An Overview of GEOVAC: A Software Application to Monitor Immunization Performance in Georgia

Second version, January 2004

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In cooperation with:

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National Center for Disease Control

Curatio International Foundation

Ministry of Labor, Health and Social Affairs
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Mission

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

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Abstract

The GEOVAC software application is a tool designed to help personnel of regional level centers of public health and the National Center for Disease Control in Georgia process a large flow of immunization-related data in much less time than the previous (manual) system. It allows them to quickly identify issues and deficiencies regarding immunization coverage, and use and distribution of vaccines, and to assess adequacy of supplies as well as major barriers (medical contraindications, parental refusals, etc.) to the functioning of the immunization system. In doing so, GEOVAC gives health workers more time to focus on the utilization of MIS data for management and disease outbreak response purposes. This second version of the application has gone through numerous revisions and suggestions based on testing in the pilot region. It is now being used nationwide.

The current document illustrates GEOVAC functions, relating them to the features of the upgraded Georgian immunization information system and demonstrating what it can offer immunization managers in the decision making process. It is designed primarily for policymakers in countries planning to strengthen their immunization and/or surveillance systems, donor organizations that can support such reforms and agencies working in these technical areas. It can also help policymakers and health workers in Georgia to plan and implement similar reforms in other sectors of the health care system.

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Acronyms

BCG	Bacillus, Calmette and Guerin Vaccine
CPH	Center for Public Health
CIF	Curatio International Foundation
CMSI	Center for Medical Statistics and Information
DT	Diphtheria and Tetanus Toxoid combination
DPT	Diphtheria, Pertussis and Tetanus vaccine
MIS	Management Information System
MMR	Measles, Mumps and Rubella vaccine
MoLHSA	Ministry of Labor, Health and Social Affairs
NCDC	National Center for Disease Control
PC	Personal Computer
PHR*plus*	Partners for Health Reform*plus* Project
Td	Tetanus and Diphtheria Toxoid
USAID	United States Agency for International Development

Contributors

The second edition of the software application has been developed based on the numerous comments, ideas, and suggestions of the Ministry of Labor, Health and Social Affairs (MoLHSA) Expanded Working Group headed by Dr. P. Imnadze, Director of the National Center for Disease Control (NCDC), and Curatio International Foundation.

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The data shown in forms and graphs in this publication are not associated with real institutions and are used for illustrative purposes only.

1. Introduction

The software application GEOVAC (refers to Georgia Vaccination) is a supplement to the immunization management information system (MIS) in Georgia that helps health workers at the National Center for Disease Control (NCDC) and regional centers of public health to do the following:

- Process a large flow of immunization program data in a timely manner. The application contains nearly 15,000 formulas to provide an insight into various aspects of the operation of the country's immunization program.
- Quickly draw the immunization manager's attention to regions or districts with suboptimal performance and specify the nature of the problem.
- Present information in a suitable form for decision making and for feedback to health workers at lower level.
- Store the data electronically for future reference.

A two-year test of GEOVAC in Georgia has proved this tool to be invaluable, as it allows a contemporary analysis of how the immunization program functions. Apart from the fact that it would be extremely difficult for such a comprehensive analysis to be done manually within a reasonable timeframe (approximately 1,000 calculations are required monthly), health workers at the central and regional levels in Georgia no longer believe that a manual exercise of this sort represents the best use of their professional time, because information technology has become widely available at these levels.

GEOVAC also fulfills Georgia's need for standardized immunization data processing tool for use throughout the national health system; thus, it obviates the development of non-standardized IT-based tools that some individual institutions had begun to create.

This document gives an overview of GEOVAC: It describes systems requirements, data entry procedures, and outputs produced on a routine basis. It also relates GEOVAC functions to the features of the upgraded Georgian immunization information system and demonstrates what it can offer immunization managers in the decision-making process.

As such, the document is designed primarily for policymakers in countries planning to strengthen their immunization and/or surveillance systems, donor organizations that can support such reforms, and agencies working in these technical areas. The document can also help policymakers and health workers in Georgia to plan and implement similar reforms in other sectors of the health care system.

2. System Requirements

The GEOVAC system requirements are minimal. Users must have a Pentium-class computer with at least 32 MB RAM and 30 MB free disk space. Any computer manufactured in 1998 or later will meet these requirements.

Users also must have Excel (Excel-97 or a newer version) installed on their computers, because GEOVAC is based on the Excel platform and contains Visual Basic for Applications program code.

Excel was chosen because it meets the following criteria:

- It is part of the Microsoft Office package, widely available and used in Georgia.
- It is simple, reliable, and virus-resistant.
- It does not require support of skilled programmers.

GEOVAC maintenance skills have been successfully transferred to the immunization program personnel in Georgia and, in fact, the Georgian language version of the application is currently in use in the country.

- It can be modified and new modules can be easily added.
- The database is easy to store and archive.
- The graphics presentation function built into Excel helps utilize the data in the decision-making process.

3. Data Entry

Data from district-level immunization reports (a sample report is in the annex to this manual) are entered on a monthly basis into the database at the regional centers of public health by an assistant epidemiologist or a PC operator. Data entry usually takes no more than two hours per region per month.

During this process an operator can verify data accuracy and protect the database from accidental mistakes using standard Excel features such as:

- Data validation
- Automatic verification of totals
- Conditional formatting of data entered

These features are fully used in the GEOVAC application.

After the data entry, regional immunization managers can immediately begin analyzing the dataset. A summary regional report is generated instantaneously and can be e-mailed to the NCDC.

4. GEOVAC Output

The GEOVAC standard automatic output files include the following reports:

- Monthly summary report on immunization practice
- Tables and graphs on immunization coverage
- Tables and graphs on major barriers to timely immunization, such as medical contraindications or parental refusals
- Tables and graphs on the timeliness of primary vaccination
- Tables and graphs on the use of vaccines

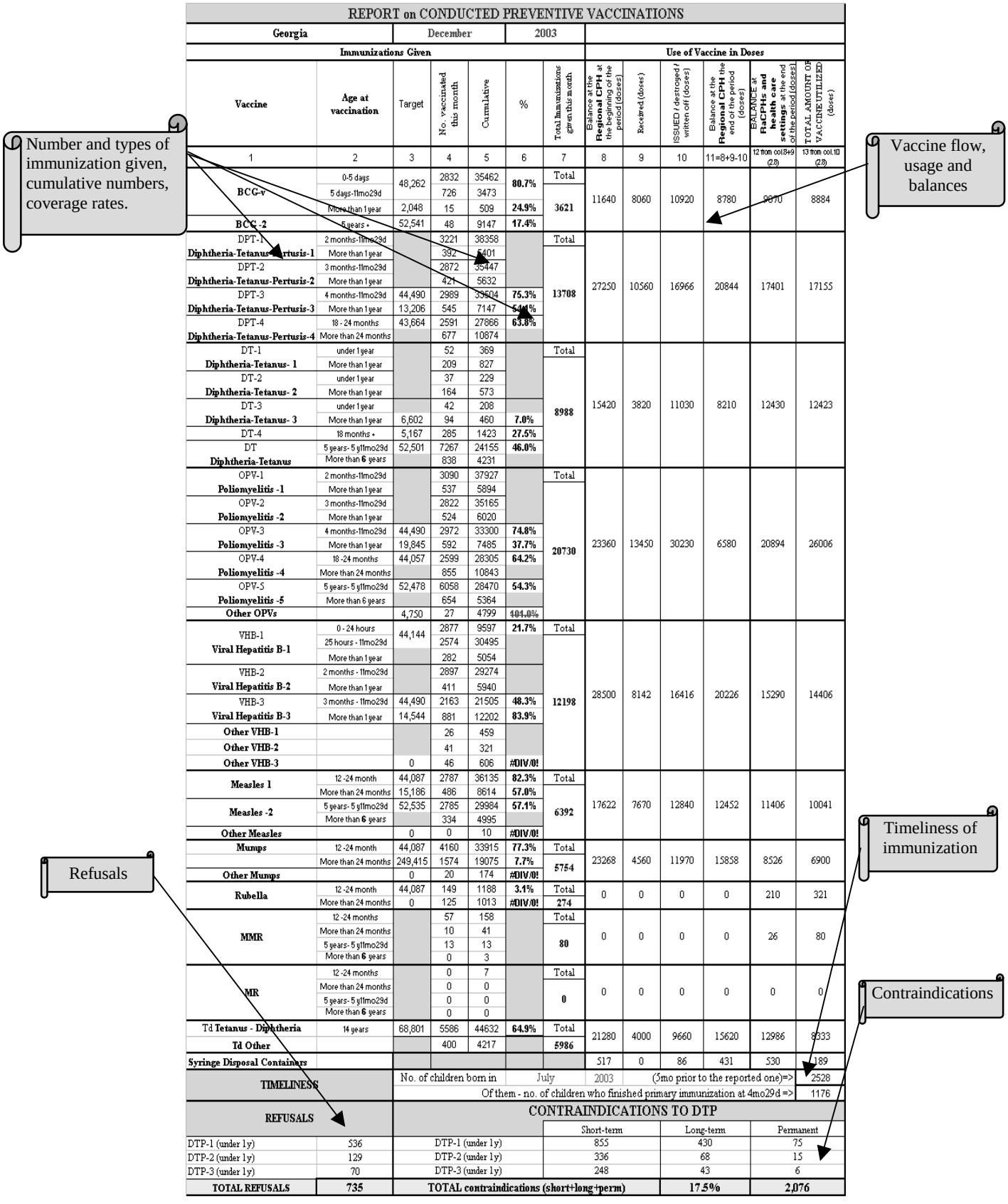
The information in all GEOVAC output (report or analytical) files is derived from the database and is protected from manual changes to preclude tampering with output numbers.

