6	City	23
Volcinesti4	PM	24
Oniscani4	PM	24
Volcinesti2	PM	25
Pirjoltenil	SC	25
Oniscanil	Amb	25
Calarasi5	City	28
Volcinesti3	PM	29
Pirjolteni4	PM	30
Oniscani3	PM	30
Pitusca2	PM	31
Bravicea3	PM	36
Dereneu2	PM	39
Sadova	SC	43
Calarasi3	City	45
Pirjolteni2	PM	48
Braviceal	SC	52
Tibirical	Amb	57
Pituscal	SC	64
Volcinestil	SC	74
Sipotenil	SC	123
Calarasil	Poly	285

TOTAL Under-1s 1367

In Calarasi there are:
28 PMs, of which
7 have <1 NBC/month
16 have <2 NBCs/month

4 Ambs, of which
2 have <2 NBCs/month

ORHEI

Facility	Type	NBC/yr
Cucuruzeni4	PM	3
Susleni6	PM	3
Braviceni2	PM	5
Bulaesti3	PM	5
Morozeni3	PM	6
Chiperceni5	PM	7
Cucuruzeni5	PM	8
Budei	City	8
Chiperceni6	PM	9
Cucuruzeni2	PM	9
Cucuruzeni3	PM	9
Braviceni3	PM	10
Chiperceni2	PM	10
Isacova2	PM	11
Susleni4	PM	11
Morozeni8	PM	12
Bulaesti2	PM	13
Telesau2	PM	13
Telesau3	PM	13
Fora de Fos2	PM	13
Chiperceni8	PM	14
Ghetlova2	PM	14
Morozeni6	PM	15
Telesau4	PM	15
Fora de Fos3	PM	15
Bolohani	City	15
Molovata2	PM	16
Morozeni2	PM	17
Morozeni5	PM	17
Morozeni7	PM	17
Pohorniceni	City	17
Morozenil	SC	18
Telesaul	Amb	18
Ciocilteni3	PM	18
Ivancea	City	18
Morozeni4	PM	19

continued

Facility	Type	NBC/yr
Ghetloval	SC	20
Podgoreni	Amb	20
Step-Soci	City	20
Chiperceni3	PM	21
Ciocilteni2	PM	22
Chiperceni4	PM	23
Susleni2	PM	23
Branesti	City	23
Piatra2	PM	25
Isacova5	PM	26
Cucuruzenil	SC	27
Ciociltenil	SC	27
Isacoval	SC	28
Pelivan3	PM	28
Susleni3	PM	31
Isacova4	PM	32
Braviceni1	Amb	32
Susleni5	PM	33
Pelivan1	Amb	37
Chiperceni7	PM	37
Isacova3	PM	38
Pelivan2	PM	40
Bulaestil	Amb	41
Chipercenil	SC	41
Piatral	SC	43
Fora de Fos1	SC	49
Oxintea	Amb	53
Molovatal	SC	54
Susleni1	SC	74
Peresecina	SC	142
Disp.de Copii	Poli	451

