Draft of Third Edition (4 May 2007)

Mongolia's Comprehensive Multi-Year Plan for Immunization (2007-2012)

Ministry of Health, Mongolia
National Center for Communicable Diseases

Contents

Executive Summary

This document is the third edition of the Comprehensive Multi-year Plan (cMYP) for the National Immunization Program (NIP) in Mongolia. This Plan covers the extended period of 2007-2012.

The Plan was developed by staff of the National Center for Communicable Disease (NCCD) supported by Ministry of Health Mongolia, WHO, UNICEF and international partners, JICA and GAVI. This version replaces and updates the earlier cMYPs developed for various periods extending up to the year 2010.

This revised Plan first details some of social, economic and health sector context for Mongolia at the current time. It notes that Mongolia is making good progress as a developing country but still faces important challenges relating to such factors as poverty, inequality, climatic extremes and global commodity price fluctuations.

With regard to immunization, Mongolia has had a very successful immunization program. Some of its major successes include the following:

- Early 1990s: Maintaining high immunization coverage despite the country undergoing major social and economic transition.
- 1992: Introduced hepatitis B vaccine into the national routine immunization schedule.
- 2000: Certified "polio free" by WHO.
- 2005: Introduced AD syringes with GAVI support replacing the earlier disposable syringes; Introduced Hib vaccine as part of a pentavalent vaccine (DTP-HepB-Hib).
- 2006: Marked decline in Hib meningitis reported in Ulaanbaatar following pentavalent vaccine introduction.
- Last five years: Conducted an active operational research program that has aimed to identify ways to improve the cold chain and assess immunization services through a sero-survey.

Furthermore, Mongolia's NIP has achieved high levels of immunization coverage and has made good progress towards measles elimination. But despite these achievements, many challenges remain before the full benefit of immunization can be realized for the people of Mongolia. The five top priority objectives to meet these challenges are:

- Objective 1: Maintaining control of vaccine-preventable diseases with high immunization coverage
- Objective 2: Improving hepatitis B control
- Objective 3: Achieving measles elimination by 2012
- Objective 4: Improving the overall quality of the National Immunization Program
- Objective 5: Evaluation and introduction of new vaccines

For each of these objectives various strategies have been developed. For each strategy there are indicators of progress described.

A key challenge is also ensuring the sustainable funding of the NIP. The third part of this Plan details the estimated costs of the objectives being meet and the funding gaps. The fourth part of this plan details how these funding gaps can be met and how sustainability can be achieved for the National

Immunization Program in Mongolia. The key needs are for additional funding by both the Government of Mongolia and donor organizations if the all the objectives are to be met.

List of acronyms and terms

AD syringes	Auto-disabled syringes
ADB	Asian Development Bank
AEFI	Adverse events following immunization
Aimag	The province level in Mongolia (there are 21 aimags in Mongolia)
Bag	The smallest geographic unit used in descriptions of the Mongolian health system. It typically consists of 10 to 100 ger dwelling families, and is most often served by a "feldsher" (physician's assistant)
BCG	Bacille-Calmette Guerine Vaccine
CBAW	Women in child-bearing age group
cMYP	Comprehensive multi-year plan (ie, this document)
c-VDPV	Circulating-vaccine derived polio virus
District	In Mongolia there are 9 districts within Ulaanbaatar city
DQS	Data quality self-assessment
DTP	Diphtheria-tetanus-pertussis vaccine
DTP3	Third dose of DTP vaccine
DTP-HepB-Hib	A pentavalent vaccine used in Mongolia (for around 75% of the country in 2007)
EPI	Expanded Program for Immunization
Feldsher	A community health worker or physician's assistant
GAVI	Global Alliance for Vaccines and Immunization (now known as the GAVI Alliance)
Global PneumoADIP	Pneumococcal Vaccines Accelerated Development and Introduction Plan
HBIG	Hepatitis B immunoglobulin
HBV	Hepatitis B virus
HepB3	Third dose of hepatitis B vaccine
Hib	*Haemophilus influenzae* type b
HPV	Human papilloma virus
ICC	Interagency Coordination Committee (for immunization)

ISS	Immunization Services Support
JICA	Japan International Cooperation Agency
MNT	Maternal and neonatal tetanus
MOH	Ministry of Health
MMR	Measles, mumps and rubella vaccine
MSV1	Measles vaccine first dose
MSV2	2nd dose of measles vaccine
MYP	See cMYP
NIP	National Immunization Program
OPV	Oral Polio Vaccine
OPV3	Third dose of OPV vaccine
PneumoADIP	See: Global PneumoADIP
SIA	Supplementary immunization activity (eg, used in campaigns to achieve measles elimination)
SNID	Sub-national immunization days
Soum	An administrative level in Mongolia (there are around 15 per aimag and 333 in total). A soum is composed of a variable number of bags and has a small hospital (20-30 beds) serving an average of 2,500 people within a radius of 80 kilometers
UNICEF	United Nations Children Fund
VAT	Value-added tax (is now 10% in Mongolia, down from 15% before the 2007 budget)
VPDs	Vaccine-preventable diseases
WHO	World Health Organization
Zud	Winter disaster (eg, the severe winters of 1999-2000 and 2001-2002)

Part I: Background and challenges for improving immunization in Mongolia

1.1 Introduction to this Plan

This is the third edition of Mongolia's cMYP for the National Immunization Program (NIP). This new version of the cMYP was required to align the plan with various goals for year 2012 (the previous version went only to 2010) and to bring it into alignment with other health sector plans that extend to the year 2012 or 2015. Also there was new information from research and various changes in the NIP in 2006 that made it desirable to update the Plan. Other organisations that include GAVI, JICA, UNICEF and WHO have also made helpful suggestions on the previous versions of the cMYP and these have been used to help improve it.

Please provide any feedback on this cMYP to the staff of the EPI Team at the National Center for Communicable Diseases (NCCD).

1.2 Social, economic and health sector context of Mongolia

Mongolia is a developing country with a population of 2.6 million people [UNDP 2006]. It is relatively urbanized with over half the population living in urban areas (56.6% in 2004). The population is also growing at 1.2% per year (for 2004). Even so it remains the country with the world's lowest population density, due to its large land area.

Since the early 1990s Mongolia has undergone rapid social and economic transformations. Economic growth averaged 2.4% between 1990 and 2004 [UNDP 2006] and is now around 6% per annum. Communication technologies are being adopted and mobile phone use is growing as is access to the Internet (80 per 1000 people in 2004) [UNDP 2006]. Major issues still facing Mongolia include poverty and inequality, as detailed below.

Persisting poverty: In 2005 the Gross National Income per capita for Mongolia was $US 690 (World Bank data). Also the "Human Development Index" (HDI) for Mongolia was 0.691 which was ranked 116th in the world out of 177 countries in 2004 (in the "medium human development" zone of countries) [UNDP 2006]. The HDI for Mongolia has increased since 1995 when it was 0.634. The 2004 HDI level for Mongolia compares to a high in the region of 0.949 (Japan) and a low of 0.553 (Laos).

On the human poverty index (HPI-1), Mongolia has a rank of 42 out of 102 developing countries [UNDP 2006]. Of children under age five years, 13% are under weight for age. A total of 35.6% of the population live below the income poverty line and 27.0% live under $US 1 per day.

More specifically, only 59% of the population had sustainable access to improved sanitation [UNDP 2006]. Also, 28% of the population are considered undernourished and 25% of children aged under five years are under height for age.

Inequality: There is also evidence that income inequalities have got worse in recent years. The poorest 10% of the population get 2.1% of the income in the country while the richest 10% get 37.0% [UNDP 2006]. The Gini index (a measure of income inequality) is quite high in Mongolia at 30.3% (but this is still much less than China at 44.7) [UNDP 2006]. Poverty particularly affects remote rural and nomadic populations as well as recent migrants to urban areas.

Economic prospects: The economic prospects for Mongolia are probably fairly favorable. Exports are increasing and there are prospects for Mongolia extracting more of its mineral wealth in the future (62% of exports are primary exports and this includes minerals [UNDP 2006]). Nevertheless, the country remains vulnerable to fluctuating commodity prices on world markets. It is also vulnerable to extreme weather events such as severe winters and drought (eg, the severe winters of 1999-2000 and 2001-2002, a "zud" (winter disaster) for Mongolia). It is still unclear what impact global climate change will have on Mongolia but it could exacerbate the severity of extreme weather events (eg, droughts).

Mongolia received $US 261.9 million in official development assistance in 2004 ($100.2 per capita [UNDP 2006]. This comprised 16.2% of GDP which indicates that Mongolia is not particularly dependent on development assistance. Also, the country is not heavily burdened by foreign debt with debt servicing at a relatively low level (ie, 2.5% of GDP) [UNDP 2006].

Government goals and expenditure on health: The Government of Mongolia is committed to improving the health status of its people [Government of Mongolia 2005a]. It is also the major spender on health in the country (see Table 1.1). Immunization is a particularly cost-effective means to reduce infant mortality and it also contributes to raising life expectancy. This is through its impact on reducing infant mortality but also on reducing adult mortality (eg, hepatitis B immunization reduces the risk of fatal liver disease in adults). Indeed, hepatitis B immunization is one of the best ways for Mongolia to prevent its current major type of cancer which is liver cancer [D.Gantulga et al 2005a]. Immunization is also likely to reduce certain types of health care costs eg, the treatment of vaccine preventable diseases (such as meningitis or pneumonia from Hib disease).

Future prospects for Government health spending: Overall the long term prospects for increased Government expenditure on health in Mongolia would appear promising on the grounds that:

- The macroeconomic prospects for the country are improving (see above).
- The Government has stated its strong commitment to meeting its health targets – as per the *Health Sector Strategic Master Plan*.
- There is a growing international evidence of the value of investing in health as a means to enhance national social and economic development.

Table 1.1: Selected aspects of health financing in Mongolia

Indicator	Value
Total expenditure on health as percentage of gross domestic product	6.7
General government expenditure on health as percentage of total expenditure on health	63.8
Private expenditure on health as percentage of total expenditure on health	36.2

General government expenditure on health as percentage of total government expenditure	10.3
External resources for health as percentage of total expenditure on health	3.2
Social security expenditure on health as percentage of general government expenditure on health	37.8
Out-of-pocket expenditure as percentage of private expenditure on health	91.1
Private prepaid plans as percentage of private expenditure on health	0.0
Per capita total expenditure on health at average exchange rate (US$)	33
Per capita total expenditure on health at international dollar rate	140
Per capita government expenditure on health at average exchange rate (US$)	21
Per capita government expenditure on health at international dollar rate	90

Source: The most recent (2003) data from the WHO website: (http://www3.who.int/whosis/core/core_select_process.cfm?country=mng&indicators=nha&language=en)

1.3 Background to the National Immunization Program in Mongolia

Mongolia started immunization services in 1961 and a national immunization program (NIP) has been implemented since 1993. The immunization program has been very successful as reflected in historical low levels of morbidity and mortality attributable to the diseases currently targeted by the national immunization program. Regular reviews of the NIP have been organized to monitor the program. The Ministry of Health (MOH) and Asian Development Bank (ADB) conducted a joint financial assessment in 2000 and a joint EPI review was conducted in 1997 and 2002 by MOH, WHO, UNICEF and JICA.

Summary of the major successes of the NIP in Mongolia

- Early 1990s: Maintaining high immunization coverage despite the country undergoing major social and economic transition.
- 1992: Introduced hepatitis B vaccine into the national routine immunization schedule.
- 1996: Started active surveillance for diseases targeted by NIP.
- 1990s: Avoided the outbreak of diphtheria that occurred in its neighbours Russia.
- 2000: Passed an Immunization Law [Government of Mongolia 2000]; Certified “polio free” by WHO;
- 2001: Established an Immunization Fund for the purchase of vaccines.
- 2002: Established Interagency Coordinating committee (ICC) on immunization.
- 2005: Introduced AD syringes with GAVI support replacing the earlier disposable syringes; Introduced Hib vaccine as part of a pentavalent vaccine (DTP-HepB-Hib).
- 2006: Marked decline in Hib meningitis reported in Ulaanbaatar.
- Last five years: An active operational research program that has aimed to identify ways to improve the cold chain and assess immunization services through a sero-survey.

Further detail on some of the key achievements of the NIP in the last five years is summarized below:

1. **Effective control of vaccine preventable diseases through sustained routine high immunization coverage**: All antigens included in the EPI had coverage over 96% in the last five years, almost eliminating the morbidity and mortality due to diphtheria, pertussis, and measles; while keeping the country free of polio and maternal and neonatal tetanus. Very high coverage was achieved in supplementary immunization campaigns conducted for measles in 2002. No cases of diphtheria and pertussis have been reported since January 2004. Even though Mongolia has one of the highest rates of chronic HBV infection in the Region, there is evidence for a reduction in chronic HBV infection rates.

2. **Establishment of sentinel hospital based surveillance for Hib meningitis**: Mongolia successfully established a sentinel surveillance system with laboratory support for bacterial meningitis involving six health facilities. The results from the surveillance system helped to inform the decision to introduce Hib vaccine in 2005. This surveillance system is now helping in evaluating the impact of Hib vaccination on reduction of childhood mortality and morbidity due to Hib meningitis.

3. **Strengthening of hepatitis B control**: Two research studies were done in 2002 and 2005 evaluating the impact of the immunization program on chronic HBV infection rates among children. Both studies pointed out higher chronic HBV infection rates than suggested by the high immunization coverage from the program [Edstam et al 2002] [WHO 2006]. This led to a complete review of hepatitis B immunization program and change in the schedule of birth dose of hepatitis B vaccine from 24-48 hours to within 24 hours of birth. A training program of health workers in all the maternity facilities was organized to improve the coverage with birth dose. In addition, a temperature monitoring study was undertaken in 2006 to assess the extent of vaccine freezing which may adversely affect the vaccine potency.