The standard Excel conditional formatting function helps quickly identify issues requiring prompt attention of the manager.

The following sections describe the GEOVAC output in more detail and illustrate many of the GEOVAC functions for both regional and national levels.

4.1 Monthly Summary Report on Immunization Practice

The monthly summary report (produced both at regional and national level) is generated from the entry of individual rayon summary reports and contains information about the number and types of all immunizations given, use of vaccines, medical contraindications to DPT 1-3 (this vaccine has been chosen as a marker), and timeliness of primary DPT series.



REPORT on CONDUCTED PREVENTIVE VACCINATIONS

Georgia		December		2003								
Immunizations Given							Use of Vaccine in Doses					
Vaccine	Age at vaccination	Target	No. vaccinated this month	Cumulative	%	Total Immunizations given this month	Balance at the Regional CPH at the beginning of the period (doses)	Received (doses)	ISSUED / destroyed / written off (doses)	Balance at the Regional CPH the end of the period (doses)	BALANCE at RaCPHs and health care settings at the end of the period (doses)	TOTAL AMOUNT OF VACCINE UTILIZED (doses)
1	2	3	4	5	6	7	8	9	10	11=8+9-10	12 from col.8+9 (2.5)	13 from col.10 (2.5)
BCG-v	0-5 days	48,262	2832	35462	80.7%	Total	11640	8060	10920	8780	9870	8884
	5 days-11mo29d		726	3473								
	More than 1 year	2,048	15	509	24.9%	3621						
BCG -2	5 years +	52,541	48	9147	17.4%							
DPT-1	2 months-11mo29d		3221	38358		Total	27250	10560	16966	20844	17401	17155
Diphtheria-Tetanus-Pertusis-1	More than 1 year		392	5401								
DPT-2	3 months-11mo29d		2872	35447								
Diphtheria-Tetanus-Pertusis-2	More than 1 year		421	5632								
DPT-3	4 months-11mo29d	44,490	2989	33604	75.3%							
Diphtheria-Tetanus-Pertusis-3	More than 1 year	13,206	545	7147	54.1%	13708						
DPT-4	18 - 24 months	43,664	2591	27866	63.8%							
Diphtheria-Tetanus-Pertusis-4	More than 24 months		677	10874								
DT-1	under 1 year		52	369		Total	15420	3820	11030	8210	12430	12423
Diphtheria-Tetanus- 1	More than 1 year		209	827								
DT-2	under 1 year		37	229								
Diphtheria-Tetanus- 2	More than 1 year		164	573								
DT-3	under 1 year		42	208								
Diphtheria-Tetanus- 3	More than 1 year	6,602	94	460	7.0%	8988						
DT-4	18 months +	5,167	285	1423	27.5%							
DT	5 years- 5 y11mo29d	52,501	7267	24155	46.0%							
Diphtheria-Tetanus	More than 6 years		838	4231								
OPV-1	2 months-11mo29d		3090	37927		Total	23360	13450	30230	6580	20894	26006
Poliomyelitis -1	More than 1 year		537	5894								
OPV-2	3 months-11mo29d		2822	35165								
Poliomyelitis -2	More than 1 year		524	6020								
OPV-3	4 months-11mo29d	44,490	2972	33300	74.8%							
Poliomyelitis -3	More than 1 year	19,845	592	7485	37.7%	20730						
OPV-4	18 -24 months	44,057	2599	28305	64.2%							
Poliomyelitis -4	More than 24 months		855	10843								
OPV-5	5 years- 5 y11mo29d	52,478	6058	28470	54.3%							
Poliomyelitis -5	More than 6 years		654	5364								
Other OPVs		4,750	27	4799	101.0%							
VHB-1	0 - 24 hours	44,144	2877	9597	21.7%	Total	28500	8142	16416	20226	15290	14406
Viral Hepatitis B-1	25 hours - 11mo29d		2574	30495								
	More than 1 year		282	5054								
VHB-2	2 months - 11mo29d		2897	29274								
Viral Hepatitis B-2	More than 1 year		411	5940								
VHB-3	3 months - 11mo29d	44,490	2163	21505	48.3%							
Viral Hepatitis B-3	More than 1 year	14,544	881	12202	83.9%	12198						
Other VHB-1			26	459								
Other VHB-2			41	321								
Other VHB-3		0	46	606	#DIV/0!							
Measles 1	12 -24 month	44,087	2787	36135	82.3%	Total	17622	7670	12840	12452	11406	10041
	More than 24 months	15,186	486	8614	57.0%							
Measles -2	5 years- 5 y11mo29d	52,535	2785	29984	57.1%	6392						
	More than 6 years		334	4995								
Other Measles		0	0	10	#DIV/0!							
Mumps	12 -24 month	44,087	4160	33915	77.3%	Total	23268	4560	11970	15858	8526	6900
	More than 24 months	249,415	1574	19075	7.7%	5754						
Other Mumps		0	20	174	#DIV/0!							
Rubella	12 -24 month	44,087	149	1188	3.1%	Total	0	0	0	0	210	321
	More than 24 months	0	125	1013	#DIV/0!	274						
MMR	12 -24 months		57	158		Total	0	0	0	0	26	80
	More than 24 months		10	41								
	5 years- 5 y11mo29d		13	13		80						
	More than 6 years		0	3								
MR	12 -24 months		0	7		Total	0	0	0	0	0	0
	More than 24 months		0	0								
	5 years- 5 y11mo29d		0	0		0						
	More than 6 years		0	0								
Td Tetanus - Diphtheria	14 years	68,801	5586	44632	64.9%	Total	21280	4000	9660	15620	12986	8333
Td Other			400	4217		5986						
Syringe Disposal Containers							517	0	86	431	530	189

TIMELINESS								
	No. of children born in	July	2003	(5mo prior to the reported one)=>	2528
	Of them - no. of children who finished primary immunization at 4mo29d =>				1176

REFUSALS		CONTRAINDICATIONS TO DTP			
			Short-term	Long-term	Permanent
DTP-1 (under 1y)	536	DTP-1 (under 1y)	855	430	75
DTP-2 (under 1y)	129	DTP-2 (under 1y)	336	68	15
DTP-3 (under 1y)	70	DTP-3 (under 1y)	248	43	6
TOTAL REFUSALS	735	TOTAL contraindications (short+long+perm)		17.5%	2,076

4.2 Tables and Graphs on Immunization Coverage

Achieving high immunization coverage rates (80-95 percent) of all target groups in all geographical areas is a key to keeping the vaccine-preventable disease epidemiological situation under control. GEOVAC makes monitoring of coverage rates and untimely immunizations an easy task for managers.

Monthly and cumulative data are presented in tables and dynamically built graphs for all antigens: BCG, polio (1-5), DTP (1-4), DT, Td, hepatitis B, and measles, mumps, rubella. The types of information that are automatically available for analysis include: immunization coverage rates broken down by region or district; "drop-out" rates for DPT, polio, hepatitis B vaccines; proportion of children immunized after established "deadlines"; proportion of children immunized with DT instead of DPT vaccine; proportion of children getting the first dose of the birth dose of the hepatitis B vaccine in compliance with the new regulations.

The following graphs illustrate some examples of how the application functions relate to the monitoring of selected immunization program indicators and how, using cross-analysis with other available data, managers can begin to understand what might be causing some of the performance problems they see.

▲ Immunization coverage

A review of the data in the GEOVAC immunization monitoring table can help managers identify both missed opportunities for vaccination and possible inventory issues.