TOTAL Under-1s 2002

In Orhei there are:
49 PMs, of which
15 have <1 NBC/month
40 have <2 NBCs/month

6 Ambs, of which
2 have <2 NBCs/month

11 SCs, of which
2 have <2 NBCs/month

Appendix C: EPI Syringes to be Issued in Orhei Raion, February and March 1995

EPI Syringes to be Issued in Orhei Raion, February and March 1995

Facility name	Cluster HQ	Annual NBC in cluster	Syringes issued in: Feb 95	Mar 95	Feb+Mar	Children <16 per month	Adults for Td /month	Total need/ month	Surplus or shortage
						10	8	18	
Budei	City*	8	0	23	23	7	5	12	-0.1
Bolohani	City*	15	40	104	144	13	10	23	4.3
Pahaniceni	City*	17	39	56	95	14	11	25	1.8
Ivancea	City*	18	7	90	97	15	12	27	1.6
Step.Soci	City*	20	39	154	193	17	13	30	4.4
Podgoreni	Amb	20	13	49	62	17	13	30	0.1
Branesti	City*	23	213	81	294	19	15	34	6.6
Ghetlova	SC	34	14	152	166	28	23	51	1.3
Braviceni	Amb	47	143	270	413	39	31	70	3.9
Oxintea	Amb	53	11	346	357	44	35	79	2.5
Cucuruzeni	SC	56	177	385	562	47	37	84	4.7
Bulaesti	Amb	59	27	126	153	49	39	88	-0.3
Telesau	Amb	59	162	215	377	49	39	88	2.3
Ciocilteni	SC	67	101	284	385	56	45	101	1.8
Piatra	SC	68	82	277	359	57	45	102	1.5
Molovata	SC	70	24	469	493	58	47	105	2.7
Fora de Fos	SC	77	83	280	363	64	51	115	1.2
Pelivan	Amb	105	235	415	650	88	70	158	2.1
Morozeni	SC	121	219	484	703	101	81	182	1.9
Isacova	SC	135	383	454	837	113	90	203	2.1
Peresecina	SC	142	357	361	718	118	95	213	1.4
Chiperceni	SC	162	191	631	822	135	108	243	1.4
Susleni	SC	175	308	543	851	146	117	263	1.2
Disp.de Copii	Poli	451	221	1039	1260	376		376	1.4
Policlinica	Poli	0	1000	570	1570	0	301	301	3.2
Casa internat	Casa		0	12	12	D K		D K	
		2,002	4,089	7,858	11,947	1,670	1,333	3,003	2.0
						Minimum		Minimum	-0.3
						Maximum		Maximum	6.6

* These facilities are listed separately in the distribution list but are part of the "suburban" cluster based on Orchei city.

\+ For each NBC there will be on average a need to administer
- 2 HepB (second and third doses)
- 1 BCG dose (booster to 6-7 year old)
- 4 DPT (four doses)
- 1 Measles
- 2 Td (boosters at 6-7 and at 14-15 years of age)

These 10 injections exclude Td booster doses administered to adults.

++ Approximately 8 syringes are needed for adult Td boosters per NBC.
- 5 five-year boosters between 20 and 40 years of age (inclusive)
- 3 ten-year boosters between 50 and 70 years of age (inclusive)

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Appendix D: WHO Policy Statement: Expanded Programme on Immunization

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WHO POLICY STATEMENT: Expanded Programme on Immunization

The Use of Opened Vials of Vaccine in Subsequent Immunization Sessions

Sufficient data have been collected on the safety and potency of EPI recommended vaccines to endorse changes in the global policy on the use of opened vials of vaccines. The new policy has the potential to reduce vaccine wastage rates by up to 30%, resulting in annual savings worldwide of US$ 40 million in vaccine costs. This statement reviews the existing policy, presents the revised policy, comments on the implications for immunization programme managers and states the scientific rationale for these policy changes.

This policy statement is applicable for vaccines which :

- **meet WHO requirements for potency and temperature stability,**
- **are packaged according to ISO[1] standards and,**
- **contain an appropriate concentration of preservative such as thiomersal (injectable vaccines only)**

Vaccines supplied via UNICEF meet these requirements.

A. Current WHO/EPI Policy

The current policy of the Expanded Programme on Immunization states that all vaccine vials which have been opened for an immunization session should be discarded at the end of that session. All opened vials should be discarded regardless of the type of vaccine or the number of doses remaining in the vial.

B. Revised WHO/EPI Policy

1. Opened vials of OPV, DTP, TT, DT and hepatitis B vaccines packaged according to ISO standards, may be used in subsequent immunization sessions until a new shipment of vaccine arrives, provided that the following three conditions are met:

- the expiry date has not passed and
- the vaccines are stored under the appropriate cold chain conditions (0-8° Celsius) and
- opened vials of vaccine which have been taken out of the health centre for immunization activities (e.g. outreach, NIDs) should continue to be discarded at the end of the day.