4. **Strengthening of cold chain**: By the end of 2005, 98% of vaccination units were provided with additional cold chain equipment. However, major improvements in cold chain equipment and cold chain related training are required (see below).

1.4 Remaining key challenges that this plan aims to address

1. **The need to improve immunization coverage for all parts of Mongolian society (including remote bags and soums as well as for mobile unregistered urban migrants)**: Mongolia has the lowest population density in the world (1.5 persons per square kilometer). In addition to the high population dispersal, resulting in increased costs associated with communication and transport, severe climatic conditions in Mongolia results in rural and remote populations and service providers being often cut off from road communications during winter. The high national average coverage figures masks lower coverage figures in some remote bag and soums. In addition, the country is rapidly urbanizing, with approximately 60% of the population now residing in urban areas. Rapid migration of populations to the capital city and Provincial towns presents significant challenges in relation to registration and tracking of immunization coverage.

This high internal migration provides further challenges to the health systems to reach these poor floating urban populations with key health services (see: The *Health Sector Strategic Master Plan* [Government of Mongolia 2005a]). Immunization service delivery is still less than optimal and often delayed for the mobile and remote rural populations. Currently, 15-25% of children receive immunization through mobile services. Outreach immunization services need to be further strengthened to provide services to these difficult to reach population groups.

2. **The persisting high levels of chronic HBV infection**: Despite relatively high reported hepatitis B vaccination rate, the chronic HBV infection rates among children are still relatively high in Mongolia. Research has identified that vaccine freezing may explain part of this problem [Edstam et al 2004], and so action has been taken to address this. There has also been action to shift the first dose of hepatitis B vaccine to within the first 24-hours after birth. However, it is not yet clear how well this action has been adopted by all aimags. Improvements in hepatitis B immunization have the potential to save health costs in the long term since hepatocellular cancer is the most common cancer in Mongolia [Ebright et al 2003] (with hepatitis B and hepatitis C probably playing important roles in causing this disease). There are many studies showing high infection rates of hepatitis B in Mongolia (eg, 3 cited by: [Raza et al 2007], and also [Tellez et al 2002]). Improving hepatitis B control is also part of Mongolia's contribution to achieving an important goal for the Region.

3. **The need for measles control**: Although outbreaks of measles are uncommon, there has been a historical pattern of measles outbreaks every four to six years. Therefore Mongolia needs to undertake various measures to ensure that measles is actually eliminated. This is a very feasible goal that other developing countries have been able to achieve. Measles elimination is also part of Mongolia's contribution to achieving an important goal for the Region.

4. **The need to improve the overall quality of immunization services:** There are a range of different issues that are needed to maximize the quality of the NIP. These include:

    - **Need for further improvements to the cold chain:** There remain many limitations with the cold chain in Mongolia (see three report summaries in Annex 2). In particular there are shortages of equipment and low technical capacity for repairs and maintenance of cold chain equipment – especially in remoter areas. Not all vaccine supplies are monitored with the appropriate monitoring devices eg, "freeze tags". There are not adequate knowledge, attitudes and practices amongst all EPI staff relating to the cold chain. Of note is that having a high quality cold chain (with some surge capacity) will assist in an influenza pandemic once a vaccine against the new strain of pandemic influenza is developed.

    - **Need for more EPI staff training:** There is a need for staff to better understand various aspects of immunization services. The gradual process of decentralization underway in Mongolia has meant a shifting of responsibilities for finance, management and planning responsibilities to the sub-national level. This presents challenges in terms of preparing middle level managers for increased accountability for program performance. A regular system of staff training at all levels with special focus on rural health facilities is therefore needed to ensure that the quality of immunization services is maintained and improved. Many other areas of training need further development – especially relating to new approaches to surveillance and relating to new vaccines. Operational research has highlighted some specific problems eg, the "shake test" to identify vaccine that has been frozen is not

well used by staff in Mongolia. Also it is not clear how well EPI staff throughout Mongolia understand the open vial policy. A shortage of vaccine during 2006 also highlights the need for training in the logistics area.

- **Need for improvements to injection safety:** In some settings where immunization occurs, the disposal of injecting equipment is by burning the waste in a drum [Logez et al 2004]. This is not ideal and there is a need for appropriately designed incinerators in such settings.

- **Need to further reduce vaccine wastage:** Some vaccine wastage occurs in settings where a low number of immunizations are given due to the large size of the vials. It is therefore possible that resources may be saved if small dose vials were included in the vaccine supply system. The use of two-dose vial for pentavalent vaccine may have already helped to reduce vaccine wastage rates to some extent.

- **Need to improve surveillance of VPDs:** To better evaluate the effectiveness of the NIP there is a need for improvements in the VPD surveillance system. For example, "viral hepatitis" is reported but it is not possible to identify by laboratory confirmation at aimag level. Also current reporting processes don't make use of the Internet (which is now available in most aimags).

5. **The need to consider the benefit of new vaccines:** Mongolia needs to complete the introduction of Hib vaccine given the evidence on how successful this vaccine is in reducing rates of meningitis. Also rash and fever surveillance in Mongolia has identified that rubella is a significant problem in the country and so there is a plan to introduce MMR vaccine in the future.

   Respiratory disease is still a major cause of hospitalisation and death in children in Mongolia. Some of this disease may potentially be prevented with a pneumococcal vaccine that is currently on the world market. Therefore Mongolia needs to access the potential benefit and cost-effectiveness of introducing such a vaccine.

6. **The need to ensure financial sustainability of the NIP**: The NIP is still highly dependent on external donors, especially for vaccine and injection equipment supplies. Currently only BCG vaccine is being procured from domestic resources. Also, the program costs are continually increasing due to introduction of new vaccines. The cost of immunizing one child was estimated to be $33 per child in 2005 (with updated estimates in Part 3 of this cMYP). There are three main reasons for the relatively high cost per child compared to other countries:
   - Introduction of pentavalent vaccine in 2005 (covering only 25% of the eligible population) resulted in an increase of vaccine and supplies spending from $226,000 in 2004 to $338,134 in 2005. The costs will further increase with nationwide expansion of this pentavalent vaccine.
   - The comparatively low absolute size of the annual birth cohort (of 47,376 in 2006) means that the non-vaccine fixed costs of the program cannot be spread over a large enough population, and therefore the unit costs of immunization is relatively.
   - There are extra costs resulting from reaching remote populations in a country with the world's lowest population density. There are also costs associated with the very severe climate in Mongolia and the lack of infrastructure such as roads in some areas.

It is important to note that a significant proportion of NIP costs (30%) are taken up by the shared costs of the immunization program. The highest proportion of shared health system cost is in the areas of human resources and transport. There are therefore important opportunities that could be taken up in the coming years to use investments such as primary health care training and transport systems to benefit the NIP as well as other primary health care services.

The table below provides a brief summary of indicators relating to the NIP in recent years.

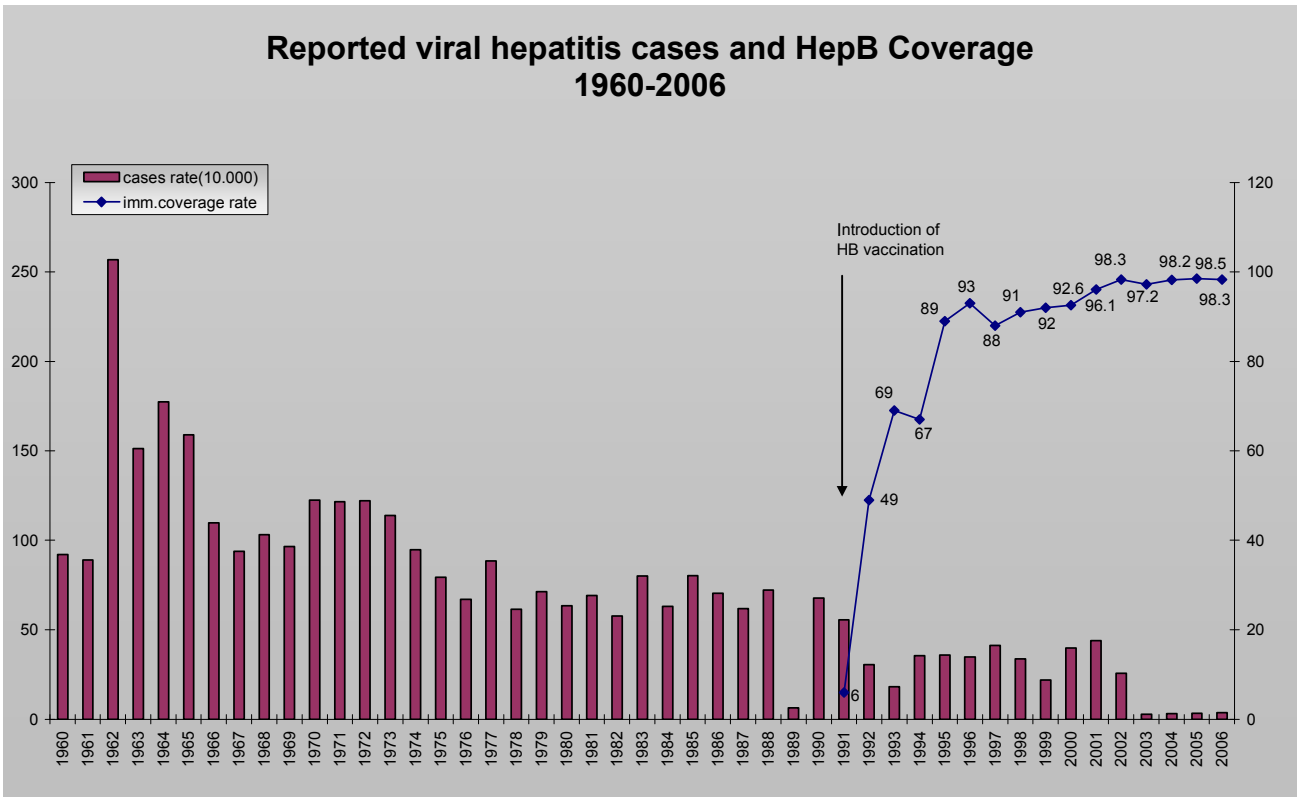
Table 1.2: Summary indicators relating to the performance of the national immunization program (2002-2006)

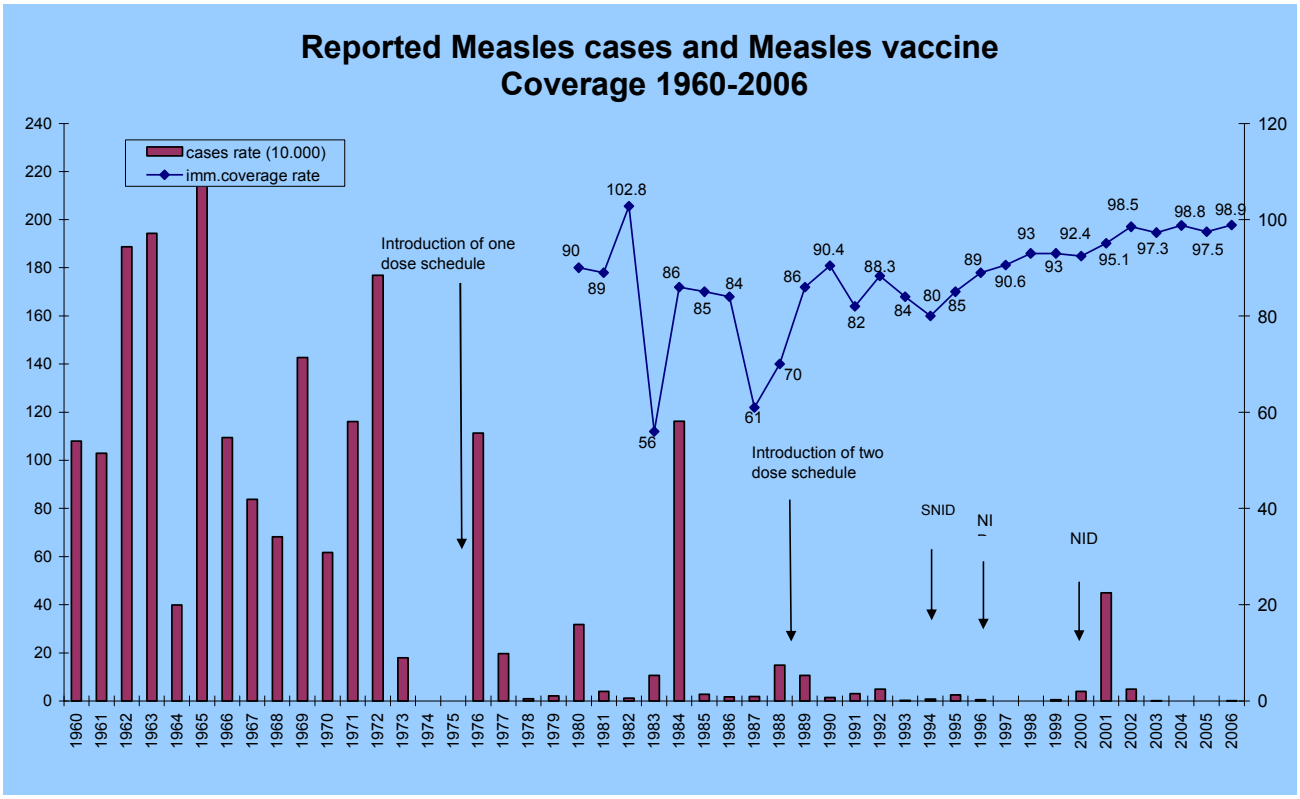
Indicator	2002	2003	2004	2005	2006
Immunization coverage					
BCG coverage (%)	98	98	98	99	98
% of aimag with 80% coverage	100	100	100	100	100
DTP3 coverage (%)	98	97	98	99	99
% of aimag with 80% coverage	100	100	100	100	100
% of aimag with drop out rate DTP1-DTP3 > 10	0	0	0	0	0
OPV3 coverage (%)	98	97	99	99	98
% of aimag with 80% coverage	100	100	100	100	100
% of aimag with drop out rate OPV1-OPV3 > 10	0	0	0	0	0
Measles coverage (MSV1) (%)	98	97	98	98	99
% of aimag with 80% coverage	100	100	100	100	100
HepB coverage (HepB3) (%)	98	97	98	99	98
% of aimag with 80% coverage	100	100	100	100	100
Disease incidence rates per 10,000 (that relate to current vaccines in the schedule)					
Generalized tuberculosis in children 0-15 age	6.84	6.90	10.10	0.05	0.03
Hepatitis B	2.68	2.96	3.16	3.4	3.7
Diphtheria	0.02	0.001	0	0	0
Pertussis	0.01	0.004	0	0	0
Measles	4.90	0.07	0	0	0.1
Neonatal tetanus	0	0	0	0	0
Poliomyelitis	0	0	0	0	0
Management and planning					
No. of health workers per 10,000 population.	135	130	132	132	-
Regular collection of district indicators at national level (Yes / No)	Y	Y	Y	Y	Y
Number of National Regulatory Authority (NRA) functions conducted	12	12	14	12	12
Number of vaccine related studies conducted/being conducted	2	2	3	2	3
Number of ICC meetings held last year	2	3	3	-	3
Availability of a waste management plan (Y/N)	N	Y	Y	Y	Y
Vaccine wastage monitoring at national level for all vaccines (Y/N)	Y	Y	Y	Y	Y
Timeliness of disbursement of funds to district and service delivery level (Y/N)	Y	Y	Y	Y	Y
New and underutilized vaccine introduction					
HepB birth dose - vaccine coverage (%)	98	99	97	99	99