Immunization coverage (%) monitoring sheet for Measles, Mumps, Rubella — Measles, Mumps, Rubella — **Region ZZ** — **2003**

Rayon/Town	Target	No. of measles-1 vaccinations given to children aged 12-24 mo														Target	Measles-1 given to children over 24 mo													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%	Over 24mo as % of all Measles 1
District 1	465	43	50	31	25	42	27	34	0	0	0	0	0	252	54.2%	156	6	5	4	2	0	1	0	0	0	0	0	0	18	11.5%	6.7%
District 2	637	59	34	55	55	59	52	44	0	0	0	0	0	358	56.2%	210	1	2	2	2	3	8	2	0	0	0	0	0	20	9.5%	5.3%
District 3	247	31	18	22	17	13	8	24	0	0	0	0	0	133	53.8%	98	1	5	5	2	2	1	1	0	0	0	0	0	17	17.3%	11.3%
District 4	766	35	78	62	63	63	54	53	0	0	0	0	0	408	53.3%	287	0	3	0	2											
District 5	566	66	29	27	36	33	52	36	0	0	0	0	0	279	49.3%	99	14	7	0	8											
District 6	631	67	44	51	58	37	39	55	0	0	0	0	0	351	55.6%	81	19	2	0	7											
District 7	349	16	24	32	35	10	23	25	0	0	0	0	0	165	47.3%	333	11	1	6	5											
District 8	348	17	29	17	28	34	20	23	0	0	0	0	0	168	48.3%	8	0	3	0	0											
TOTAL	**4,009**	**334**	**306**	**297**	**317**	**291**	**275**	**294**	**0**	**0**	**0**	**0**	**0**	**2,114**	**52.7%**	**1,272**	**52**	**28**	**17**	**29**	**49**	**25**	**22**	**0**	**0**	**0**	**0**	**0**	**222**	**17.5%**	**9.5%**

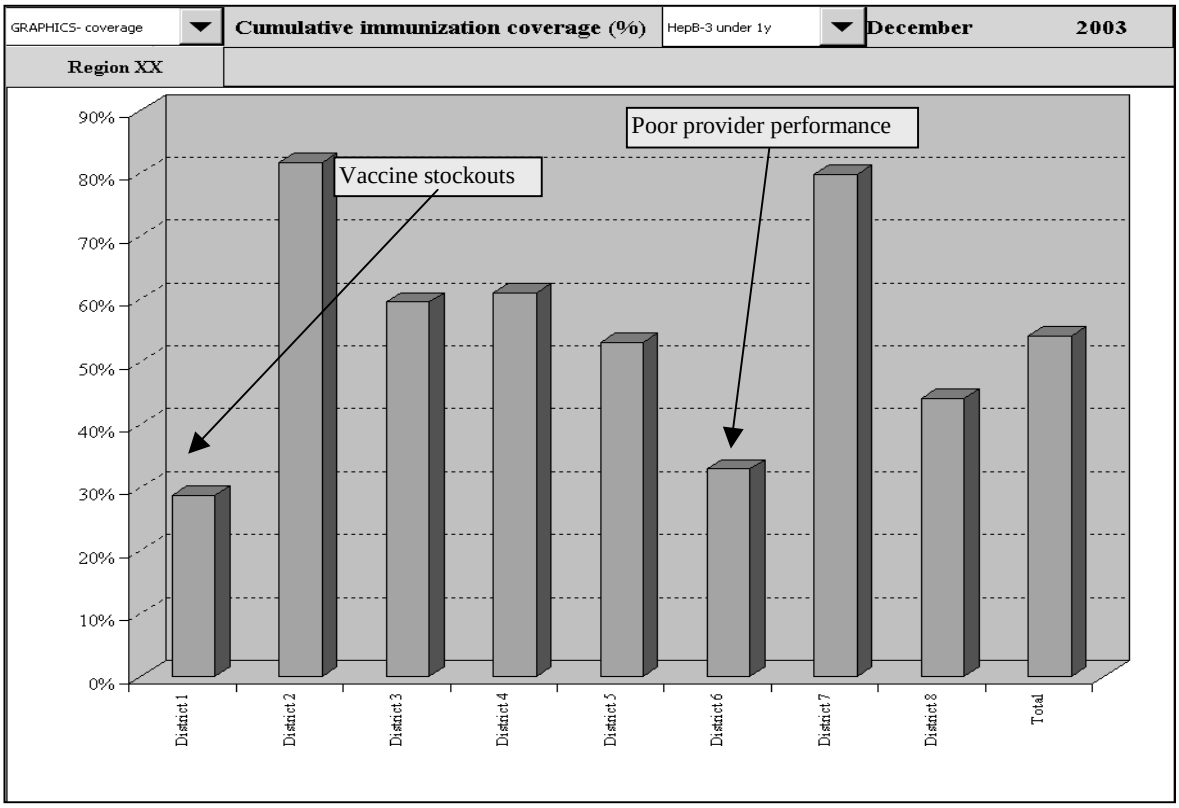
Measles-1 = 351 shots
Mumps-1 = 203 shots
351-203 = 148 missed opportunities in just one district during six months

Rayon/Town	Target	No. of mumps vaccinations given to children aged 12-24 mo														Target	Mumps vaccinations given to children over 24 mo													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%	Over 24mo as % of all Mumps
District 1	465	3	88	28	53	49	31	8	0	0	0	0	0	260	55.9%	3,052	5	12	8	6	5	15	1	0	0	0	0	0	52	1.7%	16.7%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	87	32	0	0	0	0	0	219	34.4%	6,353	0	0	0	0	0	82	8	0	0	0	0	0	90	1.4%	29.1%
District 3	247	31	18	22	23	13	18	24	0	0	0	0	0	147	59.5%	2,719	61	78	47	7	17	5	3	0	0	0	0	0	218	8.0%	59.7%
District 4	766	35	78	62	63	63	49	53	0	0	0	0	0	403	52.6%	6,788	89	28	170	69	29	9	20	0	0	0	0	0	414	6.1%	50.7%
District 5	566	82	30	17	57	4	50	36	0	0	0	0	0	276	48.8%	5,637	7	59	93	51	70	29	30	0	0	0	0	0	339	6.0%	55.1%
District 6	631	67	44	31	33	9	7	12	0	0	0	0	0	203	32.2%	10,934	73	38													
District 7	349	16	24	32	35	10	17	25	0	0	0	0	0	159	45.6%	2,026	78	107													
District 8	348	17	29	17	43	25	20	26	0	0	0	0	0	177	50.9%	1,560	62	137													
TOTAL	**4,009**	**251**	**311**	**209**	**307**	**173**	**377**	**216**	**0**	**0**	**0**	**0**	**0**	**1,844**	**46.0%**	**39,069**	**375**	**459**	**408**	**176**	**196**	**210**	**111**	**0**	**0**	**0**	**0**	**0**	**1,935**	**5.0%**	**51.2%**

No mumps vaccinations in this district for 5 months (!) due to vaccine stock-out

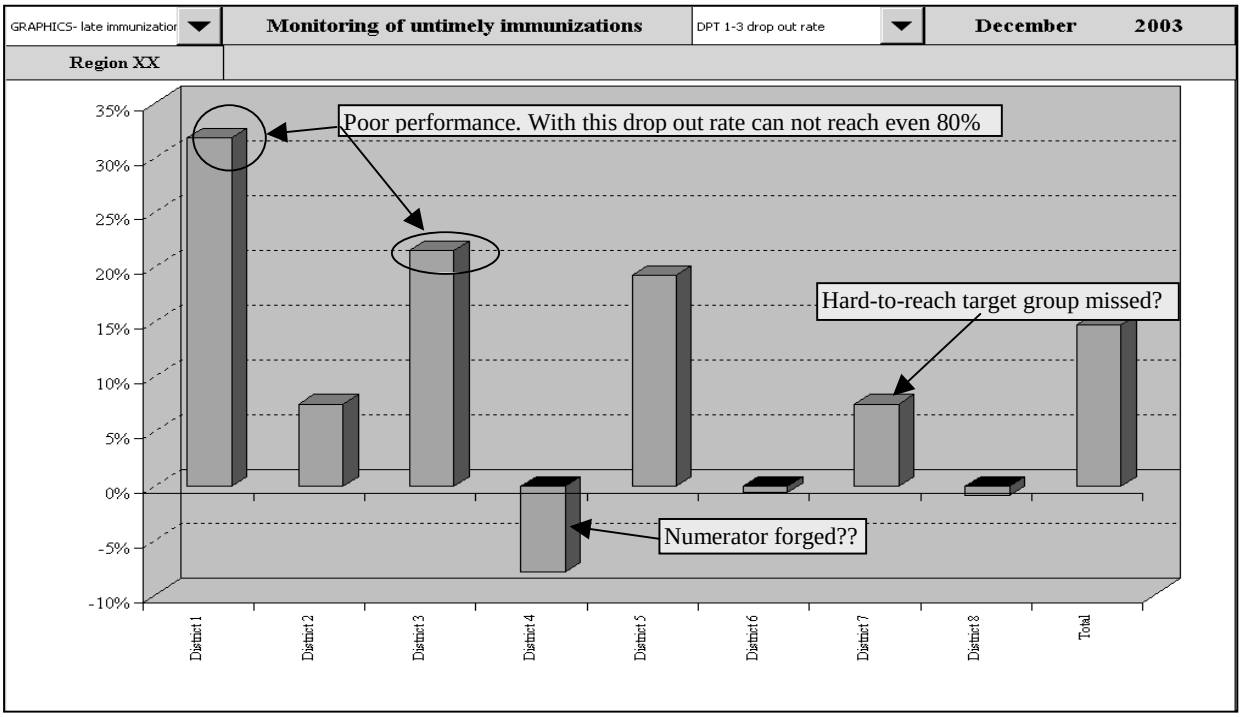
Rayon/Town	Target	No. of rubella vaccinations given to children aged 12-24 mo														Target	Rubella vaccinations given to children over 24 mo													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%	Over 24mo as % of all Rubella
District 1	465	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 2	637	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 3	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 4	766	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 5	566	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 6	631	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 7	349	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
District 8	348	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
TOTAL	**4,009**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.0%**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**#DIV/0!**	#DIV/0!