2. Opened vials of measles, yellow fever and BCG vaccines **MUST** be discarded at the end of each immunization session.

3. The vial must be discarded immediately if

- sterile procedures have not been fully observed, or
- there is even a suspicion that the opened vial has been contaminated, or
- there is visible evidence of contamination such as change in appearance, floating particles, etc...,

Source: WHO/GPV

C. Implications for EPI Programme Managers

1. Changing national EPI Policy on the use of opened vials of vaccines could initially result in confusion. Of particular importance is the failure to discriminate between the opened vials of vaccines which must be discarded immediately after an immunization session (BCG, measles and yellow fever) and those which can be stored and used for future sessions.

2. Individual Vaccine Vial Monitors (Time/Temperature indicators), when available, can be used to ensure that the vaccine in vials of OPV, DTP, TT, DT and hepatitis B has not been exposed to unacceptably high temperatures.

3. In areas where implementation of the new policy may increase the risk of administering impotent vaccines, managers should delay introduction of the policy until vaccines with individual Vaccine Vial Monitors are available.

4. Training and supervision materials and activities must be revised to reflect this change in policy. Linking the policy change to vaccine vials which have a Vaccine Vial Monitor may simplify the introduction of the new policy and training activities.

5. If a country changes its national immunization policy to allow continued use of opened vials of OPV, DTP, DT, TT and hepatitis B, programme managers will need to reestimate vaccine usage rates when forecasting vaccine requirements. As an indication, it is estimated that the new wastage will be around 15 to 20%. This should however be confirmed by local studies.

6. Training staff to distinguish between vials which can be used in subsequent sessions and vials which **must** be discarded is essential. Death due to toxic shock syndrome has resulted when reconstituted live virus vaccines kept longer than the recommended period have been injected.

D. Rationale for Changing EPI Policy on Opened Vaccine Vials

1. Two issues have dictated EPI Policy on the use of opened vaccine vials: The potency of the vaccines and the safety of their administration. Since the original policy statement, research has been conducted to determine the potency and safety of opened vials of EPI vaccines over time.

2. The potency of an opened vial of vaccine over time is primarily determined by the heat stability of that vaccine, and whether or not the vaccine has been reconstituted.

3. The potency of OPV, TT, DTP, DT and hepatitis B is a function of the heat stability. Opened vials of OPV, TT, DTP, DT and hepatitis B vaccines will remain potent as long as they are stored under appropriate cold chain conditions (0-8°C) and the vial expiry date has not passed.

4. The safety of an opened vial of vaccine is primarily dependent on the risk of contamination with a pathogenic organism and the bacteriostatic/virucidal effect of preservatives in the vaccine vial.

5. Reconstituted measles, yellow fever and BCG vaccines do not contain preservatives and **must not** be kept after the completion of the session during which they are reconstituted.

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Appendix E: Assumptions Used in Estimating Moldova's Vaccine Requirements for 1995

V.V. Sohotski
Republican SES
Chisinau, Moldova

10 February 1995

Fax: 00-373-2-729725

Dear Dr. Sohotski,

As promised, I attach a revised calculation for Moldova's 1995 vaccine supplies.

There are ~~four~~ five main changes from what we discussed on Tuesday.

1. I have updated the prices to the present quotations from UNICEF in Copenhagen (prices quoted by Kwon on 8/2/1995).

2. The commission of 6% to UNICEF should be calculated on the value of the vaccine alone, BEFORE freight charges are added. This follows the policy in other countries which use UNICEF procurement services.

3. Diphtheria vaccine (Di) is not available through UNICEF. WHO and UNICEF policy is that Td (DT-M) should be given to children aged 6 and over because DT has higher reactogenicity. This information was confirmed by Dr. Dittmann, who was at the Berlin Conference. Therefore I have substituted Td where it was proposed to use Di for the 8-14 year olds.

4. Hepatitis B for 2nd and 3rd doses at SC, Ambulatorio or Punct Medical is cheaper in single dose vials for any facility which has fewer than 42 under-1s per year. Based on the data we have for the 10 Raions studied last Friday, about half of the population of under-1s is in small facilities with <42 under-1s per year. So I have estimated that 50% of the annual requirement for Hepatitis B will be in 1-dose vials, and 50% in 10-dose vials.