Indicator	2002	2003	2004	2005	2006
Hib vaccine introduction (DTP-HepB-Hib) and coverage	-	-	-	25%	56%
Vaccine management and injection safety					
Percentage of soum with adequate number of functional cold chain equipment	90%	-	-	-	94%

Note: * For more detail see the WHO website on Mongolia:
http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm?C='mng'

Figure 1.1a & 1.1b Trends in viral hepatitis and measles and immunization coverage in Mongolia





PART II: Objectives and strategies of this cMYP for the NIP

The Ministry of Health developed a "National Program for Control of Communicable Diseases" (2002–2010) which included within it a sub-program plan for control of vaccine preventable diseases. This was approved by the Government [Government of Mongolia 2004]. In 2005, this sub-program plan was reviewed in relation to the current situation analysis and the recently developed *Health Sector Strategic Master Plan* by the Ministry of Health of Mongolia [Government of Mongolia 2005a]. This *Master Plan* of the Ministry of Health (2006-2015) takes a primary health care and health promotion focus, and focuses on seven key areas of work including service delivery, support services, communication, quality of care, health financing, human resource development and management. The *Master Plan* also includes documents that provide a medium-term expenditure framework, a planning and budgeting framework, and a monitoring and evaluation framework. The *Master Plan* mentions "immunization" 35 times and "vaccine" or "vaccination" another 27 times. In particular, it has the following targets (page 86 of the *Plan*):

> "2.2. Immunization 2010:
> - Increase immunization coverage to 98% of children under 1 at soum and bag level.
> - Reduce incidence of vaccine preventable diseases by 30% of the 2005 baseline
> 2015: - Measles eradication"

This version of the cMYP is fully compatible with the content of the *Master Plan* and the seven key areas covered by it. This cMYP has also been reviewed in the context of the key strategies identified in the Global Immunization Vision and strategies jointly developed by UNICEF and WHO (especially relating to measles elimination and improved hepatitis B control).

2.1 The Mission of the National Immunization Program

The mission of the NIP is to achieve and sustain high coverage (more than 96%) of eligible population groups with all the recommended vaccines through high quality immunization services so as to reduce morbidity and mortality by controlling or eliminating all vaccine preventable diseases. The strategic directions of the plan are covered by the objectives that relate to coverage, hepatitis B control, measles elimination, quality of immunization services and evaluating and introducing new vaccines.

Implementation of this cMYP is linked to an annual operational plan of the National Immunization Program. Annual reviews of the national program plan will be conducted with participation of aimag EPI managers, to ensure that the cMYP is linked to sub national planning needs and processes. The Plan will be jointly monitored and annually reviewed by the key implementing national and international agencies through a Country Technical Advisory Group.

2.2 Objective 1: Maintaining control of vaccine-preventable diseases with high immunization coverage

Most of the vaccine preventable diseases (VPDs) such as diphtheria, pertussis, measles, are largely controlled in Mongolia, with number of cases and deaths from these diseases at historical lows. But there is still a need to maintain high coverage with these antigens to maintain the gains in reduction in disease morbidity and mortality (and to ensure elimination in the case of measles). The need to maintain immunity is shown by the large-scale outbreaks of diphtheria and pertussis in Eastern Europe after 1990.

Mongolia has achieved polio free status. However, there is a need to maintain high coverage levels until the disease is eradicated globally. The re-introduction of poliovirus in Indonesia and Bangladesh after staying polio free for almost 10 years, and emergence of c-VDPV in some countries in the Region emphasizes the need to continuously maintain high coverage of OPV3. Although Mongolia has had no cases of neonatal tetanus for many years, immunization is still required given the widespread presence of the organism in the environment.

Table 2.1: Key strategies and indicators for Objective 1

Key strategies	Indicators (milestones) of progress	Comments
1) Achieve and maintain high coverage for all current vaccines in the immunization schedule.	(i) Continue to have coverage levels of 96% or more for the routine vaccines at the national level and for each aimag (ie, DTP3, Measles2, OPV3, DTP-HepB-Hib3). Periodic coverage surveys and sero-surveys may be conducted at times to ensure that vaccinations are being delivered and are contributing to the appropriate levels of immunity. (ii) EPI Team has prepared a proposal for a law or order by the Minister of Education and Minister of Health requiring children entering pre-school/kindergarten and school to have completed immunizations. Also to consider information systems to allow for immunization status checks at the start of military service, college and other institutes.	See also Objective 5 relating to the expansion of Hib vaccine in Mongolia. There is nationwide introduction of the pentavalent vaccine that includes Hib in 2008. Other countries have such laws – though some only prevent non-immunized children attending schools during outbreaks.
2) Conduct regular catch-up immunization campaigns for all children who missed routine immunization.	Campaigns are conducted at least once a year in aimags with high migration during National Immunisation days (in May and October).	
3) Improving reach to migrant populations.	(i) Improvements are made to registration and tracking (through a national identification database). (ii) Provide staff training for Internet and database use.	A database has been development (version 1).
4) Improve quality aspects of providing immunizations.	See the indicators under Objective 4 relating to training, injection safety, cold chain and logistics.	
5) Conduct supplementary immunization activities (SIAs) for measles and if outbreaks of VPDs occur.	(i) See the indicators under Objective 3 (for measles). (ii) Successful control of any VPD outbreaks occurs promptly.	

Table 2.2: Selected disease incidence indicators (per 10,000 population) to measure Objective 1 (based on disease surveillance)

VPD in children aged 0-15 years	2007	2008	2009	2010	2011	2012
Generalized tuberculosis*	0.12	0.07	0.05	0.02	<0.02	<0.02
Diphtheria	0.03	0.02	0.02	0.02	<0.02	<0.02
Tetanus	0	0	0	0	0	0
Pertussis	0.01	0.01	0.01	0.01	<0.01	<0.01
Measles	1.2	0.7	0.2	0.2	0	0
Hib meningitis incidence (for Ulaanbaatar)	Decline#	Decline#	Decline#	Decline#	Decline#	Decline#
Poliomyelitis	Polio free status is maintained with zero cases.					
Hepatitis B	-	-	A decline in HBsAg prevalence shown in a possible sero-survey – see Objective 2. Prevalence of HBsAg in infants is under 2% by 2012.			
Mumps	The prevention of mumps outbreaks is a provisional indicator.					
Rubella	As above, along with the prevention of all rubella outbreaks. Planning to introduce a sentinel surveillance system for congenital rubella syndrome is currently underway.					

Notes:
* Immunization against tuberculosis is just one of a number of different control strategies and it is not a completely effective vaccine. Therefore a failure to achieve this incidence indicator may relate to non-immunization factors such as poverty, household crowding and incomplete success with TB treatment programs.
# Indicators for Hib meningitis incidence from the sentinel surveillance system involving six hospitals in Ulaanbaatar have yet to be developed, but a provision indicator is a continuing declining rate of diagnosed Hib meningitis each year of the six year period.

2.3 Objective 2: Improving hepatitis B control

As detailed in Part I, hepatitis B infection rates are relatively high in Mongolia and liver cancer is the most common cancer (with this cancer being related to hepatitis B and hepatitis C infection). Mongolia also wishes to support the goal of the Region which is to reduce chronic HBV infection rates to less than 2% by 2012.

Two research studies were done in 2002 and 2005 evaluating the impact of the immunization program on chronic HBV infection rates among children. Both studies pointed out higher chronic HBV infection rates than suggested by the high immunization coverage from the program [Edstam et al 2002] [WHO 2006] (though the latter study estimated that the programme had reduced the prevalence of chronic HBV infection by more than 2 times from the baseline level). This work led to a complete review of hepatitis B immunization program and change in the schedule of birth dose of hepatitis B vaccine from 24-48 hours to within 24 hours of birth. A training program of health workers in all the maternity facilities was organized to improve the coverage with birth dose. In addition, a temperature monitoring study was undertaken in 2006 to assess the extent of vaccine freezing which may adversely affect the vaccine potency [Gantulga et al 2006].

Table 2.3: Key strategies and indicators for Objective 2 (hepatitis B)

Key strategies	Indicators (milestones) of progress	Comments
1) Achieve and maintain high coverage for all doses of hepatitis B immunization.	(i) Achieve a level of at least 96% coverage for the 3rd dose of hepatitis B vaccine at the national level and for every aimag (by 2007 and maintained in following years). (ii) Identify successful coverage by conducting a sero-survey (in conjunction with a measles sero-survey in 2008).	See also Objective 1 on increasing coverage for all immunizations.
2) Improve delivery of the first dose of vaccine within 24 hours of delivery.	(i) Achieve a level of 95% coverage for the first dose within 24 hours of delivery at the national level and for every aimag (by 2008 and maintained in following years). (ii) Have conducted regular nurse vaccinator training at maternity hospitals.	
3) Improve the cold chain to lower the risk of vaccine freezing.	(i) Have strengthened freeze tag monitoring at all levels of vaccine distribution. (ii) Have undertaken a cold chain assessment every two years. (iii) Have included the importance of vaccine freezing prevention in any training for staff.	See also Objective 4 on improving quality of immunization services.
4) Improve laboratory-based surveillance for hepatitis B	(i) Have established a reference laboratory for hepatitis B at the national level by 2008. (ii) Have built laboratory capacity at the aimag level for basic diagnostic capacity for hepatitis.	
5) Study the value of delivering hepatitis B immunoglobulin (HBIG) at birth	The EPI Team has obtained additional information or conducted a study to examine the benefit of providing HBIG at birth (with or without maternal screening for HBsAg).	See Annex 4 for additional information.
6) Sustainable government funding for hepatitis B vaccine (pentavalent vaccine)	The Government of Mongolia fully funds the hepatitis B monovalent vaccine from 2008 (and co-financing the pentavalent vaccine in 2011 with full financing in 2012).	Currently funded by JICA (and GAVI for the pentavalent vaccine).

2.4 Objective 3: Achieving measles elimination by 2012

The measles incidence in Mongolia is currently low with the last major outbreak occurring in 2001 and another small outbreak in 2006/07. There were no cases reported for 2004 to 2005. However, the historical pattern in Mongolia is for outbreaks every four to six years with very few cases between outbreaks. A national goal of measles elimination is set for 2012 to coincide with the regional goal of measles elimination by 2012 (promoted by WHO and UNICEF). Mongolia already has a national immunization schedule with two doses of measles vaccine, with the 2nd dose given after the first birthday in line with the global recommendations. Other countries in Asia have been successful with measles elimination such as South Korea [CDC 2007].

Table 2.4: Key strategies and indicators for Objective 3

Key strategies	Indicators (milestones) of progress	Comments
1) Achieve and maintain high coverage of both doses of measles.	A level of 95% coverage for the 2nd dose of measles immunization is achieved at the national level and for every aimag (by 2008 and maintained in following years).	See also Objective 1 on increasing coverage for all routine immunizations.
2) Improve surveillance for measles (case-based).	(i) Processes are established. (ii) All aimags are meeting requirements for timely and continuing reporting of all rash and fever cases (by telephone).	It is just the National Laboratory that is involved in measles surveillance in Mongolia.
3) Improve National Laboratory capacity and improve the specimen transportation system (eg, kits and boxes needed for surveillance).	(i) National Laboratory meets WHO standards and requirements for laboratory surveillance for measles by 2009. (iii) Samples are being effectively transferred from the aimag level to the national laboratory (for 80% of aimags by 2009).	
4) Improve training of staff involved in surveillance.	(i) Staff at the National Laboratory have had the necessary proficiency training by 2008. (ii) Staff in aimags receive information needed for measles surveillance and how to manage specimen collection and transport (each year from 2008).	See also the other objective of enhancing staff training within Objective 4 (Quality).
5) Conduct supplementary immunization activities (SIAs) for measles.	(i) SIA conducted in 2007 (children aged 2-10 years) based on the results of a recent sero-survey [Gantulga et al 2005b].	SIAs are needed to address gaps in the population immunity due to vaccine failure and incomplete coverage. Mongolia conducted

Key strategies	Indicators (milestones) of progress	Comments
	(ii) SIA conducted in 2011 (children aged 2-5 years).	successful SIAs for measles in 2002.
6) Sustainable government funding for measles	The Government continues to fund measles vaccine (from the Immunization Fund) and explores financing support for MMR vaccine when introduced.	