These data can also be shown graphically, allowing for easy comparison between districts. Cross-analysis of the data from various tables allows immunization managers to identify specific reasons for underperformance of districts or facilities; for example, failure to achieve vaccination coverage targets (see the following graph) may be due to lack of vaccine, high proportion of parental refusals, high proportion of contraindications, or simply poor performance of area providers. Once the reason(s) is known, the district/region can tailor measures to correct the problem.



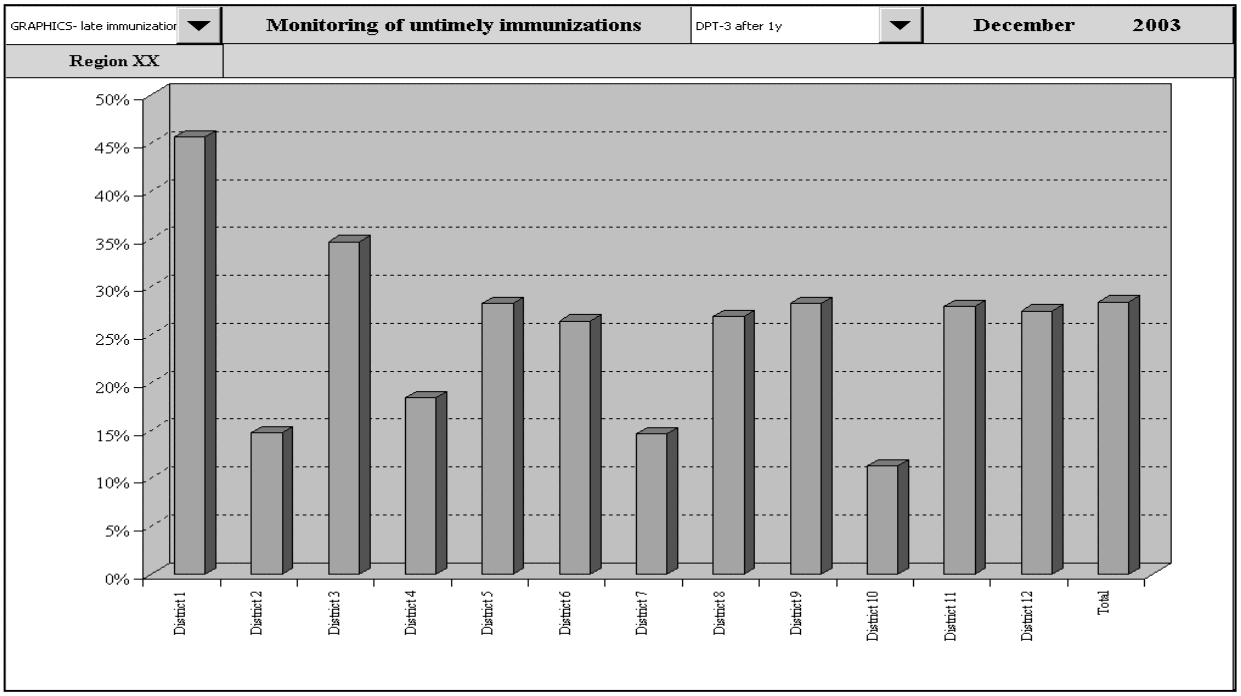
▲ Drop-out rates

Drop-out rate refers to the proportion of children who receive the first dose of a 3-dose vaccination series but do not get the final (third) dose. High drop-out rates will impede reaching vaccination coverage targets. Specific reasons for dropping out of the immunization schedule (contraindications? refusals? no vaccine?) need to be investigated using the information from other tables. For example, a combination of a low drop-out rate and a low coverage rate may indicate that a hard-to-reach population group is not getting even the first dose of the series (as seen in District 7 in the following graph). A negative drop-out rate is associated with poor data quality, often from the data having been tampered with at the peripheral level to make an impression of a better-than-actual performance.

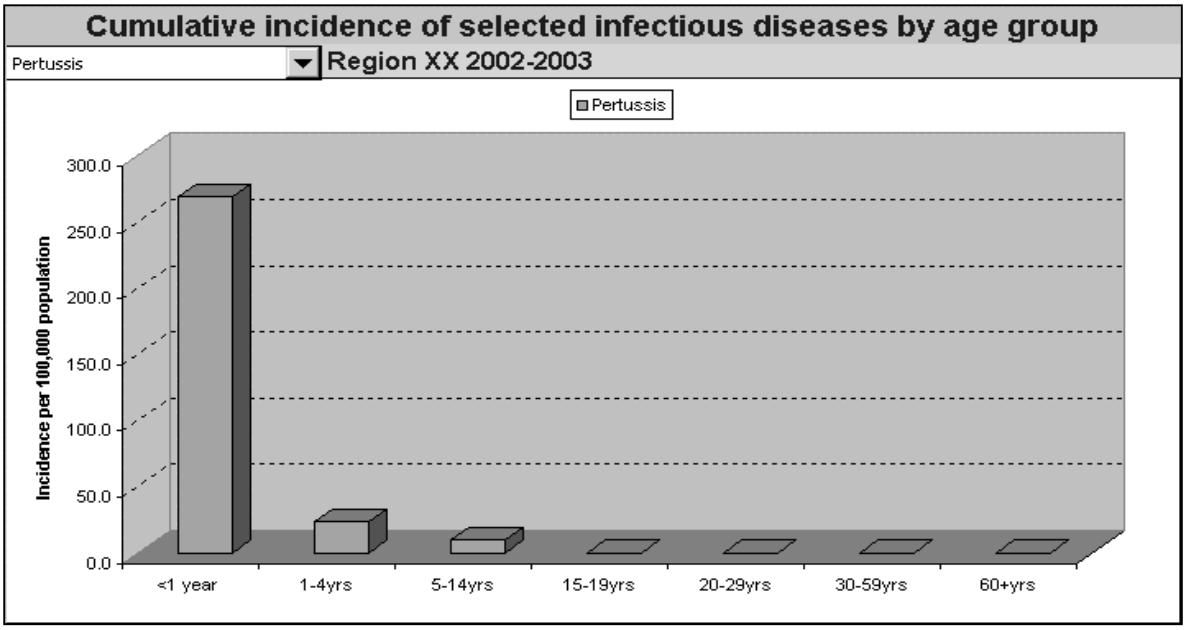


▲ Proportion of children immunized after established "deadlines"

Vaccinating children much later than envisioned in the immunization calendar is often inappropriate, because such children are left unprotected and susceptible to potentially life-threatening diseases. The following graph indicates that many districts are not putting adequate efforts in reaching children before their first birthday.