5. Measles vaccine in 1-dose vials is a different proportion because only one dose is given, so the wastage factor is also different. The price differential also leads to a different break-even point. In this case, the best arrangement is if Policlinics, SCs and Ambulatorios with 60 or more under-1s per year take 10-dose vials. About one-third of the target population is covered by facilities with this number of under-1s. The remaining children (two-thirds) should be covered using 1-dose vials of Measles.

For both Hepatitis B and Measles vaccine, I have assumed that there is no wastage (wastage multiplier = 1) where 1-dose vials are used.

The total value of the proposed order, after adjusting for the vaccine in stock, comes to US $500,012 (excluding returnable deposits).

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Dr. Sohotski

I will telephone to see whether you have any queries.

With many apologies for the delay in faxing this to you. I think that the final draft - with single dose vials for Measles and Hepatitis B - is the best proposal.

With best wishes,

Rachel Feilden

Rachel Feilden
Basics Consultant

copy sent to BASICS 14 Feb 1995

ASSUMPTIONS USED IN ESTIMATING MOLDOVA'S VACCINE REQUIREMENTS FOR 1995

Rachel Feilden, Consultant for BASICS
Draft, 9 February 1995

1. The immunisation schedule is as follows:

0-24 hours	HepB 1					
4-7 days		BCG				
1 month	HepB 2					
3 months			DPT 1	OPV 1		
4.5 months			DPT 2	OPV 2		
6 months	HepB 3		DPT 3	OPV 3		
12 months					Measles	
22-24 months			DPT 4	OPV 4		
6-7 years		BCG		OPV 5		Td
14-15 years						Td
20-40 years					every 5 years	Td
>40 years					every 10 years	Td
Total doses	3	2	4	5	1	10

Children under 1 who are contraindicated for Pertussis vaccine (about 5% of eligibles) will receive DT instead of DPT: two doses of DT plus a booster at 22-24 months will be given.

2. Control of Diphtheria outbreaks: The age distribution of cases in 1994 shows that the number of cases rises sharply at ages over 36 months to a peak at 9 years of age, falling sharply to age 16 when the cases are at the level for all adult age groups (71 cases among ages 16-70 in 1994). Between 1988 and 1992 the adult population received a booster of Td (=DT-M or ADSM). The strategy for preventing Diphtheria in Moldova is as follows:

a)	Children under 3 who received Td instead of DPT in 1992, 1993, 1994	DT 1 booster	12 800 children
b)	Children aged 3-6	DT ~~Td (DT-M)~~ 1 booster	300 000 children } spreadsheet uses DT
c)	Children aged 7-9 who received Td in 1994 as part of changing age of second booster from 9 to 6 years	No additional booster	
d)	Children aged 8-14 years	Td (DT-M) 1 booster	Di vaccine not available WHO recommends Td.

3. Frequency of services (in days per year) will be as follows:

	Hep B	BCG	DPT	OPV	Measles	Td
Maternities	365	3 x 52				
Policlinics						
Cities	52	groups of	5 x 52	5 x 52	2 x 52	5 x 52
Raions	52	8 children	2 x 52	2 x 52	52,26 or 12**	2 x 52
SCs/SUBs	26	"	26	26	12 if 10-dose	26
Ambs/SVAs	12	* 2 sessions	12	12	as needed if	12
FMs/FAPS	12	per year	12	12	single dose	12

* BCG Booster: About half of the PMs will have fewer than 16 children eligible for BCG booster dose at 6-7 years old. Therefore they can give this booster usir two vials of BCG if the booster is organised as a local campaign (all doses given on one day will minimise the wastage.

If this is not done and PMs are permitted to give BCG every month, then the wastage multiplier for PMs will rise to more than 5 (wastage over 80%) and the national wastage multiplier would increase to 4 (average wastage of 75%).