2.5 Objective 4: Improving the overall quality of the National Immunization Program

The quality of immunization provision is important to ensure that children are provided with effective vaccine (ie, vaccine that has not been damaged through heating or freezing). Other aspects of quality relate to injection safety (ie, with eliminating risk to children and health workers) and to always having vaccine supplies available (good planning and logistics). Surveillance is very important to ensure that the program is effective in meeting its mission of decreasing morbidity and mortality from vaccine preventable diseases.

Table 2.5: Key strategies and indicators for Objective 4 (program quality)

Key strategies	Indicators (milestones) of progress	Comments
1) To strengthen human capacity	(i) Have conducted additional training of the EPI workforce in the areas of planning and management, AEFI and safe immunization, and all aspects of "Immunization in Practice" (20% of staff at soum level per year). (ii) Have undertaken training on planning and management for aimag-level managers every two years (given increasing responsibilities under the decentralizing public administration in Mongolia). (iii) Have undertaken regular assessment of training needs of staff at different service delivery levels (every three years). (iv) Have updated training curriculum and learning materials relating to EPI (every three years).	See various training issues in the other objectives.
2) Improving the performance of the cold chain	(i) Have renovated buildings for the walk-in cool room (by 2007). (ii) Have strengthened freeze tag monitoring at all levels of vaccine distribution by 2009. (iii) Have undertaken a cold chain assessment every two	See also Objective 2 (hepatitis B).

Key strategies	Indicators (milestones) of progress	Comments
	years. (iv) Have emphasized the importance of vaccine freezing prevention in any training sessions for EPI staff. (v) Have regularly replaced and repaired or upgraded damaged and worn out cold chain equipment at all levels (see the costing details in Part 3). (vi) Have adequate stock of spare parts and repair equipment for the cold chain (from 2008). (vii) Training of contractors in technical capacity for cold chain for maintenance (in 2007 and at regular periods after that). (viii) Fix the cold rooms at aimag and soum levels to ensure they are meeting building standards for storage.	
3) Improving injection safety (& safe disposal)	(i) Have implemented the National Policy on Health Waste Management. (ii) Have implemented the Safe Immunization Strategy of 2006. (iii) Have undertaken additional injection safety assessments of aimag and soum levels (in the next EPI Review). (iv) Have included a line-item in the national budget for procurement of AD syringes (by 2007). (v) National EPI supports and encourages hospitals to have appropriate incineration equipment (by 2010). (vi) National EPI supports the production of safety boxes in Mongolia. (vii) National EPI supports the joint venture for producing AD syringes in Mongolia (still being planned in 2008).	GAVI support for purchasing AD syringes ends in 2007.
4) Improving logistics for vaccine and injection supplies	(i) Conducted a review of the stock management of vaccines and injection supplies to identify any areas of waste (by 2009). (ii) No vaccine stock-outs at any service delivery level (from 2007 onwards).	Of note is that the use of two-dose vial for pentavalent vaccine may have already helped to

Key strategies	Indicators (milestones) of progress	Comments
	(iii) Have conducted a review of the best range of vial sizes for all EPI vaccines to see if additional savings are possible (by 2008). Also to get Mongolia's open vial policy of one week to be extended eg, to the four weeks recommended by WHO (by Ministry of Health order) (by 2008). (iv) Have conducted additional staff training for Mongolia's open vial policy at aimag and soum levels (relevant to DTP, DT, HepB, and OPV). (v) Training of EPI staff in logistics at all levels and training in computer skills for logistics.	reduce the vaccine wastage.
5) Improving surveillance of vaccine preventable disease (VPDs)	(i) Have strengthened surveillance for those VPDs where diagnosis is more complex (ie, hepatitis B, measles, and Hib disease) (for each year from 2007). (ii) Have developed a system for electronic weekly disease reporting over the Internet from aimags to the national level (by 2012). (iii) Have regularly reviewed the need for introducing any new laboratory methods into laboratory diagnosis for VPDs (particularly for measles and Hib disease). (iv) Training of EPI staff in surveillance and using computers to assist with surveillance.	See also Objective 2 for hepatitis B, 3 for measles, and Objective 5 (Hib disease).
6) Review the immunization schedule	Have prepared a paper for the Ministry of Health on the advantages and disadvantages of various changes to the schedule (eg, schedule of the DTP, DT, Measles or measles containing vaccine).	

It is recognised that the above Table does not fully address the difficulties in attracting and retaining EPI staff at the aimag and soum levels. However, it is not possible to provide extra remuneration to EPI staff without this occurring for the whole health workforce (ie, with large financial implications for the government). Instead, this plan attempts to increase professional satisfaction for these workers by enhancing training.

2.6 Objective 5: Evaluation and introduction of new vaccines

Since the start of its immunization program, Mongolia has successfully introduced new vaccines to its schedule (ie, hepatitis B and Hib).

Hib (in the pentavalent vaccine): There is now good evidence that the introduction of Hib vaccine to selected areas of Mongolia has reduced rates of Hib meningitis (ie, in Ulaanbaatar [Nymadawa et al 2007]). This highlights the value of completing the introduction of Hib vaccine to all of the children in Mongolia. At the end of 2005, Hib vaccine (in the form of a pentavalent vaccine) was provided to only 25% of eligible population. The NIP aims to expand the Hib vaccine in a stepwise manner to all the children by 2008.

MMR: The rash and fever surveillance system in Mongolia has identified that rubella is a significant problem. In 2006 there were 4.8 cases per 10,000 population of rubella in the total population. Mumps has also been identified as a problem with outbreaks in Ulaanbaatar in 2001 [Ebright et al 2003] and in 2005/2006 (6.7 and 19.7 per 10,000 population respectively – Annual Report from the Health Development Center). The occurrence of these diseases highlights the benefits of MMR which the MOH plan to introduce in 2009. In some countries where rubella vaccination rates have been low there is a risk of increased adverse outcomes by raising the age of infection (ie, so that pregnant women are infected and infants are born with congenital rubella syndrome). This risk is fairly low in Mongolia given the historical success with achieving high coverage rates with all immunizations in the NIP.

Pneumococcal vaccine: Respiratory disease is still a major cause of hospitalisation and death in children in Mongolia [Ebright et al 2003]. Some of this disease may potentially be prevented with a pneumococcal vaccine that is currently on the world market and has proven effectiveness. Therefore Mongolia needs to assess the potential benefit and cost-effectiveness of introducing such a vaccine.

Rotavirus vaccine: A project on rotavirus is currently being undertaken by the Health Sciences University of Mongolia, but there are no results yet available. A previous small study did not identify rotavirus as a problem [Hansman et al 2005]. Therefore this vaccine is not considered in this cMYP. However, this issue will be reviewed in future revisions of this cMYP.

HPV vaccine: The human papilloma virus causes cervical cancer and some developed countries have added this vaccine to their immunization schedules. However, although this vaccine has been shown to effectively prevent infection with HPV, there is still no definitive evidence that this vaccine prevents cervical cancer in the following decades. Also this new vaccine is extremely expensive. Therefore this vaccine is not considered in this cMYP. However, this issue will be reviewed in future revisions of this cMYP.

Table 2.6: Key strategies and indicators for Objective 5 (new vaccines)

Key strategies	Indicators (milestones) of progress	Comments
1) Complete the introduction of Hib vaccine.	(i) Hib vaccine (as the pentavalent vaccine) is provided to children throughout Mongolia in 2008 as planned. (ii) Sentinel Hib surveillance continues to be undertaken and it show declining rates of Hib meningitis. (iii) A module on Hib immunization is included in the regular training programs for the health workers at all levels (by 2008).	To date there is evidence that Hib vaccine is reducing rates of Hib meningitis in Ulaanbaatar.
2) Obtain sustainable government co-funding for the pentavalent vaccine.	The Government of Mongolia co-funds the pentavalent vaccine from 2011 and fully funds it from 2012.	Currently the vaccine is funded by JICA and GAVI.
3) Introducing MMR vaccine	(i) MMR vaccine is planned to introduce and provided to children throughout Mongolia in 2009. (ii) Rash and fever surveillance shows a decline in rubella cases in Mongolia (after MMR is introduced).	The year 2009 is when the immunization schedule will be next updated.
4) Obtain initial funding support from donors for introducing MMR vaccine.	Funding support commitments from donors is successfully obtained by 2008.	
5) Further evaluation of the potential use of pneumococcal vaccine.	(i) Further research work on the disease burden attributable to pneumococcal disease and vaccine cost-effectiveness is undertaken in Mongolia by 2008. (ii) That any introduction of pneumococcal vaccine is done in the same areas as for Hib vaccine introduction and will use the same sentinel surveillance system.	This research will potentially be funded by GAVI through the "Global PneumoADIP" (Pneumococcal Vaccines Accelerated Development and Introduction Plan).
6) Obtain initial funding support from donors for introducing pneumococcal vaccine (if indicated).	If disease burden research indicates the value of this vaccine, then a key indicator will be obtaining funding support commitments from donors (a year prior to the program starting).	This vaccine is relatively expensive and so funding support is likely to be needed.

Part III: Costing and financing of the NIP: 2007-2012

The costing of this version of the cMYP for 2007-2012 has included the costing for vaccines, injection equipment and supplies, cold chain equipment and operational costs. No costing was done for the capital cost of buildings as this is unlikely to be changed during the current plan. A detailed Excel worksheet is available that describes the formulas for all the calculations and extra details on the key input data and assumptions for the calculations are detailed in Annex 3. All costs in this cMYP are in US dollars.

3.1 Vaccines

Traditional vaccines: The total cost for traditional six antigens (BCG, DTP, MSV2, OPV, and DT) for children up to 15 years of age as per the current immunization schedule (Annex 1) is estimated to be about $171,000 per year in 2007 (Table 3.1). Nearly all these costs are covered by the Government of Mongolia (Table 3.2).

Hepatitis B and Hib vaccines: Mongolia currently provides hepatitis B vaccine (monovalent) to all the eligible populations, and but is phasing out monovalent hepatitis B vaccine with pentavalent DTP-Hib-HepB vaccines which began in 2005 (with completion of phasing out planned for 2008). However, the birth dose will continued to be provided with monovalent vaccine. All the cost of monovalent hepatitis B vaccine is currently borne by JICA. The pentavalent vaccine (DTP-HepB-Hib) is funded by GAVI (but with the Government involved in co-financing in 2011 and full financing in 2012).

MMR vaccine: The costs of MMR are included in this updated plan. No funding source for MMR vaccine has yet been confirmed.

In summary, the Government of Mongolia is currently only financing a relatively small part of total vaccine costs ranging (ie, 19% in 2007) (Table 3.2). GAVI is a major funder (up to 80% in 2008). A proportion of vaccine financing is unsecured from 2009 onwards (at 20%-21% up to 2012).

Table 3.1 Projected cost of traditional and new vaccines during 2007-2012

Vaccine	2007	2008	2009	2010	2011	2012
Traditional six antigens						
BCG	$26,080	$26,941	$27,830	$28,748	$29,697	$30,677
DTP (primary series)	$13,542	$0	$0	$0	$0	$0
OPV	$56,694	$58,565	$60,497	$62,494	$64,556	$66,686
Measles (two dose schedule)	$41,565	$42,937	$0	$0	$0	$0
DTP (booster dose)	$17,515	$18,093	$18,690	$19,306	$19,944	$20,602
DT for adolescents (8 & 15 years)	$15,940	$16,224	$16,516	$16,818	$17,128	$17,447
Subtotal	***$171,335***	***$162,758***	***$123,533***	***$127,366***	***$131,324***	***$135,412***
Hepatitis B						
Hepatitis B (birth dose)	$23,493	$16,826	$17,381	$17,955	$18,547	$19,159
Hepatitis B (2nd and 3rd dose monovalent)	$11,865	$0	$0	$0	$0	$0
Subtotal	***$35,357***	***$16,826***	***$17,381***	***$17,955***	***$18,547***	***$19,159***

Vaccine	2007	2008	2009	2010	2011	2012
New vaccines						
Hib vaccine as DTP-HepB-Hib	$531,437	$716,594	$732,107	$748,046	$764,423	$789,649
MMR	$0	$0	$222,637	$229,984	$237,573	$245,413
Pneumococcal vaccine (not costed)	$0	$0	$0	$0	$0	$0
Subtotal	***$531,437***	***$716,594***	***$954,744***	***$978,030***	***$1,001,996***	***$1,035,062***
Grand total	**$738,129**	**$896,178**	**$1,095,658**	**$1,123,350**	**$1,151,867**	**$1,189,633**

Table 3.2 Financing sources for traditional and new vaccines during 2007-2012

Vaccine	2007	2008	2009	2010	2011	2012
Traditional six antigens						
Government of Mongolia	$140,278	$162,758	$123,533	$127,366	$131,324	$135,412
JICA (DTP)	$31,057	$0	$0	$0	$0	$0
Subtotal	***$171,335***	***$162,758***	***$123,533***	***$127,366***	***$131,324***	***$135,412***
Hepatitis B						
Government of Mongolia	$0	$16,826	$17,381	$17,955	$18,547	$19,159
JICA	$35,357	$0	$0	$0	$0	$0
New vaccines - Hib as pentavalent						
GAVI	$531,437	$716,594	$732,107	$748,046	$0	$0
GAVI - 50% co-financing	$0	$0	$0	$0	$382,211	$0
Government - 50% co-financing	$0	$0	$0	$0	$382,211	$0
Government	$0	$0	$0	$0	$0	$789,649
New vaccines - MMR						
Unsecured	$0	$0	$222,637	$229,984	$237,573	$245,413
Subtotal (HepB + new vaccines)	***$566,794***	***$733,420***	***$972,125***	***$995,985***	***$1,020,543***	***$1,054,221***
Grand total	**$738,129**	**$896,178**	**$1,095,658**	**$1,123,350**	**$1,151,867**	**$1,189,633**
Financing - Percentages						
Government financing (total %)	19.0%	20.0%	12.9%	12.9%	13.0%	79.4%
Government - 50% co-financing	0.0%	0.0%	0.0%	0.0%	33.2%	0.0%
GAVI financing (total %)	72.0%	80.0%	66.8%	66.6%	0.0%	0.0%
GAVI - 50% co-financing	0.0%	0.0%	0.0%	0.0%	33.2%	0.0%
JICA financing (total %)	9.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Unsecured (total %)	0.0%	0.0%	20.3%	20.5%	20.6%	20.6%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

3.1.2 Vaccines for use during campaigns

Only measles SIAs are planned in 2007 and 2011 for age groups 2-10 years and 2-5 years respectively. The 2007 campaign vaccines will be fully funded via GAVI through the UN Foundation. The funding for the 2011 campaign is unsecured.