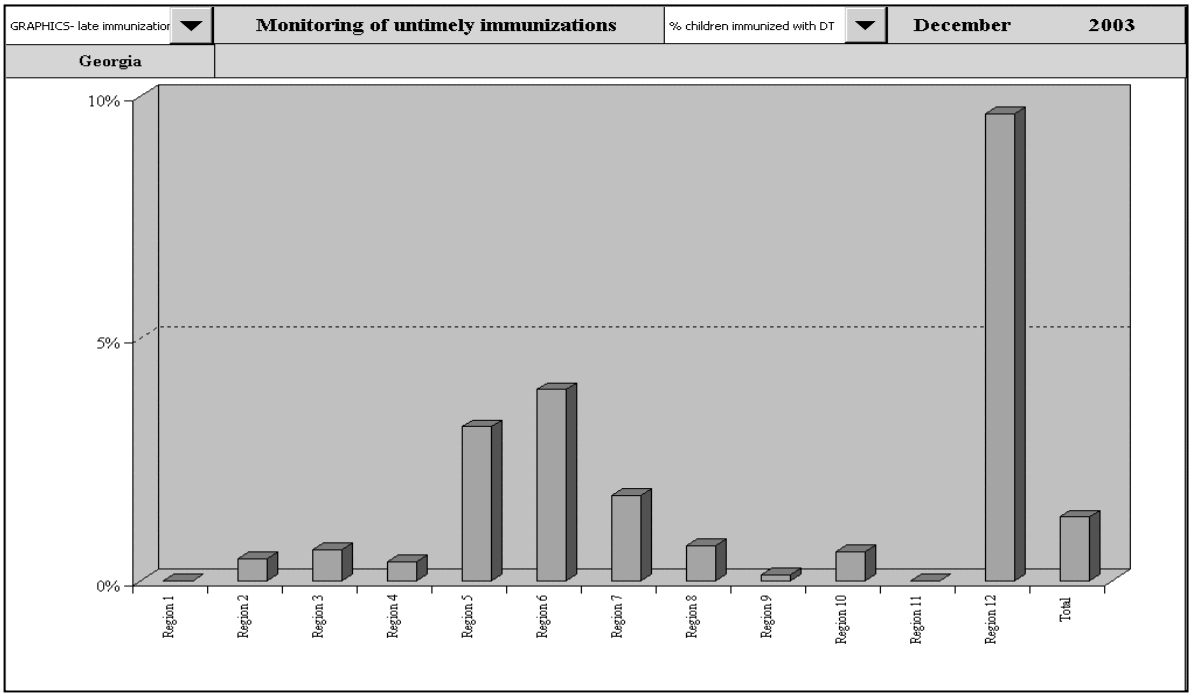


By looking at other data, one can also show the effects of untimely vaccinations. Note in the following figure how delayed pertussis immunization for more than 25 percent of children has resulted in a very high pertussis morbidity rate in this region.



▲ **Proportion of children immunized with DT as opposed to DPT**

Because GEOVAC facilitates data entry and analysis, managers will have time to explore many technical issues that they may not have looked at previously. For example, inappropriate practices like the one depicted in the following graph (9 percent of children immunized with DT as opposed to DPT) are often limited to only a few regions. The issue can be resolved through re-training of pediatricians in those areas.



4.3 Tables and Graphs on Contraindications and Refusals

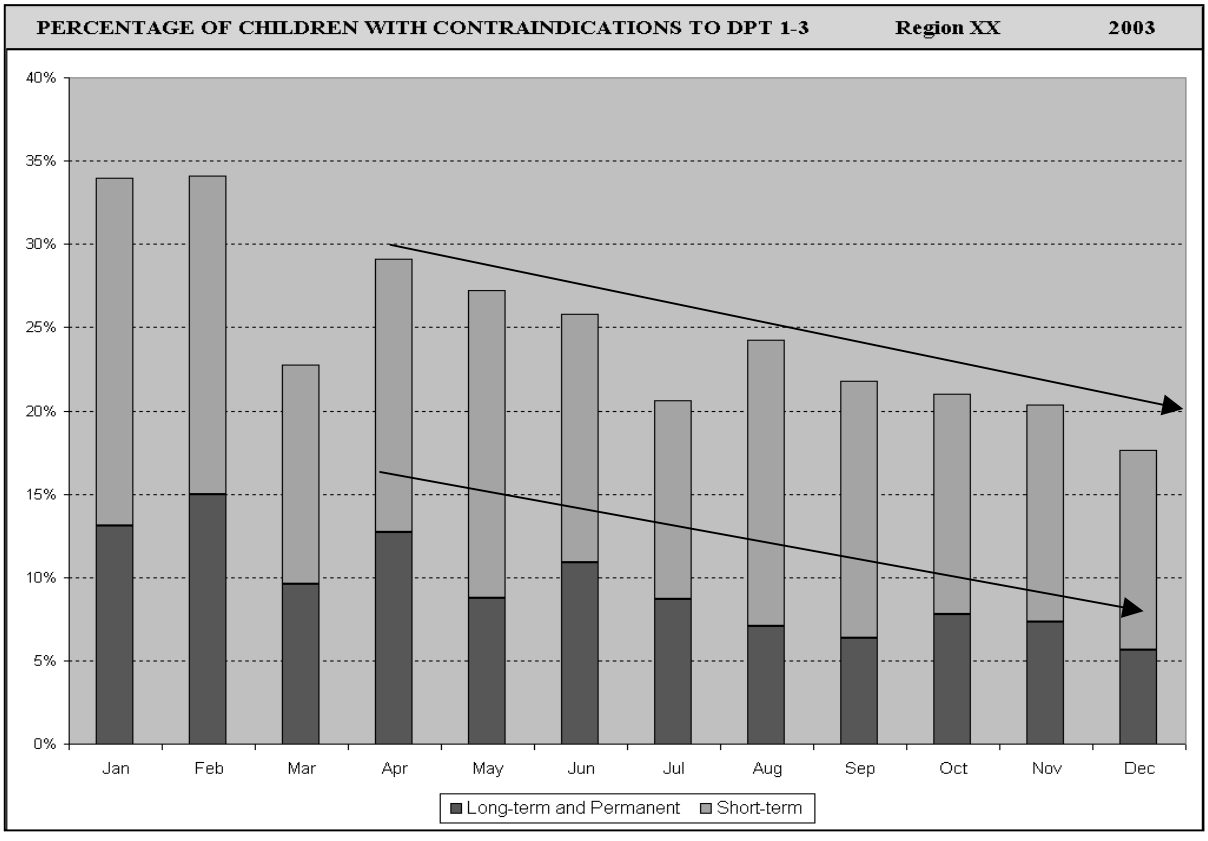
Medical contraindications and parental refusals are the main barriers to timely immunization of children.

GEOVAC allows the user to analyze these barriers by type (short-term, long-term, permanent), by region/district/town, by month, and by structure (e.g., DPT 1, 2 or 3). DPT vaccine has been chosen as a marker reflecting the situation with immunizations in general.

The following graphs and tables illustrate selected functions of the application related to the monitoring of the main immunization barriers.

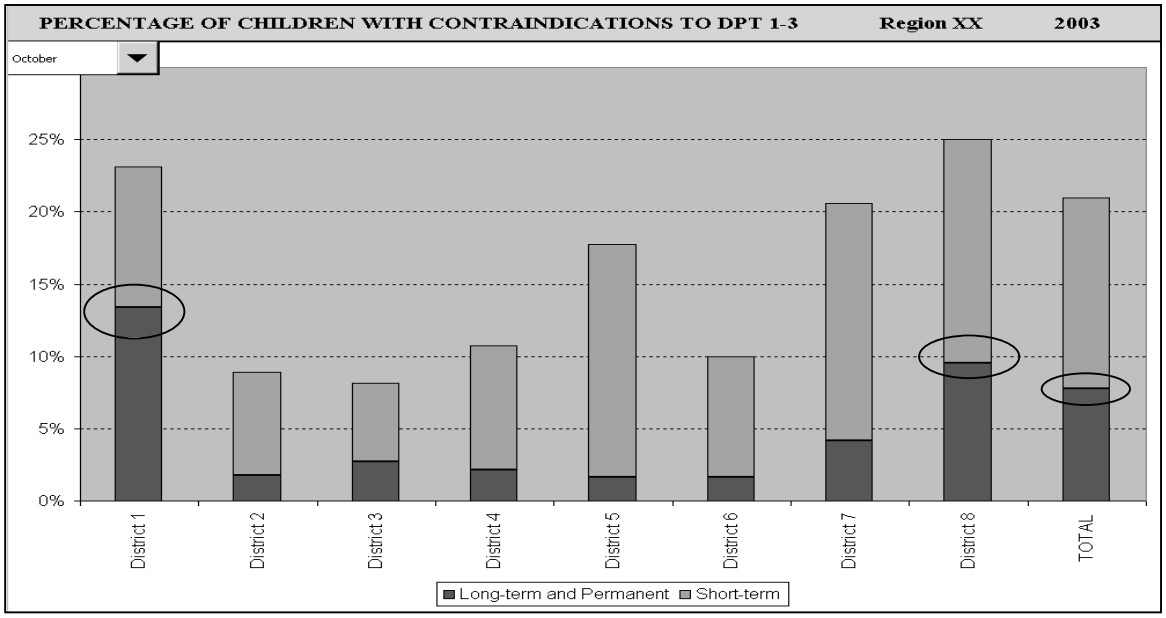
- **Percentage of children with long-term, permanent, and short-term contraindications to DPT 1-3 by month**

The issue of excessively administered contraindications (according to the World Health Organization, the rate of long-term and permanent contraindications should be less than 2 percent of children under 1 year of age) could be addressed through specific training of physicians and changes in regulations such as limiting the authority of a physician to delay immunization for 1 month only. Longer-term contraindications can be authorized only by the decisions of a district physician board. The graph below demonstrates that efforts to reduce contraindications using these strategies were successful in bringing down contraindications.