4. The maximum number of doses that can be obtained from multidose vials are shown below under (a). Use of opened vials is shown under (b), assuming that correct cold chain is maintained. These protocols for using opened vials combined with the session frequencies in (2) will enable the EPI to achieve the wastage multipliers shown in (c). Wastage multipliers have been estimated using data on the size of eligible populations from a sample of Moldovan facilities. The multipliers imply that the percent of vaccine wasted will be as shown in (d).

Vaccine	Vial size	(a) Doses from each vial	(b) Use of opened vial	(c) Wastage multiplier	(d) Percent wasted
Hep B	10	9	Within one week	1.11	10% at Maternity
				2.00	50% at P,SC,Amb,PM
BCG	20	17	Within 2 hours	2.50	60% at Maternity
BCG	10	8	Within 2 hours	1.57	33% at P,SC,Amb,PM
DPT	10	9	Within one week	1.50	33%
DT	10	9	not applicable	10.00	90% (contraindicated c
OPV	10	10	Within one week	1.30	23%
Measles	10	9	Within 6 hours	5.00	80% average now +
				1.71	42% at Policlinics **
Td	20	17	Within one week	1.40	29% for boosters
				1.20	17% for campaign
* DT	10	9	within one week	1.30	23% for campaign

+ A three-month transition period has been built in during which 10-dose vials now in stock will continue to be used, with the high wastage rates associated with small numbers of eligibles.

** Allocation of Measles 10-dose vials at Policlinics:
If the following rules are followed, the average session size will be 6 children and wastage will be 42%.

Under-1s per Policlinic per year	Number of 10-dose vials	Session frequency
< 108 children/year	12 vials/year	1 session/month
at least 108 but < 234 children	26 vials/year	1 session every two weeks
at least 234 but < 468 children	52 vials/year	1 session every week
468 or more children/year	104 vials/year	2 sessions per week

5. Vaccine prices: Quotations from UNICEF Copenhagen as of February 1995 have been used throughout.

6. Mixed vial sizes: Multidose vial sizes and small numbers of children per facility make high wastage unavoidable. Single-dose vials are more economical for Measles and Hep B vaccine at small facilities.

(a) Hepatitis B: At present prices single dose vials are more economical at facilities with less than 43 under-1s per year. The distribution of children and facilities means that about half of the eligible children should receive their second and third doses using single-dose presentation.

(b) Measles: Wastage rates are higher because vaccine cannot be kept beyond the end of a session and because only one dose is required. The distribution of facilities and children suggests that the urban population (approximately one-third of the eligibles) and any rural facility with more than 60 under-1s per year should be covered using 10-dose vials. Most of the rural facilities - SCs, Ambulatorios and PMs - have smaller populations and any which will immunise fewer than 5 per month should be served using single dose vials.

7. The new WHO guidelines on keeping opened vials of vaccine are expected within the next two weeks. These estimates of vaccine requirements have assumed that DPT, OPV and HepB multidose vials can be kept for up to a week after opening as long as correct cold chain is maintained.

8. Quantities of vaccine required have been calculated including a reserve of 25% of the annual requirement, and taking into account the existing level of stocks. The net quantities of each type of vaccine required are summarized below, showing the number of vials required of each size. The detailed calculations are shown on the ~~two~~ five pages attached.

Vaccine	Vial size	Number of vials
BCG	20 dose	14,286
DPT	10 dose	32,550
Measles	10-dose	4,428
Measles	1-dose	55,000
OPV	10-dose	36,725
Td	20-dose	90,722
HepB	10-dose	9,288
HepB	1-dose	125,000
DT	10-dose	51,914