Table 3.2 Financing of vaccine during campaigns (2007-2012)

	2007	2008	2009	2010	2011	2012
Total cost	$79,830				$35,349	
Government	$0				$0	
GAVI through the UN Foundation	$79,830				$0	
Unsecured	$0				$35,349	

3.2 Injection equipment and supplies

Mongolia introduced AD syringes for all EPI vaccines in 2005 with GAVI support. The GAVI support for AD syringes and safety boxes will end in 2007 and the Government of Mongolia will take over the funding of AD syringes in 2008. However, the syringes for the new vaccine (eg, for DTP-HepB-Hib), will come from GAVI during the whole plan period bundled with the vaccine. The total cost of the AD syringes and safety boxes was $43,000 in 2007 (Table 3.3). The majority of these costs will be financed by the Government of Mongolia beginning from 2008 (Table 3.4). The financing is partly unsecured from 2010 onwards (at 31% of the total).

Table 3.3 Cost of injection equipment supplies (AD syringes and safety boxes) for routine EPI

Injection supplies associated with particular vaccines	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Traditional six antigens						
BCG	$4,442	$4,589	$4,740	$4,897	$5,058	$5,225
DTP primary vaccine series	$2,968	$0	$0	$0	$0	$0
Measles first and 2nd dose	$8,498	$8,778	$0	$0	$0	$0
DTP booster dose	$3,838	$3,965	$4,096	$4,231	$4,371	$4,515
DT for adolescents (two doses)	$7,756	$8,012	$8,276	$8,549	$8,831	$9,123
Subtotal	***$27,502***	***$25,343***	***$17,112***	***$17,677***	***$18,260***	***$18,862***
Hepatitis B						
Hepatitis B birth dose	$3,917	$4,047	$4,180	$4,318	$4,461	$4,608
Hepatitis B 2nd and 3rd dose	$1,978	$0	$0	$0	$0	$0
Subtotal	***$5,896***	***$4,047***	***$4,180***	***$4,318***	***$4,461***	***$4,608***
New vaccines						
Hib vaccine as DTP-Hib-HepB	$9,660	$13,171	$13,606	$14,055	$14,519	$14,998
MMR	$0	$0	$9,068	$9,367	$9,676	$9,996
Subtotal	***$9,660***	***$13,171***	***$22,674***	***$23,422***	***$24,195***	***$24,994***
Grand total	**$43,057**	**$42,562**	**$43,966**	**$45,417**	**$46,916**	**$48,464**

Table 3.4 Financing sources for injection equipment supplies during 2007-2012

Funders of injection supplies associated with vaccines	2007	2008	2009	2010	2011	2012
Traditional six antigens	*$27,502*	*$25,343*	*$26,180*	*$27,044*	*$27,936*	*$28,858*
Government	$0	$25,343	$26,180	$27,044	$27,936	$28,858
GAVI	$27,502	$0	$0	$0	$0	$0
Hepatitis B	*$5,896*	*$4,047*	*$4,180*	*$4,318*	*$4,461*	*$4,608*
Government	$0	$4,047	$4,180	$4,318	$4,461	$4,608
GAVI	$5,896	$0	$0	$0	$0	$0
New vaccines (Hib)	*$9,660*	*$13,171*	*$13,606*	*$14,055*	*$14,519*	*$14,998*
Government	$0	$0	$0	$0	$0	$0
GAVI	$9,660	$13,171	$13,606	$14,055	$0	$0
Unsecured	$0	$0	$0	$0	$14,519	$14,998
Financing of injection supplies - Percentages	**$43,057**	**$42,562**	**$43,966**	**$45,417**	**$46,916**	**$48,464**
Government financing (total %)	0%	69%	69%	69%	69%	69%
GAVI (total %)	100%	31%	31%	31%	0%	0%
Unsecured (total %)	0%	0%	0%	0%	31%	31%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

3.2.2 Injection supplies during the campaigns

The cost of AD syringes, reconstitution syringes and safety boxes for the nationwide measles SIAs in 2007 and 2011 are detailed in the Table 3.5 below. The 2007 campaign injection supplies will be fully funded via GAVI through the UN Foundation. The funding for the 2011 campaign is unsecured.

Table 3.5: Summary of financing for injection supplies for campaigns (measles)

Summary Financing of Injection supplies	2007	2008	2009	2010	2011	2012
Total requirement	**$37,665**				**$16,678**	
Government	$0				$0	
GAVI through UN Foundation	37,665				$0	
Unsecured	$0				$16,678	

3.3 Cold chain equipment

Though 98% of all vaccination units were supplied with some new cold chain equipment, most of the cold chain is quite old, as majority of it was installed in 1993. This cMYP covers increased cold chain expenditure to allow for various improvements (as recommended in three reports in Annex 2). The financing of training relating to the cold chain is covered under operational costs (see the next Section).

Of note is that nearly all the financing for the cold chain improvements is unsecured – including for 2007 (Table 3.7).

Table 3.6: Summary of costs for capital equipment for the cold chain (all levels of the system)

Cold chain equipment (all levels)	2007	2008	2009	2010	2011	2012
Walk-in-cooler (cold store) (UNICEF funded)	$22,285	$0	$0	$0	$0	$0
Renovate a building facility for the national cold room	$50,000	$0	$0	$0	$0	$0
Cold boxes	$0	$12,153	$5,064	$0	$5,064	$0
Vaccine carriers	$0	$26,420	$0	$0	$13,210	$0
Freezers	$0	$10,760	$0	$0	$0	$0
Refrigerator MK074	$25,364	$25,364	$25,364	$25,364	$25,364	$25,364
Refrigerator MK 304	$5,320	$0	$5,320	$0	$0	$0
Alcohol stem thermometer	$1,170	$0	$0	$0	$1,170	$0
Voltage regulators	$2,547	$0	$2,547	$0	$2,547	$0
Spare parts for ice line refrigerator	$3,180	$0	$0	$5,196	$0	$0
Tool kits for refrigerators (n=23 in 2009)	$0	$0	$22,205	$0	$0	$0
Cold chain assessment equipment (2008) TinyTalk data loggers	$0	$4,000	$0	$0	$0	$0
Freeze tags	$0	$9,174	$0	$9,174	$0	$9,174
New vehicles for transport (Russian jeeps, motor bikes)	$0	$77,040	$77,040	$77,040	$77,040	$77,040
Insulated van at National level	$0	$25,000				
Generators & generator spare parts (n=73)	$5,110	$5,110	$5,110	$5,110	$5,110	$5,110
Maintenance & spare parts for entire cold chain (5% of estimated total capital value)	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Total cost	**$124,976**	**$205,021**	**$152,650**	**$131,884**	**$139,505**	**$126,688**

Table 3.7: Summary of financing for cold chain capital equipment

Financing sources	2007	2008	2009	2010	2011	2012
UNICEF*	$22,285	$0	$0	$0	$0	$0
Unsecured	$102,691	$205,021	$152,650	$131,884	$139,505	$126,688
Total	**$124,976**	**$205,021**	**$152,650**	**$131,884**	**$139,505**	**$126,688**

Note: * Possibly with support from AusAID.

3.4 Operational costs

The items costed under operational costs included human resources, IEC and advocacy, training, vaccine delivery costs, surveillance, waste management, office supplies, program management and operational costs for any vaccination campaigns planned during the plan period. Collectively, these costs are large (ie, $1.2 million for 2007) (Table 3.8). Most of these costs are covered by the Government of Mongolia (82% in 2007). However, there are unsecured costs – including for 2007 (Table 3.9).

Table 3.8: Summary of operational costs (all levels of the system)

Program component	2007	2008	2009	2010	2011	2012
Annual rate of inflation (all salaries and costs)	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*
Human Resources (salaries, etc.)						
National level all staff (10 in 2007)	$24,000	$24,480	$24,970	$25,469	$25,978	$26,498
National level new staff (2: 1 in 2007 & 1 in 2008)	$2,300	$4,600	$4,692	$4,786	$4,882	$4,979
All costs for supervision by national level staff	$10,000	$10,200	$10,404	$10,612	$10,824	$11,041
All costs for supervision by aimag/city level staff	$16,854	$17,191	$17,535	$17,886	$18,243	$18,608
All costs for outreach vaccinators/mobile teams	$136,709	$139,443	$142,232	$145,077	$147,978	$150,938
Salaries of the shared health workers						
National (3 staff at 50% in 2007)	$3,600	$3,672	$3,745	$3,820	$3,897	$3,975
Aimag/city district (46 in 2007)	$6,223	$6,347	$6,474	$6,604	$6,736	$6,871
Soum (684 in 2007)	$210,355	$214,562	$218,853	$223,230	$227,695	$232,249
Bag\family (1028 in 2007)	$279,377	$284,965	$290,664	$296,477	$302,407	$308,455
Subtotal (human resources)	***$689,418***	***$705,460***	***$719,570***	***$733,961***	***$748,640***	***$763,613***
IEC						
Social mobilization	$8,000	$8,160	$8,323	$8,490	$8,659	$8,833
Broadcasting of messages on mass media (TV, radio etc)	$10,000	$10,200	$10,404	$10,612	$10,824	$11,041
Printing of IEC materials	$13,005	$13,265	$13,530	$13,801	$14,077	$14,359
Communication workshops between health sector and local authorities	$6,000	$6,120	$6,242	$6,367	$6,495	$6,624
Subtotal (IEC)	***$37,005***	***$37,745***	***$38,500***	***$39,270***	***$40,055***	***$40,857***
Vaccine delivery and fuel for generators (cold chain)						
Vaccine delivery costs (to aimag & soum levels)	$153,979	$157,059	$160,200	$163,404	$166,672	$170,005
Fuel costs for generators for the cold chain (see below)	$105,303	$107,409	$109,557	$111,748	$113,983	$116,262
Shared transportation costs for vaccines	$14,415	$14,703	$14,997	$15,297	$15,603	$15,915
Subtotal (vaccine delivery)	***$273,697***	***$279,170***	***$284,754***	***$290,449***	***$296,258***	***$302,183***
Training						
Training of staff at different levels (including Nat. Imm Day workshops)	$25,000	$25,000	$20,000	$15,000	$10,000	$10,000
Cold chain training - all levels (including technicians for all aimags)	$40,000	$10,000	$5,000	$5,000	$5,000	$5,000
Subtotal (training)	***$65,000***	***$35,000***	***$25,000***	***$20,000***	***$15,000***	***$15,000***
Surveillance						

Program component	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Budget for monitoring and disease surveillance	$5,618	$5,730	$5,845	$5,962	$6,081	$6,203
Active AFP and measles surveillance	$6,242	$6,367	$6,494	$6,624	$6,757	$6,892
Improve reporting of measles by family doctors	$5,000	$5,100	$5,202	$5,306	$5,412	$5,520
Outbreak investigation	$6,000	$6,120	$6,242	$6,367	$6,495	$6,624
Data management (database software, training of staff, guidelines etc)	$20,000	$15,000	$10,000	$10,200	$10,404	$10,612
Knowledge Attitude Practice Survey	$10,000	$0	$0	$0	$0	$0
Measles and hepatitis B serosurvey for immunity status	$0	$30,000	$0	$0	$0	$0
Lab-sample transportation	$2,247	$2,292	$2,338	$2,385	$2,432	$2,481
Surveillance lab equipment (including diagnostic kits)	$5,000	$5,100	$5,202	$5,306	$5,412	$5,520
Regional laboratory training	$10,404	$10,612	$10,824	$11,041	$11,262	$11,487
Subtotal (surveillance)	***$70,511***	***$86,321***	***$52,148***	***$53,191***	***$54,254***	***$55,339***
Waste Management						
Number of incinerators obtained	*0*	*3*	*4*	*6*	*8*	*9*
Incinerator installation (capital cost) for all aimag and districts	$0	$51,000	$68,000	$102,000	$136,000	$153,000
Maintenance and running costs for waste management	$0	$7,650	$17,850	$33,150	$53,550	$76,500
Subtotal (waste management)	***$0***	***$58,650***	***$85,850***	***$135,150***	***$189,550***	***$229,500***
Office supplies and equipment						
Desktop computers with printer (36 required) - bulk purchase	5400	5400	5400	5400	5400	5400
Photocopy machine (1 at National level)	0	$5,000	0	0	0	0
Laptop computer (national and aimag levels) - 3 required	4000	2000	2000	2000	0	0
LCD projector (2 required)	5200	5200	5200	5200	5200	5200
Other office equipment	$8,066	$8,227	$8,392	$8,560	$8,731	$8,906
Subtotal (office supplies and equipment)	***$22,666***	***$25,827***	***$20,992***	***$21,160***	***$19,331***	***$19,506***
Program Management						
Meetings (10 meetings, $200 each)	$2,000	$2,040	$2,081	$2,122	$2,165	$2,208
Evaluations: Annual supervision	$11,861	$12,098	$12,340	$12,587	$12,839	$13,096
Program review (every 3 years)	$0	$0	$10,000	$0	$0	$10,000
Maintenance and overhead costs (electricity, water, etc.	$3,121	$3,183	$3,247	$3,312	$3,378	$3,446
Office supplies (stationary & paper)	$2,000	$2,040	$2,081	$2,122	$2,165	$2,208
Subtotal (program management)	***$18,982***	***$19,362***	***$29,749***	***$20,144***	***$20,547***	***$30,958***
Operational cost for the measles campaigns						
Per diems for running the measles campaigns	$11,340	$0	$0	$0	$7,560	$0
Total	**$1,188,619**	**$1,247,536**	**$1,256,562**	**$1,313,324**	**$1,391,196**	**$1,456,955**