- **Percentage of children with long-term, permanent, and short-term contraindications to DPT 1-3 by district and month**

Further analysis can be very enlightening, and GEOVAC can help examine whether the problem is widespread or confined to individual districts. The following graph looks at the issue of contraindications to DPT 1-3, this time, by district, for selected month(s). As the graph shows, the problem is, in fact, confined to just a few districts, which makes it easier to address.



- **Percentage of children with refusals to DPT 1-3 by month and district**

With the help of the GEOVAC tool, it is not very difficult to identify areas (see highlighted rows) where parental education needs to be strengthened.

Rayon/Town	REFUSALS TO DPT 1-3											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[illegible]	[illegible]											
District 2	0%	0%	0%	7%	4%	0%	0%	0%	0%	0%	0%	0%
District 3	19%	17%	14%	0%	10%	11%	9%	3%	5%	5%	5%	5%
District 4	12%	7%	6%	3%	16%	7%	9%	4%	5%	11%	10%	10%
District 5	20%	24%	13%	7%	5%	4%	10%	6%	6%	2%	4%	3%
[illegible]	[illegible]											
District 7	8%	12%	12%	15%	6%	4%	5%	4%	4%	5%	8%	6%
District 8	1%	3%	2%	7%	5%	7%	3%	4%	4%	1%	3%	0%
[illegible]	[illegible]											
District 10	0%	0%	0%	9%	7%	6%	8%	4%	9%	0%	4%	2%
District 11	9%	0%	0%	9%	9%	6%	9%	0%	6%	21%	4%	4%
District 12	0%	0%	3%	0%	8%	0%	3%	6%	3%	7%	6%	7%
TOTAL	**12.9%**	**14.7%**	**7.6%**	**13.2%**	**11.6%**	**13.0%**	**10.4%**	**6.2%**	**8.3%**	**7.8%**	**9.0%**	**6.7%**

4.4 Tables and Graphs on Vaccine Flow and Use

For each of the vaccines used in Georgia, the GEOVAC worksheets allow the following to be done:

- Monitor vaccine flow by region and district every month
- Determine/project an annual need in vaccines at each level and monitor the proportion of the need already received
- Monitor vaccine balances at regional and district stores and in health facilities on a monthly basis
- Determine and monitor vaccine usage/wastage patterns by region/district and month

The following graphs and tables illustrate selected functions of the application related to the monitoring of vaccine flow and use

- **Projections of annual vaccine needs by rayon and by antigen**
- **Vaccine flow by antigen and by month**

WORKSHEET ON VACCINE NEED AND FLOW | Hepatitis B & Measles - flow | **Region ZZ** | 2003

HEP B

Rayons/towns	Rayon wastage factor (projected)	Annual need (doses)	Balance on 31.12	Shortfall (doses)	Received from RPHC: Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total received (doses)	Received + balance (doses)	% of the annual need	Used doses reported
District 1	1.30	2,706	132	2,574	240	174	300	0	0	60	460	0	0	0	0	0	1,234	1,366	50%	1,008
District 2	1.30	3,221	0	3,221	190	0	480	0	1,080	0	0	0	0	0	0	0	1,750	1,750	54%	1,186
District 3	1.30	1,183	54	1,129	84	0	300	0	240	0	420	0	0	0	0	0	1,044	1,098	93%	744
District 4	1.30	3,513	0	3,513	192	1,236	0	600	420	0	0	0	0	0	0	0	2,448	2,448	70%	2,118
District 5	1.30	2,605	24	2,581	540	0	120	720	0	210	210	0	0	0	0	0	1,800	1,824	70%	1,510
District 6	1.30	2,631	372	2,259	0	1,800	0	0	0	0	0	0	0	0	0	0	1,800	2,172	83%	1,488
District 7	1.30	2,129	0	2,129	60	360	504	0	0	120	420	0	0	0	0	0	1,464	1,464	69%	1,128
District 8	1.30	1,399	48	1,351	72	210	96	180	252	150	60	0	0	0	0	0	1,020	1,068	76%	912
TOTAL	1.30	19,386	630	18,756	1,378	3,780	1,800	1,500	1,992	540	1,570	0	0	0	0	0	12,560	13,190	68%	10,094

MEASLES

Rayons/towns	Rayon wastage factor (projected)	Annual need (doses)	Balance on 31.12	Shortfall (doses)	Received from RPHC: Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total received (doses)	Received + balance (doses)	% of the annual need	Used doses reported
District 1	1.60	2,420	440	1,980	0	0	1,200	0	0	0	1,870	0	0	0	0	0	3,070	3,510	145%	980
District 2	1.60	3,026	190	2,836	200	0	800	0	1,100	0	0	0	0	0	0	0	2,100	2,290	76%	1,440
District 3	1.60	1,260	80	1180	80	0	600	0	0	0	1,110	0	0	0	0	0	1,790	1,870	148%	600
District 4	1.60	3,770	0	3,770	0	610	300	0	0	160	0	0	0	0	0	0	1,070	1,070	28%	1,380
District 5	1.60	2,734	130	2,604	300	0	1,300	0	0	0	1,000	0	0	0	0	0	2,600	2,730	100%	1,350
District 6	1.60	2,760	610	2,150	0	860	0	0	0	0	1,000	0	0	0	0	0	1,860	2,470	89%	1,040
District 7	1.60	2,154	110	2,044	0	240	1,000	0	0	0	1,200	0	0	0	0	0	2,440	2,550	118%	850
District 8	1.60	1,564	500	1,064	100	100	800	0	0	0	1,000	0	0	0	0	0	2,000	2,500	160%	820
TOTAL	1.60	19,688	2,060	17,628	680	1,810	6,000	0	1,100	160	7,180	0	0	0	0	0	16,930	18,990	96%	8,460

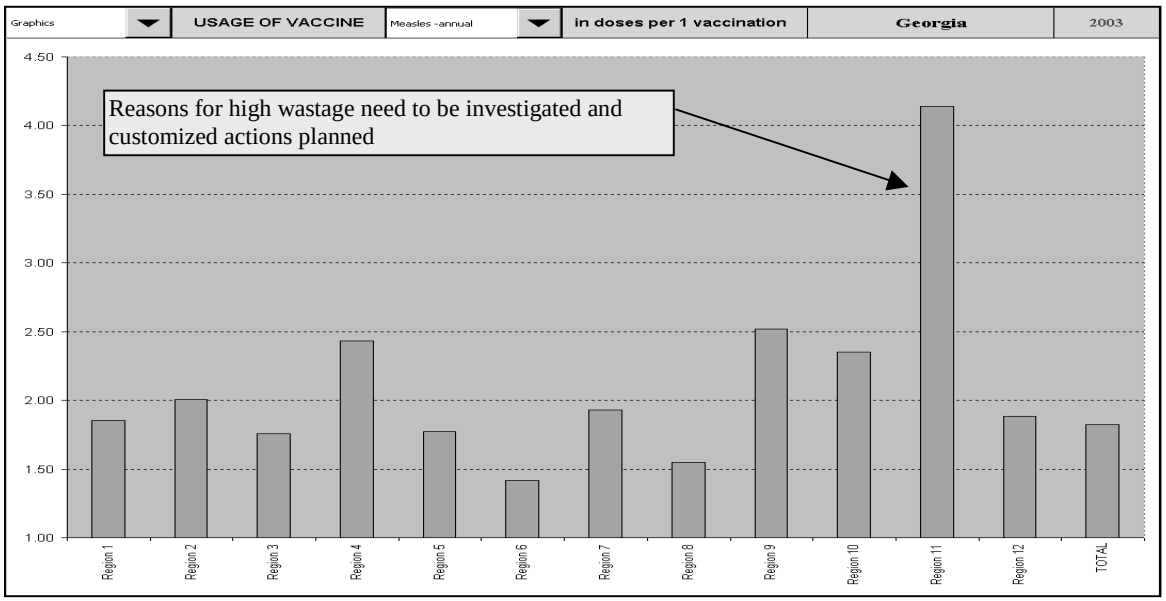
Annual need projections can take into account individual wastage rates in districts

Incorrectly reported measles vaccine receipts (1380 doses used, but only 1070 received)

Excessive supply increases the risk of vaccine damage due to improper storage conditions and may lead to stock-outs elsewhere

▲ Vaccine wastage by region, district, antigen, quarter

Vaccine wastage information can be displayed in many different ways, all of which provide the manager with critical information to understand the extent of the problem, the location of the problem, and other explanatory factors.