Rachel Feilden
9 February 1995

MOLDOVA'S VACCINE REQUIREMENT FOR 1995

	BCG	DPT	Measles 10-dose	Measles 1-dose	OPV	Td	HepB 10-dose	HepB 1-dose	DT 10-dose
Doses per year, including reserve of 25%	465,320	495,000	140,780	55,000	536,250	1,852,440	341,580	125,000	519,140
Vial size	20	10	10	1	10	20	10	1	10
Vials, including reserve	23,266	49,500	14,078	55,000	53,625	92,622	34,158	125,000	51,914
Existing stock (vials)	8,980	16,950	9,650	0	16,900	1,900	24,870	0	0
Annual + Reserve - Stock	14,286	32,550	4,428	55,000	36,725	90,722	9,288	125,000	51,914
Price/vial	$1.40	$0.85	$1.60	$0.75	$0.95	$1.30	$5.65	$0.80	$0.75
Cost of vaccine XX	$20,000	$27,668	$7,085	$41,250	$34,889	$117,939	$52,481	$100,000	$38,936
Airfreight	10%	10%	10%	10%	10%	10%	3%	3%	10%
Cost of vaccine & freight	$22,000	$30,434	$7,793	$45,375	$38,378	$129,732	$54,055	$103,000	$42,829
Commission on XX 6%	$1,200	$1,660	$425	$2,475	$2,093	$7,076	$3,149	$6,000	$2,336
TOTAL BY VACCINE	$23,200	$32,094	$8,218	$47,850	$40,471	$136,809	$57,204	$109,000	$45,165

TOTAL COST OF VACCINE $500,012

* These are the numbers of vials to order for each size of vial

SCHEME 4: With the reduced wastage multipliers and a mixture of vial sizes

Policlinics	*	2-3 days per week	++	Cities: 2 days per week
			++	Raions: 1 or 2 days /month
SCs/SUBs	*	every two weeks (26/year)	+	once/month (12/year)
Ambs/SVAs	*	once/month (12/year)	+	once/month (12/year)
PMs/FAPS	*	once/month (12/year)	+	once/month (12/year)

Vaccine	BCG Newborns	BCG Booster	DPT	Measles 10-dose	Measles 10-dose	Measles 1-dose	OPV
Strategy	Maternity hospital	Campaign	*	++ +	++ +	as needed	*
Target population 1995	60,000	60,000	60,000	20,000	15,000	40,000	60,00
+ backlog from 1994	6,000	6,000	6,000	2,000	transitio	4,000	6,00
Total population	66,000	66,000	66,000	22,000	15,000	44,000	66,00
Number of doses	1	1	4	1	1	1	5
Reduced wastage multipliers	Maternity 2.50	SC/Amb/PM 1.57	1.50	1.71	5.00	1.00	1.30
Doses needed	165,000	103,620	396,000	37,620	75,000	44,000	429,000
Vial size	Newborn 20	Booster 10	10	10	10	1	10
Vials needed Subtotal	8,250	10,362	39,600	3,762	7,500	44,000	42,900
Reserve of 25%	2,063	2,591	9,900	941	1,875	11,000	10,725
TOTAL VIALS incl reserve	10,313	12,953	49,500	4,703	9,375	55,000	53,625
TOTAL DOSES incl reserve	206,260	129,530	495,000	47,030	93,750	55,000	536,250
Price/vial US $	$1.40	$1.40	$0.85	$1.60	$1.60	$0.75	$0.95
Cost of vaccine	$14,438	$18,134	$42,075	$7,525	$15,000	$41,250	$50,944
Air freight	10%	10%	10%	10%	10%	10%	10%
Cost of vaccine & freight	$15,882	$19,948	$46,283	$8,277	$16,500	$45,375	$56,038
Commission on cost of vaccine 6%	$953	$1,197	$2,777	$497	$990	$2,723	$3,362
Share to each vaccine	$16,835 2.3%	$21,144 2.9%	$49,059 6.8%	$8,774 1.2%	$17,490 2.4%	$48,098 6.6%	$59,400 8.2%

Cost of vaccine $726,499 for 1995 requirement 9 February 1995

Existing stock is then subtracted (see next page)

Continued

SCHEME 4 (continued)	BCG	BCG	DPT	Measles 10-dose	Measles 10-dose	Measles 1-dose	
Existing stock (doses)	179,600	0	169,500	96,500	0	0	1
Net requirement (doses)	26,660	129,530	325,500	44,280	<--	55,000	3
Existing stock (vials)	8,980	0	16,950	9,650	0	0	
*Net requirement (vials) =Annual + Reserve - Stock	14,286	<--	32,550	4,428	<--	55,000	
Cost of vaccine	$20,000	<--	$27,668	$7,085	<--	$41,250	$
Airfreight	10%		10%	10%		10%	
Cost of vaccine & freight	$22,000	<--	$30,434	$7,793	<--	$45,375	$
Commission on 6% cost of vaccine	$1,200	<--	$1,660	$425	<--	$2,475	
TOTAL COST OF VACCINE	$23,200	<--	$32,094	$8,218	<--	$47,850	$
Share to each vaccine	4.6%		6.4%	1.6%		9.6%	
TOTAL FOR 1995	$500,012						

*These are the number of vials to order.