Table 3.9: Summary of financing for operational costs

Financing of operational costs - Amounts	2007	2008	2009	2010	2011	2012
Government*	$974,302	$996,042	$1,015,962	$1,036,282	$1,057,007	$1,078,147
Assumed 50% Government	$37,933	$38,442	$36,460	$34,490	$32,529	$33,080
Assumed 50% donor (eg, UNICEF, WHO based on past funding)**	$37,933	$38,442	$36,460	$34,490	$32,529	$33,080
Unsecured	$138,451	$174,611	$167,678	$208,063	$269,129	$312,648
Total	**$1,188,619**	**$1,247,536**	**$1,256,562**	**$1,313,324**	**$1,391,196**	**$1,456,955**
Financing of operational costs – Percentages						
Government*	82.0%	79.8%	80.9%	78.9%	76.0%	74.0%
Assumed 50% Government	3.2%	3.1%	2.9%	2.6%	2.3%	2.3%
Assumed 50% donor (eg, UNICEF, WHO based on past funding)**	3.2%	3.1%	2.9%	2.6%	2.3%	2.3%
Unsecured	11.6%	14.0%	13.3%	15.8%	19.3%	21.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes:
* Includes local government funding of fuel for generators.
** Agencies such as UNICEF and WHO have traditionally supported aspects of training, IEC materials, evaluations and operational research and aspects of surveillance.

3.5 Total budget requirement for the NIP and financing sources (2007 – 2012)

Total budget requirement for the NIP in 2007 is $2.21 million (Table 3.10). Every year there are increases in the projected budget (ie, up to $2.82 million in 2012). Every year there are unsecured funds with this proportion going from 10.9% in 2007 up to 24.8% in 2012. The next section discusses how these unsecured funds can be obtained. In 2007 the estimated cost of the NIP per live birth was only $45.2 (Table 3.10). This would appear to make the program an extremely cost-effective intervention in health spending terms. It is however higher than in many other developing countries since Mongolia is using pentavalent vaccine.

Table 3.10: Total financing – current and requirements

Total financing - Amounts	2007	2008	2009	2010	2011	2012
Government of Mongolia	$1,152,513	$1,243,457	$1,223,697	$1,247,453	$1,654,016	$2,088,913
GAVI	$691,988	$729,765	$745,713	$762,101	$382,211	$0
JICA	$66,414	$0	$0	$0	$0	$0
UNICEF	$22,285	$0	$0	$0	$0	$0
Assumed 50% donor (based on past funding)	$37,933	$38,442	$36,460	$34,490	$32,529	$33,080
Unsecured	$241,142	$379,632	$542,965	$569,931	$712,753	$699,747
Total	**$2,212,276**	**$2,391,296**	**$2,548,835**	**$2,613,975**	**$2,781,510**	**$2,821,740**
Total financing –						

Total financing - Amounts	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Percentages						
Government of Mongolia	52.1%	52.0%	48.0%	47.7%	59.5%	74.0%
GAVI	31.3%	30.5%	29.3%	29.2%	13.7%	0.0%
JICA	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%
UNICEF	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Assumed 50% donor (based on past funding)	1.7%	1.6%	1.4%	1.3%	1.2%	1.2%
Unsecured	10.9%	15.9%	21.3%	21.8%	25.6%	24.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Cost of the NIP per live birth	$45.2	$47.3	$48.8	$48.5	$49.9	$49.0

Part IV: Strategies for improving financial sustainability of immunization in Mongolia

4.1 Increasing Government of Mongolia contributions

Given the need for additional program funding identified in the Part 3 of this cMYP, it is necessary for the Government commitment (via the Immunization Fund) to gradually increase over the six-year time period of this Plan. This should be feasible as the MOH expect that health sector funding will keep up with economic growth.

The table below describes some of the extra areas that the Government could fund more fully. For vaccines it involves a step by step approach (adding a vaccine at a time) to the budget of the Government in order that the Immunization Fund increases its investment. It is expected that the Government could negotiate a new agreement with GAVI for co-financing of MMR (for 2009).

Table 4.1 Summary of funding by Government and other agencies of key components of the NIP with ideas for change to improve the security of financing

2007	2008	2009	2010	2011	2012
Government – currently planned					
BCG, OPV, DT, measles	BCG, OPV, DT, measles	BCG, OPV, DT, measles	BCG, OPV, DT, measles	BCG, OPV, DT, measles	BCG, OPV, DT, measles
	HepB1 (at birth)	HepB1, DTP	HepB1, DTP	HepB1, DTP	HepB1, DTP
	Injection safety 100%*	Injection safety 100%*	Injection safety 100%*	Injection safety 100%*	Injection safety 100%*
Salaries of staff & selected operational costs	Salaries of staff & selected operational costs	Salaries of staff & selected operational costs	Salaries of staff & selected operational costs	Salaries of staff & selected operational costs	Salaries of staff & selected operational costs
				Co-funding of pentavalent vaccine	Full funding of pentavalent vaccine
Government – potential					
		Possible co-funding of MMR vaccine?	Possible co-funding of MMR vaccine?	Possible co-funding of MMR vaccine?	Possible full funding of MMR vaccine?
Increased support for cold chain & operational costs?	Increased support for cold chain & operational costs?	Increased support for cold chain & operational costs?	Increased support for cold chain & operational costs?	Increased support for cold chain & operational costs?	Increased support for cold chain & operational costs?
GAVI – currently planned & potential expansion					
Injection safety equipment					
Pentavalent vaccine	Pentavalent vaccine	Pentavalent vaccine	Pentavalent vaccine	Co-funding of pentavalent vaccine	
		Government to make proposal to GAVI for MMR co-funding?	Government to make proposal to GAVI for MMR co-funding?	Possible co-funding of MMR vaccine?	Possible co-funding of MMR vaccine?
Immunization services support for coverage	ISS support probable	ISS support probable	ISS support probable		
JICA – currently planned & potential expansion					
DTP					
Hepatitis B					
Other - Government to clarify with JICA?	Other - Government to clarify with JICA?	Other - Government to clarify with JICA?	Other - Government to clarify with JICA?	Other - Government to clarify with JICA?	Other - Government to clarify with JICA?

Notes: * Safety boxes and AD syringes.

4.2 Strengthening donor commitment and contributions

This section summarizes the roles of donors and international agencies and how these can be developed in the immunization area. Firstly it is important to note that there is a key role for the Government of Mongolia and the MOH in regularly communicating with donors and coordinating their contributions – so as to maximize the benefits of cooperation and minimize risks of gaps in funding occurring. This is one of the functions of having an updated cMYP and an active ICC.

GAVI Alliance: Tables 3.10 and 4.1 above highlight the very important role played by GAVI now and during the next few years of this Plan. To extend this support it will be necessary for some arrangement to be made with GAVI concerning co-funding of the pentavalent vaccine for the years 20011 onwards. GAVI has also provided conditional funding support for Mongolia's application for Immunization Services Support (ISS). There is a process underway in 2007 for this application to GAVI to be revised and the ISS support being confirmed (this is for a total of $105,620 spread over four years to improve coverage). Future applications to GAVI may be needed for funding support for new vaccines (eg, pneumococcal vaccine).

JICA: JICA has a long history of supporting immunization in Mongolia and it has contributed substantial amounts of resource in the forms of vaccines, injection equipment, cold chain supplies and support for operational research. The key findings from an evaluation report by JICA [JICA 2006] that describes the good results for immunization as part of JICA's support for the Maternal and Child Health Project are detailed in Annex 2 (Section A2.7).

In 2007 JICA reported that it was able to definitely commit to providing funding support for immunization for the next financial year (see Table 32.). But after this the support for immunization is unclear as JICA is currently assessing other additional requests from the Government of Mongolia (concerning support for health worker training in rural areas and also support for the *Health Sector Strategic Master Plan*).

Some actions that can be considered to encourage JICA to maintain at least some of its generous contribution to immunization for the years from 2008 on include the following:

- That the Government does more work to prioritise immunization in its future requests for support from JICA.
- That JICA is informed of the immunization components within the *Health Sector Strategic Master Plan* – if JICA decides to provide funding around the Plan. This *Master Plan* includes targets (page 115) of: (i) Increasing immunization coverage to 98% of children under 1 at soum and bag level b 2010; (ii) Reducing the incidence of vaccine preventable diseases by 30% of the 2005 baseline by 2010; and (iii) Measles eradication.
- That JICA is encouraged to emphasize preventive activities such as immunization in health worker training in rural areas (if JICA decides to strengthen its support in the health worker training area).

UNICEF: UNICEF also has a long history of supporting immunization in Mongolia. It has supported cold chain maintenance and upgrading, training and capacity building, operational research and in providing strategic level support for promoting immunization. Although UNICEF has limited capacity for direct funding support, these various types of contributions are likely to continue into the future. UNICEF is also involved in a demonstration project that includes immunization. This is the *Convergent Basic Social Services Program* which is an integrated child health program in a defined geographic area. This project may provide a model for improving child health in Mongolia in the future. UNICEF also has an interest in improving childhood registration (for immunization and the provision of other social services).

Also related to immunization is UNICEF's focus on emergency preparedness (including pandemic influenza). Such preparedness includes support for a more effective early warning system and having adequate capacity for using a new pandemic influenza strain vaccine when it comes available.

WHO: WHO has a long history of supporting immunization in Mongolia. It has focused on technical support, operational research and in providing strategic level support for promoting immunization (eg, with UNICEF on setting Regional goals for measles elimination and improved hepatitis B control). These various types of contributions are likely to continue into the future. However, WHO has limited capacity for direct funding support.

ADB: The Asian Development Bank supports immunization indirectly through its support of primary health care programs in Mongolia. It also supports data quality improvement which is relevant to immunization services. In 2001 ADB published a detailed document on financing of the NIP in Mongolia [ADB 2001].

Other possible donors: The Australian Development Agency (AusAID) has provided support for the health sector in Mongolia since 2000 (as detailed in: [Government of Mongolia 2005b]). This agency has also expressed interest concerning support for the *Health Sector Strategic Master Plan* – which includes targets relating to immunization. Therefore it is possible that AusAID could be interested in supporting aspects of the NIP in Mongolia (eg, for new vaccines).

4.3 Improving efficiency, lowering costs and reducing waste

This cMYP includes within Objective 4 (Quality) a number of actions that could save program funds. These include:

1) ***Logistics:*** Improving logistics which could reduce vaccine wastage (including promoting the open vial policy and expanding the policy to four weeks).
2) ***Cold chain:*** Improving the cold chain which could also reduce vaccine wastage.
3) ***Staff turnover:*** Improving training of staff which could improve staff retention and reduce the costs associated with high staff turnover.
4) ***Distance learning for training:*** On a National Immunization Day in 2006, distance learning via videoconferencing and involving three aimags and Ulaanbaatar and around 200 health workers was successfully undertaken. Expanding distance learning (the majority of aimags now have Internet access) may reduce travel costs associated with training activities.
5) ***Local manufacture:*** Possibly the local manufacture in Mongolia of safety boxes (and potentially also AD syringes) will lower the costs of these immunization supplies.
6) ***Source of cold chain equipment and cold chain vehicles:*** The current cold chain equipment is nearly all from Japan (it was supplied by JICA). If the Mongolian Government starts to purchase such equipment for itself, there may be savings from buying Mongolian or Chinese products. Some Chinese refrigeration equipment is considered to be of a good standard, parts are readily available in Mongolia and reasonable guarantees are offered. Chinese motor bikes and Russian jeeps are already purchased for Mongolia's immunization program.
7) ***Fuel for generators:*** For remote soums that use generators to power the cold chain, it is possible that solar power or wind power may be more cost effective options. Some soums already use

solar generators. However, this issue needs careful consideration due to maintenance and spare parts issues (and some locations do not suitable for wind generation).

In general, improving program quality will reduce the risk of adverse publicity for the program which could reduce public support for immunization (with this lowering coverage rates).

4.4 Identifying other sources of support for the NIP

The process of updating this cMYP identified the following possibilities:

1. ***Applications to the Health Development Support Fund:*** Additional support from this fund can be obtained through specific proposals. This may be needed for funding requests for new vaccines and cold chain equipment (if routine Government funding or donor funding is not available).

2. ***Local government:*** Seeking support from local government at the aimag level for enhancing support for immunization activities. This has already occurred in aimags with more economic resources (eg, Sukhbaatar aimag providing vehicles for assisting in campaigns). There is a need to train aimag EPI managers on how to mobilize resources from local authorities. At present local government already provides some support for immunization eg, fuel for generators to supply electricity for the cold chain.