Monitoring wastage by quarter at every level allows immunization managers to see if the applied wastage reduction strategies work or not. Automatically highlighted vaccine use rates indicate excessive levels of vaccine usage. Vaccine wastage monitoring may also help determine areas where additional efforts are needed.

WORKSHEET ON THE USE OF VACCINE | Hepatitis B & Measles - usage | **in Region XX** | 2003

HEP B

Rayons/towns	January		February		March		April		May		June		July		August		September		October		November		December		Number of doses used per 1 vaccination			
	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	I quarter	II quarter	III quarter	IV quarter
District 1	576	359	462	230	420	246	438	331	396	301	402	340	462	400	270	237	558	489	750	693	676	612	703	660	1.78	1.27	1.15	1.08
District 2	30	22	90	55	84	60	84	76	102	79	78	60	96	64	78	46	115	96	108	80	102	73	101	66	1.49	1.29	1.41	1.42
District 3	222	92	186	104	192	154	168	130	288	183	186	97	258	115	168	149	234	143	300	252	210	168	210	180	1.71	1.57	1.62	1.20
District 4	78	74	168	135	222	146	210	140	162	154	198	177	210	163	192	156	294	255	186	146	138	111	174	148	1.32	1.21	1.21	1.23
District 5	42	31	84	64	84	55	90	56	78	48	108	81	78	54	66	51	90	68	63	49	72	65	89	61	1.40	1.50	1.35	1.28
District 6	60	47	30	26	78	57	48	43	90	49	66	47	72	54	48	38	120	51	102	69	72	63	66	50	1.29	1.47	1.68	1.32
District 7	114	105	240	186	210	201	186	166	300	216	216	208	216	193	216	187	300	279	408	327	312	283	269	259	1.15	1.19	1.11	1.14
District 8	78	27	186	117	121	69	96	87	132	99	162	77	108	65	60	30	188	138	183	88	156	101	173	73	1.81	1.48	1.53	1.95
District 9	382	64	96	54	126	86	126	83	168	125	180	117	144	79	90	42	130	106	108	91	140	117	132	108	2.96	1.46	1.60	1.20
District 10	36	22	132	116	240	168	132	124	120	114	138	109	198	124	150	122	185	164	175	165	174	149	205	171	1.33	1.12	1.30	1.14
District 11	60	49	96	58	96	81	132	72	126	93	118	47	164	64	66	52	174	66	114	61	60	55	156	82	1.34	1.77	2.22	1.67
District 12	12	11	96	57	72	55	90	73	108	74	72	70	108	69	48	31	146	100	100	53	96	52	58	41	1.46	1.24	1.41	1.74
TOTAL	1690	903	1866	1202	1945	1378	1800	1380	2070	1535	1924	1420	2114	1444	1452	1140	2634	1955	2597	2073	2208	1849	2336	1899	1.58	1.34	1.34	1.23

MEASLES

Rayons/towns	January		February		March		April		May		June		July		August		September		October		November		December		Number of doses used per 1 vaccination			
	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	used (dose)	Immunizations made	I quarter	II quarter	III quarter	IV quarter
District 1	460	280	610	394	630	408	580	367	520	304	650	381	540	400	340	248	890	609	460	327	390	318	292	143	1.60	1.66	1.53	1.45
District 2	50	12	50	22	80	31	60	22	120	58	120	52	100	40	70	29	150	56	40	20	120	78	74	58	2.77	2.27	2.86	1.50
District 3	230	60	200	52	150	102	170	73	250	79	130	55	220	63	200	64	340	211	240	179	100	69	132	106	2.71	2.66	2.25	1.33
District 4	90	59	90	66	120	98	130	81	100	67	150	77	130	76	220	180	460	351	80	65	110	89	96	72	1.35	1.69	1.33	1.27
District 5	100	23	110	38	260	69	140	24	80	39	140	57	140	70	80	45	120	46	80	37	20	17	54	42	3.62	3.00	2.11	1.60
District 6	100	33	60	56	80	72	50	37	60	24	50	27	30	26	40	27	110	81	70	48	20	12	54	34	1.49	1.82	1.34	1.53
District 7	260	108	260	250	180	137	160	121	180	94	200	116	270	164	400	247	300	223	200	99	190	90	144	129	1.41	1.63	1.53	1.68
District 8	70	30	120	33	80	19	50	36	110	95	250	126	170	55	50	31	160	113	150	74	20	7	122	75	3.29	1.60	1.91	1.87
District 9	230	70	130	79	170	52	150	71	190	74	160	60	122	99	150	61	130	69	140	56	160	57	72	66	2.64	2.44	1.76	2.08
District 10	120	74	70	15	120	60	90	38	140	96	190	151	440	318	170	132	140	102	120	75	110	65	84	46	2.08	1.47	1.36	1.69
District 11	60	10	130	22	80	22	80	25	110	39	60	15	100	19	120	44	150	83	80	32	60	27	96	57	5.00	3.16	2.53	2.03
District 12	50	26	80	36	70	25	120	34	90	49	210	148	160	108	70	31	120	31	60	53	40	14	50	48	2.30	1.82	2.06	1.30
TOTAL	1820	765	1910	1063	2020	1095	1780	929	1950	1018	2310	1265	2422	1438	1910	1139	3070	1875	1720	1065	1340	843	1270	876	1.97	1.88	1.66	1.56

Wastage reduction strategies seem to be working in this region: note how wastage factor decreases every quarter

Optimization of procurement through a mix of different size vial products and adoption of wastage reduction policies (such as multi-dose policy) nationwide may free up funds for the procurement of other vaccines, like rubella, which currently appear to be unaffordable.

VACCINE USAGE summary in Region XX 2003 — Vaccine Usage Summary

Rayons (Towns)	BCG			Polio			DPT			Hepatitis B			DT			Measles			Mumps			Rubella			MMR			Td		
	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor	Doses Used	Immunizations Made	USAGE factor
District 1	7,400	2,301	3.22	12,270	8,044	1.53	8,481	6,603	1.28	6,113	4,898	1.25	1,150	990	1.16	6,362	4,059	1.57	2,774	2,540	1.09	0	0	###	0	0	###	2,480	1,846	1.34
District 2	740	134	5.52	2,440	1,140	2.14	1,700	903	1.88	1,068	766	1.39	370	219	1.69	1,034	478	2.16	456	385	1.18	0	0	###	0	0	###	510	431	1.18
District 3	1,170	215	5.44	5,300	2,410	2.20	3,630	2,107	1.72	2,622	1,767	1.48	290	167	1.74	2,362	1,113	2.12	1,216	721	1.69	0	0	###	0	0	###	851	638	1.33
District 4	850	415	2.05	3,830	2,669	1.43	3,180	2,540	1.25	2,232	1,804	1.24	80	59	1.36	1,776	1,281	1.39	968	815	1.19	0	0	###	0	0	###	620	496	1.25
District 5	700	153	4.58	2,150	1,091	1.97	1,660	1,055	1.57	944	682	1.38	110	23	4.78	1,324	507	2.61	360	287	1.25	0	0	###	0	0	###	350	279	1.25
District 6	440	60	7.33	1,510	1,124	1.34	1,350	974	1.39	852	594	1.43	200	137	1.46	724	477	1.52	446	350	1.27	0	0	###	0	0	###	465	371	1.25
District 7	1,260	580	2.17	4,950	3,742	1.32	4,060	3,236	1.25	2,987	2,610	1.14	187	160	1.17	2,744	1,778	1.54	772	720	1.07	0	0	###	0	0	###	1,110	879	1.26
District 8	900	244	3.69	3,710	1,504	2.47	2,340	1,304	1.79	1,643	971	1.69	360	148	2.43	1,352	694	1.95	678	505	1.34	0	0	###	0	0	###	640	440	1.46
District 9	1,190	290	4.10	3,800	2,085	1.82	3,240	1,957	1.66	1,822	1,072	1.70	220	134	1.64	1,804	814	2.22	774	579	1.34	0	0	###	0	0	###	556	399	1.39
District 10	840	316	2.66	3,450	2,166	1.59	2,664	1,799	1.48	1,885	1,548	1.22	530	322	1.65	1,794	1,172	1.53	808	699	1.16	0	0	###	0	0	###	800	585	1.37
District 11	500	42	###	3,120	1,239	2.52	2,130	967	2.20	1,362	780	1.75	380	170	2.24	1,126	395	2.85	658	412	1.60	0	0	###	0	0	###	520	349	1.49
District 12	620	108	5.74	2,050	1,097	1.87	1,680	944	1.78	1,006	686	1.47	250	125	2.00	1,120	603	1.86	500	393	1.27	0	0	###	0	0	###	550	402	1.37
TOTAL	16,610	4,858	3.42	49,580	28,311	1.72	36,115	24,389	1.48	24,536	18,178	1.35	4,127	2,654	1.56	23,822	13,371	1.76	10,409	8,406	1.24	0	0	#DIV/0!	0	0	#DIV/0!	9,452	7,115	1.33

▲ Vaccine balances at health settings and CPH by antigen, month and district

Rational vaccine stock management is a key to the uninterrupted functioning of the immunization program.