SCHEME 4: With the reduced wastage multipliers and a mixture of vial sizes

Policlinics		++	Cities: 2 days per week
Policlinics	*	++	Raions: 1 or 2 days /month
SCs/SUBs	*	+	once/month (12/year)
Ambs/SVAs	*	+	once/month (12/year)
PMs/FAPS	*	+	once/month (12/year)

Vaccine		Td Boosters	HepB 10-dose	HepB 10-dose	HepB 1-dose	DT 10-dose	DT 10-dose	Td
Strategy		Campaign	Maternity	++ +	as needed	Contra-indicated children	Campaign	Campaig
Target population 1995		60,000	60,000	30,000	30,000	3,000	312,800	581,200
+ backlog from 1994		6,000	6,000	20,000	20,000	0		
Total population		66,000	66,000	50,000	50,000	3,000	312,800	581,200
Number of doses		10	1	2	2	3	1	1
Reduced wastage multipliers		1.40	1.11	2.00	1.00	10.00	1.30	1.20
Doses needed		924,000	73,260	200,000	100,000	90,000	406,640	697,440
Vial size		20	10	10	1	10	10	20
Vials needed	Subtotal	46,200	7,326	20,000	100,000	9,000	40,664	34,872
Reserve of 25%		11,550	1,832	5,000	25,000	2,250	No reserve	No reserve
TOTAL VIALS incl reserve		57,750	9,158	25,000	125,000	11,250	40,664	34,872
TOTAL DOSES incl reserve		1,155,000	91,580	250,000	125,000	112,500	406,640	697,440
Price/vial	US $	$1.30	$5.65	$5.65	$0.80	$0.75	$0.75	$1.30
Cost of vaccine		$75,075	$51,746	$141,259	$100,000	$8,438	$30,498	$45,334
Air freight		10%	3%	3%	3%	10%	10%	10%
Cost of vaccine & freight		$82,583	$53,298	$145,497	$103,000	$9,281	$33,548	$49,867
Commission on cost of vaccine	6%	$4,955	$3,198	$8,730	$6,180	$557	$2,013	$2,992
Share to each vaccine		$87,537 12.0%	$56,496 7.8%	$154,227 21.2%	$109,180 15.0%	$9,838 1.4%	$35,561 4.9%	$52,859 7.3%

Cost of vaccine see previous page 9 February 1995

Existing stock is then subtracted (see next page)

SCHEME 4 (continued)	Td	HepB 10-dose	HepB 10-dose	HepB 1-dose	DT 10-dose	DT 10-dose	T
Existing stock (doses)	38,000	248,700	0	0	0	0	
Net requirement (doses)	1,117,000	92,880	<--	125,000	112,500	406,640	697
Existing stock (vials)	1,900	24,870	0	0	0	0	
* Net requirement (vials) =Annual + Reserve - Stock	55,850	9,288	<--	125,000	11,250	40,664	34
Cost of vaccine	$72,605	$52,481	<--	$100,000	$8,438	$30,498	$45
Airfreight	10%	3%		3%	10%	10%	
Cost of vaccine & freight	$79,866	$54,055	<--	$103,000	$9,281	$33,548	$49
Commission on cost of vaccine 6%	$4,356	$3,149	<--	$6,000	$506	$1,830	$2
TOTAL COST OF VACCINE	$84,222	$57,204	<--	$109,000	$9,788	$35,378	$52
Share to each vaccine	16.8%	11.4%		21.8%	2.0%	7.1%	

* These are the number of vials to order.