3. ***Free/subsidized advertising:*** Obtaining free or subsidized advertising time on television or radio for immunization-related activities as part of a public service by the companies who own these stations. There is also a new public broadcasting radio station that could be used for promoting immunization (though there are no longer any state-owned television channels in Mongolia). National and aimag level EPI workers can also work with the news media to promote positive news stories about immunization (eg, on the decline in Hib disease). This can provide essentially free advertising for the value of immunization.

4. ***Sponsorship:*** Identifying businesses or wealthy individuals who may wish to provide sponsorship for immunization activities. One example is Vodafone in two districts of Ulaanbaatar where this company has supplied computers to EPI offices. Although sponsorship is still fairly rare in Mongolia, consideration could be given to training EPI managers in seeking out such sponsorship funding. However, sponsorship funds should not be obtained from companies that produce products that harm health (eg, tobacco companies).

5. ***Tax revenue:*** The Government of Mongolia currently taxes alcohol and tobacco and revenue from these sources contributes 2% of the newly established *Health Development Support Fund* (which started in April 2007) [Government of Mongolia 2005c]. In the future these taxes could be increased and the revenue could be tagged within the Fund for supporting prevention programs such as the NIP.

6. ***Tax exemption for vaccines:*** Ideally because of their public health importance, vaccines should be exempt VAT. This recommendation was made previously by ADB [ADB 2001].

References

ADB, (2001). Mongolia National Immunization Program: Financing Assessment. Manila: Asian Development Bank (ADB).

Andre F, Zuckerman A, (1994). Review: protective efficacy of hepatitis B vaccines in neonates. *J Med Virol* 44: 144-51.

CDC, (2007). Elimination of measles - South Korea, 2001-2006. *Morb Mortal Wkly Rep* 56: 304-7

Chien Y, Jan C, Kuo H, Chen C, (2006). Nationwide hepatitis B vaccination program in Taiwan: effectiveness in the 20 years after it was launched. *Epidemiol Rev* 28: 126-35.

Dhiman R, (2006). Cold chain evaluation (Report to WHO). Manila: World Health Organization.

Ebright JR, Altantsetseg T, Oyungerel R, (2003). Emerging infectious diseases in Mongolia. *Emerging Infectious Diseases* 9: 1509-15.

Edstam JS, Dulmaa N, Nymadawa P, et al, (2002). Comparison of hepatitis B vaccine coverage and effectiveness among urban and rural Mongolian 2-year-olds. *Preventive Medicine* 34: 207-14.

Edstam JS, Dulmaa N, Tsendjav O, et al, (2004). Exposure of hepatitis B vaccine to freezing temperatures during transport to rural health centers in Mongolia. *Preventive Medicine* 39: 384-8.

EPI Team & WHO, (2007). EPI data quality self-assessment in Mongolia (Draft Report). Ulaanbaatar: EPI Team & WHO.

Gantulga D, Griffiths U, Wiersma S, et al, (2005a). Hepatitis B vaccination in Mongolia: Costs and disease impact twelve years after vaccine introduction. Ulaanbaatar: National Centre for Communicable Diseases.

Gantulga D, Orgil T, Munkhtsetseg C, et al, (2006). Report on temperature monitoring of the vaccine cold chain in Mongolia. Ulaanbaatar, Mongolia: National Center of Communicable Diseases, Ministry of Health.

Gantulga D, Tuul R, Anand S, et al, (2005b). Determination of immunity level against vaccine preventable diseases among general population of Mongolia. Ulaanbaatar, Mongolia: National Center of Communicable Diseases, Ministry of Health.

Government of Mongolia, (2000). Law on Immunization. Ulaanbaatar, Mongolia: Government of Mongolia.

Government of Mongolia, (2004). Government Resolution 129 (Annex 1): The National Program for Control of Communicable Diseases. Ulaanbaatar, Mongolia: Government of Mongolia.

Government of Mongolia, (2005a). Health Sector Strategic Master Plan 2006-2015. Ulaanbaatar, Mongolia: Ministry of Health, Government of Mongolia.

Government of Mongolia, (2005b). Health Sector Strategic Master Plan 2006-2015: Medium-term expenditure framework (Volume 2). Ulaanbaatar, Mongolia: Ministry of Health, Government of Mongolia.

Government of Mongolia, (2005c). Law on Tobacco Control. Ulaanbaatar, Mongolia: Government of Mongolia.

Hansman G, Kuramitsu M, Yoshida H, et al, (2005). Viral gastroenteritis in Mongolian infants. *Emerg Infect Dis* 11: 180-2.

JICA, (2006). Evaluation of Maternal and Child Health Project Ulaanbaatar: Japan International Cooperation Agency (Mongolia Office). http://www.jica.go.jp/english/evaluation/project/expo/as/2006/mon_01.html.

Lee C, Gong Y, Brok J, et al, (2006a). Effect of hepatitis B immunisation in newborn infants of mothers positive for hepatitis B surface antigen: systematic review and meta-analysis. *BMJ* 332: 328-36

Lee C, Gong Y, Brok J, et al, (2006b). Hepatitis B immunisation for newborn infants of hepatitis B surface antigen-positive mothers. *Cochrane Database Syst Rev* 19: (2):CD004790. .

Logez S, Soyolgerel G, Fields R, et al, (2004). Rapid assessment of injection practices in Mongolia. *Am J Infect Control* 32: 31-7.

National Statistical Office of Mongolia, (2006). Monthly Bulletin of Statistics. Ulaanbaatar, Mongolia: National Statistical Office of Mongolia, Government of Mongolia.

Nymadawa P, Nortma M, Medsaikhan J, et al, (2007). Childhood bacterial meningitis in Ulaanbaatar, Mongolia (2002-2007). Ulaanbaatar, Mongolia: National Center of Communicable Diseases, Ministry of Health.

Raza S, Clifford G, Franceschi S, (2007). Worldwide variation in the relative importance of hepatitis B and hepatitis C viruses in hepatocellular carcinoma: a systematic review. *Br J Cancer* 96: 1127-1134.

Tellez I, Altankhuu M, Vermund S, et al, (2002). Hepatitis, syphilis, and HIV sentinel surveillance in Mongolia 1999-2000. *Sex Transm Infect* 78: 223-226.

UNDP, (2006). Human Development Report 2006. Beyond scarcity: Power, poverty and the global water crisis. New York: United Nations Development Program.

WHO, (2006). Report of “Impact assessment of hepatitis B vaccination program in Mongolia survey". Manila: World Health Organization.

Annex 1: Immunization schedule in Mongolia

Table A1: Mandatory immunization schedule in the National Immunization Program of Mongolia, 2006

Vaccine	After birth within 24 hours	2 months	3 months	4 months	8-11 months	14-21 months	2 years	7 years	15 years
BCG**	1st dose								
OPV	1st dose	2nd dose	3rd dose	4th dose					
HepB*	1st dose	2nd dose			3rd dose				
DTP*		1st dose	2nd dose	3rd dose			Booster#		
DT								1st booster#	2nd booster
Measles					1st dose	2nd dose			
Pentavalent (DTP-HepB-Hib)*		1st dose	2nd dose	3rd dose					

Notes:
* Pentavalent vaccine has been introduced in a phased manner since January 2005, and will be expanded nationwide by the beginning of 2008. This will result in phasing out of DTP and the 2nd and 3rd dose of monovalent hepatitis vaccine with the nationwide expansion of the pentavalent vaccine.
** A BCG booster given earlier at six years of age was discontinued in June 2006.
# See Objective 4 (Quality) about a review of the value of these immunization events.

Annex 2: Conclusions and key recommendations from recent studies on immunization in Mongolia

A2.1 Executive summary from Report of "Impact assessment of hepatitis B vaccination program in Mongolia" survey [WHO 2006]

Background: Because Mongolia is one of the most highly endemic countries for Hepatitis B virus (HBV) infection in the world, hepatitis B vaccine (HepB) was introduced into the National Expanded Program on Immunization (EPI) in 1991. However, relatively few data exist on HBV infection among children born after the introduction of universal vaccination regarding the situation of chronic hepatitis B after mass vaccination in the country, and none provided national estimation for chronic HBV infection. We aimed to estimate the national prevalence of HBV infection among the elementary school-children, and compare urban and rural areas using a representative national data.

Methods: We conducted a school-based cross-sectional nationwide survey of second grade children using a stratified multistage probability random cluster sampling from four main regions and two biggest cities of Mongolia. Serum samples from study subjects were tested for HBV markers with CLIA

(chemiluminescence immunoassay) using kits of Abbott© Japan Co., Ltd, at the SRL Laboratory in Japan. Liver enzymes (ALT, AST, GGT) were also evaluated by standard methods by using kits of CicaLiquid (Kanto Kagaku Co Ltd).

Results: From a total of 1182 children enrolled in this study (Response rate is, 93%), 1,145 children (592 boys and 553 girls) aged 7 - 12 were tested for HBV markers which represents nearly 2% of all second grade population in Mongolia. The overall prevalence (95%CI) of HBsAg, anti-HBs, and anti-HBc among the study population was 5.2 (3.93-6.49), 26.2 (23.65-28.75), and 15.6 (13.44-17.76), respectively. Moreover, among those who were HBsAg positive, 67.8% were highly infectious as indicated by the presence of HBeAg. Significantly higher prevalence of HBsAg, and anti-HBc were found for rural children comparing to urban children (7.7% vs. 3.0%; and 21.0% vs. 11.2%), for boys comparing to girls (6.6% vs. 3.6%; and 17.9% vs. 13.2%). HBV seropositivity rate was increased by age. Interestingly, significantly higher rate of anti-HBc and HBsAg were found among children vaccinated during the winter in the rural areas, though the differences were not significant in urban areas.

Conclusions: The results of the study suggests decline in prevalence of chronic HBV infection by more than 2 times from the baseline level of 12% to 5% most likely due to universal vaccination against HBV. However, the levels are substantially higher than the levels achieved with similar coverage levels in countries/areas such as Taiwan (China), Alaska or Singapore. Nonetheless, serious rural-urban differences in the prevalence of chronic HBV infection warrants further investigation of the issue and careful analysis of national immunization program to identify potential problems with maintaining vaccine potency till its administration. Potential issues might include poor vaccine storage leading to vaccine freezing especially during the winter time.

A2.2 Summary from "EPI Data Quality Self-Assessment in Mongolia" [EPI Team & WHO 2007]

Main conclusion: "Overall, consistency of reported data is acceptable, and the findings of this DQS do not suggest that there would be systematic over-reporting in Mongolia." However, this report noted some reporting problems in one of the aimags studied.

Recommendation 1: The Ministry of Health should consider planning further data quality self-assessments in other aimags and districts, by the trained staff, to determine whether data manipulation is a specific or a generalized problem, to raise awareness among aimag staff about the importance of good data, and to send a strong message that data manipulation is not acceptable. EPI managers should be aware that they are accountable for the reports they have signed off.

(Another six recommendations on improving data quality followed).

A2.3 "Hepatitis B vaccination in Mongolia: Costs and disease impact twelve years after vaccine introduction" [Gantulga et al 2005a]

Main conclusion: This study has illustrated that the hepatitis B vaccine has been an extremely effective way of reducing the prevalence of hepatitis B in Mongolia. The model estimated that approximately 26,797 hepatitis B infections are prevented every year by vaccinating the birth cohort. If the cohort had not been vaccinated, it is estimated that these infections would have lead to 607 future hepatitis B related deaths (not discounted). If death averted transfer into estimated life years gained is 12,692. According by the study the cost per death averted is US$423 and per life year gained is US$20.

A considerable amount of health care resources are currently being spent on treating hepatitis B infections. In year 2002, the Government hospitals treated approximately 991 acute hepatitis B patients, 4,348 chronic hepatitis B patients, 2,110 hepatitis B cirrhosis patients and 946 hepatitis B liver cancer patients. This is a total of 8,395 patients. We estimated that this amounted to US$1.5 million in 2002. In comparison, the costs of hepatitis B vaccine delivery amounted to US$ 256,957 during the same year. Hence, the hepatitis B vaccine is likely to result in considerable future cost savings.

A2.4 "Cold chain evaluation" [Dhiman 2006]

Main conclusions: "The efficiency of the current [national] store is limited by the lack of security and inadequate maintenance of the store. There is a lack of fool-proof processes to protect the vaccines from exposure to extreme temperatures. Supervision and surveillance is less than adequate as there is no full-time staff." …. "The store must therefore be relocated to a place with adequate infrastructural facility, where the EPI Team can provide adequate and timely support to run the store efficiently".

"The existing cold chain storage volume is sufficient to address the routine EPI-program needs and to include a new vaccine."

"Some gaps identified in the current EPI policy specifically related to procurement and maintenance of cold chain infrastructure could pose a risk to the success of an emergency vaccination program during a pandemic."

"There is no established plan for ongoing refresher training. Training is urgently required in the area of vaccine management, hygiene and infection control."

"Infrastructure at the soum level in terms of water, sanitation, waste disposal, electricity, cold chain store room facility, transport and communication is insufficient and/or not available."

Two pages of recommendations were provided for strengthening the cold chain at the national level

A2.5 "Report on temperature monitoring of the vaccine cold chain in Mongolia" [Gantulga et al 2006]

Main conclusions: This study found that vaccine was being exposed to heating temperatures for 4.9% of the time, to below 2 degrees Celsius for 7.9% of the time, and to temperatures where freezing could occur for 2.8% of the time. It reported that there was a risk that vaccines could be frozen in the cool room and Vaccine Central Store (VCS) of the NCCD. Also, it found that all aimags and districts involved in the study (except for one aimag and one district) have stored DTP vaccines at temperatures where freezing could occur.