The GEOVAC Worksheet on the Balance of Vaccines makes this task easier by helping health workers determine a "safety minimum" of vaccine stock at their level in order to re-order vaccines in a timely manner when available supplies drop below the recommended level. The table below demonstrates that few districts have the necessary safety minimum in stock and some have critical stock-outs of major vaccines.

WORKSHEET ON THE BALANCE OF VACCINES in CPH and health settings at the end of

December — **Region XX** 2003

Rayons/towns	BCG				POLIO				DPT				DT				Td				Hepatitis B			
	in RPHC	in health settings	RPHC + health settings	Safety minimum	in RPHC	in health settings	RPHC + health settings	Safety minimum	in RPHC	in health settings	RPHC + health settings	Safety minimum	in RPHC	in health settings	RPHC + health settings	Safety minimum	in RPHC	in health settings	RPHC + health settings	Safety minimum	in RPHC	in health settings	RPHC + health settings	Safety minimum
District 1	780	200	980	3,242	1020	0	1,020	4,288	660	490	1,150	3,066	920	210	1,130	1,225	320	400	720	1,073	954	584	1,538	2,604
District 2	100	40	140	267	260	0	260	325	210	10	220	258	10	0	10	87	190	0	190	160	78	46	124	275
District 3	40	20	60	653	280	0	280	820	260	80	340	675	60	40	100	178	70	20	90	336	186	12	198	666
District 4	120	20	140	844	110	0	110	1,152	160	10	170	867	150	0	150	471	30	10	40	623	102	42	144	688
District 5	40	0	40	347	120	0	120	482	120	10	130	365	0	0	0	145	100	0	100	172	30	9	39	262
District 6	80	0	80	301	140	0	140	434	110	90	200	300	20	30	50	426	60	20	80	679	186	42	228	275
District 7	40	60	100	1,034	60	0	60	1,158	50	80	130	930	0	43	43	306	30	0	30	366	0	49	49	825
District 8	0	100	100	488	190	0	190	635	180	60	240	470	240	50	290	382	70	20	90	544	288	30	318	423
District 9	140	0	140	649	300	0	300	875	340	190	530	648	20	10	30	252	170	60	230	330	222	112	334	503
District 10	0	0	0	575	0	0	0	729	70	156	226	595	0	40	40	178	80	60	140	226	90	90	180	415
District 11	0	200	200	269	490	0	490	401	160	90	250	329	80	20	100	111	140	0	140	127	114	42	156	275
District 12	80	0	80	338	120	0	120	356	170	0	170	275	0	0	0	105	50	0	50	132	49	0	49	212
TOTAL	1,420	640	2,060	9,006	3,090	0	3,090	11,656	2,490	1,266	3,756	8,779	1,500	443	1,943	3,864	1,310	590	1,900	4,767	2,299	1,058	3,357	7,424

Critical vaccine stock-outs of major vaccines

5. In Conclusion

Countries that plan to strengthen their immunization information systems as well as donor organizations that are interested in supporting these efforts should consider investing a small portion of their funds in the development of a simple and unpretentious supplementary tool such as the GEOVAC application, which can easily maintained and modified in-country, without external technical assistance.

Such a tool systematizes the process of using information technology for immunization data processing at the provincial and peripheral levels in countries where health systems are underfunded, but where, nevertheless, technology is becoming widely available. It makes data processing and analysis much more efficient, and allows users to quickly find the underlying roots of the problems and to perform the types of analyses that they may not have done before due to either mathematical complexity or limited amount of time available for data processing.

Because it transforms data into information rapidly and in a format that assists interpretation, a software application like GEOVAC is also a very powerful tool to facilitate data utilization for management at all levels of the health system. Some examples of the types of managerial decisions made with the help of GEOVAC that were observed in Georgia included improved vaccine supply management resulting in fewer stock-outs at the peripheral level, establishment of physician commissions to deal with excessive administration of contraindications, timely follow-up with poorly performing facilities, and adoption of new vaccine wastage reduction strategies, such as the multi-dose policy, stakeholder discussions of the need to optimize the national vaccine procurement strategy.

Although GEOVAC was developed specifically for the Immunization MIS system in Georgia, similar software could easily be created for other countries that wish to improve their MIS.

Annex: Sample District Level Immunization

REPORT on CONDUCTED PREVENTIVE VACCINATIONS

Distict 1 | November | 2003

Immunizations Given				Use of Vaccine in Doses					
Vaccine	**Age at vaccination**	Number of vaccinated	Total Immunizations Given	Balance at the beginning of the period (doses)	Received (doses)	ISSUED (doses)	Balance at the Rayon CPH the end of the period (doses)	BALANCE at health care settings at the end of the period (doses)	TOTAL AMOUNT OF VACCINE USED (doses)
1	**2**	3	4	5	6	7	8=5+6-7	9 from column 7 (1.8)	10 from column 8 (1.8)
BCG-v	0-5 days		Total				0		
	More than 6 days		**0**						
BCG -2	5 years +								
DPT-1	2months -11mo 29d	13	Total	140	200	150	190	30	150
Diphtheria-Tetanus-Pertusis-1	More than 1 year	4							
DPT-2	3months -11mo 29d	23	**86**						
Diphtheria-Tetanus-Pertusis-2	More than 1 year	3							
DPT-3	4months -11mo 29d	12							
Diphtheria-Tetanus-Pertusis-3	More than 1 year	6							
DPT-4	18 - 24 months	21							
Diphtheria-Tetanus-Pertusis-4	More than 24 months	4							
DT-1	under 1 year		Total				0		
Diphtheria-Tetanus- 1	More than 1 year								
DT-2	under 1 year								
Diphtheria-Tetanus- 2	More than 1 year								
DT-3	under 1 year		**0**						
Diphtheria-Tetanus- 3	More than 1 year								
DT-4	18 months +								
DT	5 years- 5 y11mo29d								
Diphtheria-Tetanus	More than 6 years								
OPV-1	2months -11mo 29d	13	Total	280	200	150	330	30	190
Poliomyelitis -1	More than 1 year	4							
OPV-2	3months -11mo 29d	23							
Poliomyelitis -2	More than 1 year	3							
OPV-3	4months -11mo 29d	12							
Poliomyelitis -3	More than 1 year	6	**137**						
OPV-4	18 -24 months	21							
Poliomyelitis -4	More than 24 months	4							
OPV-5	5 years- 5 y11mo29d	50							
Poliomyelitis -5	More than 6 years	1							
Other OPVs									
VHB-1	0-24 hours	7	Total	60	120	102	78	36	102
Viral Hepatitis B-1	25 hours -11mo 29d	3							
	More than 1 year	4							
VHB-2	2months -11mo 29d	24							
Viral Hepatitis B-2	More than 1 year	2	**73**						
VHB-3	3months -11mo 29d	23							
Viral Hepatitis B-3	More than 1 year	10							
Other Hepatitis B-1									
Other Hepatitis B-2									
Other Hepatitis B-3									
Measles 1	12 -24 month	24	Total	120		100	20	20	120
	More than 24 months								
Measles -2	5 years- 5 y11mo29d	54	**78**						
	More than 6 years								
Other Measles									
Mumps	12 -24 month	20	Total	66		38	28	12	48
	More than 24 months	24	**44**						
Other Mumps									
Rubella	12 -24 month		Total				0		
	More than 24 months		**0**						
MMR	12 -24 months		Total				0		
	More than 24 months								
	5 years - 5y11mo29d		**0**						
	More than 6 years								
MR	12 -24 months		Total				0		
	More than 24 months								
	5 years - 5y11mo29d		**0**						
	More than 6 years								
Td **Tetanus - Diphtheria**	14 years	104	Total	150	100	60	190	10	120
Td Other			**104**						
Syringe Disposal Containers				16	12	3	25	11	3
TIMELINESS	No. of children born in		June	2003	(5mo prior to the report month)=>				15
	Of these - no. of children who finished primary immunization at 4mo29d =>								7

REFUSALS		CONTRAINDICATIONS TO DTP			
			Short-term	Long-term	Permanent
DTP-1 (under 1y)	0	DTP-1 (under 1y)		2	
DTP-2 (under 1y)	0	DTP-2 (under 1y)	1	1	
DTP-3 (under 1y)	0	DTP-3 (under 1y)	2		
TOTAL refusals	**0**	**TOTAL contraindications (short+long+perm)**			**6**