The study also found that 27% of the doctors responsible for immunization and 55% of the vaccinator nurses-feldshers consider that exposure of vaccines to warm/hot temperatures is more risky than the exposure to freezing. This incorrect knowledge may have explained why refrigerator temperatures are not set at the correct levels. Freeze tag monitoring was only used 15-20% of the time.

A total of 14 recommendations were made for improving the cold chain. These covered moving the CVS to a better site, building a new cool room, use of data loggers, staff training (eg, on the "shake test"), and improving the power supply for immunization units that use solar energy generators.

A2.6 Sero-survey Report: "Determination of immunity level against vaccine preventable diseases among general population of Mongolia" [D.Gantulga et al 2005b]

Main conclusions: This study found that vaccination coverage is consistent with official reports at around 95%-98%. But it reported that the lower immunity level in soums may be adversely affected by poor storage and overcooling of vaccines in carriers during the transportation of the DTP. Also the analysis of the epidemiological situation and measles immunity levels demonstrate that there is a need for supplementary vaccination for measles every four years.

Main recommendations: These included the need to improve primary registration of vaccination coverage, changes in the immunization schedule for vaccines containing tetanus toxoid, SIAs against measles, training and supervision of staff involved in the NIP, and improvements in the cold chain.

A2.7 JICA's Evaluation Report: "Maternal and Child Health Project" [JICA 2006]

A summary of the evaluation results for the EPI part of the Maternal and Child Health Project are given in the table below.

Narrative summary	Indicators that can be verified	Result
Project purpose Prevention system for EPI target diseases is strengthened.	1 Certification by WHO regional committee 1 National documentation for certification for poliomyelitis eradication 2 National EPI coverage data 3 National EPI surveillance data	1. Certification of poliomyelitis eradication by WHO regional committee is provided in 2001. 2. National EPI vaccine coverage is improved. 3. EPI disease surveillance including active hospital investigation is improved and expanded.
Outputs 1. Vaccination rate in soum and bag level is improved	1-1. Coverage of each vaccine in last 5 years has reached more than 90% 1-2. Number of soums conducted coverage survey 1-3. Number of workshops on national and aimag level	This output is fully achieved. 1. Coverage of each vaccine has reached more than 90%. National coverage was 89% in 1995. By the end of 2005, coverage of BCG is 98.7%, OPV 99%, DTP 99%, DTP+HepB+Hib 99.3%, measles vaccine 97.5% and HepB vaccine 98.5%. The project outcome is high and it envisaged by the evenly increase of all 6 vaccines. 2. Active coverage survey is conducted in all aimags and soums. 3. Number of workshops were conducted 6 times in national level and 34 times in aimag level.
2. Surveillance system for EPI target diseases is improved	2-1. AFP surveillance indicators 2-2. Number of workshops for medical workers 2-3. Publication for medical workers	This output is completely achieved. 1. AFP surveillance indicator were 1.4 in 1997, and 1.0 in 2001. 2. See 1-3. 3. 17 guidebooks have been published.
3. Cold chain and logistics system are improved.	3-1. Discrepancy between record and physical stock of vaccines in central storage is decreased 3-2. Storage condition in aimag and soum 3-3. Workshops for cold chain	This output is fully achieved. 1. No discrepancy in every vaccine confirmed in 6th May 2002 2. Ice-lined refrigerators have supplied in 26% of soums (100% in 1997). Generators have supplied in 96.3% of soums (41% in 1997). 3. Workshops for cold chain were conducted 1 for national level, 17 for aimag level.
4. Technical level of EPI medical staff is improved.	4-1. Number of training for EPI medical staff 4-2. Number of audience in the training course for EPI medical staff	This output is fully achieved. See 1-2.

Comments on sustainability: "Government is highly committed in implementing EPI program, and it has included vaccination issues in goals of many of its policy documents, including Millennium Development Goal, Poverty reduction strategy etc."

"MOH in collaboration with donor agencies is developing Multi-year plan for National Immunization Program, which identifies actions to be taken until 2010. It will also ensure sustainability of the Project achievements."

"The government also aims to improve self-reliance of EPI program by improving Vaccine Fund. It is expected that by 2010 the government becomes self-reliable and buys all the vaccines necessary for Mongolia by itself."

Comments on organizational aspects: "Partnership between MOH and international organizations especially JICA and UNICEF was perfect. They cooperate openly, share ideas and divide responsibilities and work on different elements of the Program so support each other. This collaboration continues at present and other donors that enter in this collaboration also become part of this well organized collaboration and works in good partnership."

"Surveillance system for EPI target diseases is maintained at high level of performance. National Polio Laboratory and National Measles Laboratories are working in full capacity and ensure confirmation of disease cases by Lab diagnosis."

Financial aspects: "MOH is receiving supply of EPI vaccines by other donors."

"By Master Plan of EPI planed on Oct 2005, MOH will achieve independence on 2010 completely. Therefore, financial aspect is not secured sustainability at the present moment."

Factors that have promoted project: "Vaccination is included in work plan of every level governors and understood by most of the policy-makers and decision-makers, therefore, although government officials are changed frequently, even new ones are also committed for improving vaccination coverage."

Factor that have inhibited project: "High turnover and staff mobility negatively influence on sustainability of the project, because due to these previously trained staff are changed or move away and new staff needs to be trained again. Frequent natural calamities sometimes negatively influence on the vaccination coverage because due to harsh winter and draught people move from their original living places to other aimags where they are not registered and cannot access health services Including vaccination."

Conclusions: "On overall, EPI Project implemented by JICA 1997-2002 has successfully achieved its goals and greatly contributed to strengthening EPI Programme in Mongolia. Enabling policy and legislative environment, existence of adequately trained human resource, well-structured infrastructure, promising financial long-term funding mechanism and government's commitment to maintain project achievements are the factors, which ensure sustainability of EPI Project in Mongolia."

Recommendations: "Cold chain equipment provided by JICA, UNICEF and WHO are becoming old and requires maintenance. Therefore, government should pay attention on training qualified repairmen and allocating budget for purchase of necessary spare parts and maintenance of equipment. In order to operate the National Vaccine Fund efficiently, Mongolia needs to work with step-by-step plan and to seek ways to buy vaccines cheaper by using contacts of international partners."

Annex 3: Explanatory notes relating to costing calculations

This Annex details some of the key aspects of the updated costing calculations. A specially adapted version of the costing tool needed to be produced to allow for: (i) calculations out to the year 2012; (ii) value-added tax (VAT) just being applied to select vaccines; (iii) other customizations (eg, changing vaccines and vaccine wastage with the introduction of new vaccines at certain points in the time period. In general, a 2% inflation rate is used for an increase in costs over time. The capital and depreciation costs for buildings are not considered in the analyses. Neither are the costs of the primary training of health workers (ie, to become nurses or doctors). Hence the total costs may are probably slight under-estimates of the true total costs.

Demographic data: The updated data used was based on national statistics [National Statistical Office of Mongolia 2006]. The projected annual growth in the live birth rate was based on the average annual increase between 2004 and 2006 of 3.3%. It was assumed that this rate of growth would continue during the period covered by this cMYP but it is plausible that with increased economic development the birth rate may start to stabilize or decline. However, a recent Government financial package to support parenting may act to keep fertility rates relatively high.

It was conservatively assumed that (i) the infant mortality rate would remain stable at the average 2004-2006 level (ie, 21.2 per 1000 live births); and (ii) that infants dying in the first year of life would die prior to receiving any vaccines (ie, both these assumptions will tend to under-estimate the number of surviving live infants). The Table below shows the figures used in the calculations.

Table A3: Demographic projections used in the costings

	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
	Actual	***Projected***					
Live births (N)	47,376	48,939*	50,554	52,223	53,946	55,726	57,565
Infant mortality (N)	937	1,038	1,072	1,107	1,144	1,181	1,220
Infants to be vaccinated	46,439	47,902	49,483	51,116	52,802	54,545	56,345

Note: * It is possible that this could be an under-estimate as fertility rates may increase as this year is of special cultural significance to many people in Mongolia (year of the "Golden Pig").

Vaccine prices and usage: UNICEF prices for 2006 were used in the calculations (from: http://www.unicef.org/supply/files/vaccine_2006.pdf). Specific data include:

1) DTP cost was based on 10 dose vials.
2) OPV cost was based on 10 dose vials.
3) Hepatitis B was based on 10 dose vials ($0.224 per dose) but this is similar to the cost of two dose vials (at $0.240 per dose).
4) The lowest cost MMR was selected (ie, the Leningrad-Zagreb strain for mumps) and for single dose vials.

5) Coverage data was based on the most recent year of data and used coverage for the last required dose of each vaccine eg, OPV4, DTP3 etc (2006 data). The use of the pentavalent vaccine in 2007 was estimated to cover 75% of the eligible population (up from 55.8% in 2006). In 2008 it was projected to have the same coverage of DTP3 ie, 99%.
6) No account was taken of declining vaccine prices – though this is quite plausible over this time period.
7) Revised waste figures were used (average for the last five years as calculated by the National EPI Team). A shift to a two-dose vial of hepatitis B for the birth dose in the future was considered likely to reduce wastage. Also a shift to single dose MMR vaccine was considered likely to substantially reduce wastage.
8) Value-added tax was charged on all vaccine purchased through the Immunisation Fund (ie, BCG, polio, measles and DT in 2008) but not for vaccine purchased by donor agencies.
9) To cover the cost of transport from the overseas manufacture to Ulaanbaatar in Mongolia, an extra 15% was added to the vaccine price (as per the Excel costing tool provided by GAVI).
10) It is possible that some vaccines purchased by the Immunization Fund for the NIP in the future may be by open tender. This may result in slightly different prices for vaccines. Nevertheless, UNICEF prices have been used throughout in this costing analysis.

Campaigns: It was assumed that there would be two campaigns of SIAs for measles (using monovalent vaccine). One in 2007 (children aged 2-10 years) and another in 2011 (children aged 2-5 years). Demographic data used the figures derived above (for routine immunization). Coverage was estimated to be 96% based on previous campaigns.

Sero-surveys: It was assumed that there would be a sero-survey for measles in 2008 and the opportunity would be taken to combine this with a hepatitis B sero-survey (to assess the benefit of the new policy that focuses on the first dose within 24 hours of birth).

Injection supplies: These were based on UNICEF AD syringe prices for 2005 (http://www.unicef.org/supply/files/Projections_AD_Syringes_2005.pdf). No account was taken of possible future local manufacture that may become cheaper. A lower wastage for supplies was used of 5% (compared to in the previous cMYP). All mixing syringes were replaced by AD syringes.

Cold chain supplies: The new costing estimates were based on EPI Team assessments and those from [Dhiman 2006]. The following are explanatory notes:
1) ***National walk-in-cooler:*** The report by Dhiman [Dhiman 2006] estimated that the cost of refurbishing the national store at a specified location (location "B" in the report) would be approximately $30,000. This was likely to be a marked under-estimate according to the EPI Team. Therefore a higher estimate is used in the calculations of $50,000.
2) ***Voltage regulators:*** These were included to protect every refrigeration unit from high voltage fluctuation (as recommended in the Dhiman Report).
3) ***Vehicles:*** The Dhiman Report found that the cold chain in Mongolia involved 124 vehicles (19% not operational) and 261 motor bikes (30% not operational). However, there were no data for three aimags and for Ulaanbaatar and the current situation in 2007 is significantly worse (eg, there were only 2 cars for the 9 districts in Ulaanbaatar in 2007, when nine is consider to be the desirable number by the EPI Manager for Ulaanbaatar). Therefore the cost calculations for the six-year time period were based on obtaining over the six years: one car (Russian jeep) for each aimag (n=21) and each district (n=9); one motorbike for 50% of the 333 soums (165) and for four districts; and one

Western jeep (national level). The local cost estimates were of $10,000 for a Russian jeep and $800 per motorbike and $20,000 for a Western jeep.

4) ***Spare parts and maintenance:*** The total current value of all cold chain capital equipment in Mongolia is not precisely known. But for the purposes of estimating the cost for spare parts and maintenance (at 5% of the total) it was conservatively estimated to be only around $200,000 (due to the old age of most of the equipment). It is well known that there is a shortage of maintenance tool kits at the aimag level – and also of staff and mechanics who can do repairs and maintenance. The report by Dhiman also recommended the creation of a national spare parts store along with a national repair and maintenance workshop for the cold chain equipment.
5) ***Cold chain assessment:*** This is planned for 2008 and was costed at $4000 (110 data logger devices (the *TinyTalk* brand) at approximately $32 each and approximately $500 for the software).
6) ***Inflation:*** There was no inflation adjustment made for cold chain supplies as it was considered that the cost of refrigeration equipment would probably tend to decline over time (owing partly to the increasing competitiveness of the Chinese manufacturing sector for whiteware).
7) ***Freeze tags****:* The cost was based on 2004 prices for lots of 1350 (at 4.80 Swiss Francs per tag) ie, $3.98 per tag.
8) ***Generators:*** The EPI Team estimated a need for 73 generators ($400 each plus 5% for spare parts). See "operational costs" for the fuel costs for these generators.

Operational costs: The new costing estimates were based on EPI Team assessments and local prices for 2007 in Mongolia. Specific details are explained below.

- ***Workforce:*** The numbers of workers at different levels was revised for 2007 values and wages/salaries adjusted (up by approximately 50% since 2005).
- ***Training:*** This was increased as per various recommendations in operational research reports – including cold chain specific training.
- ***Surveys:*** These included one "knowledge, attitudes and practices" survey; and a combined measles and hepatitis B sero-survey.
- ***Incinerators:*** The capital cost for new incinerators ($17000 average [range: $13000 to $21,000]) was to cover all 21 aimags and 9 districts over the six year period. The maintenance and running cost was based on 15% of the cumulative capital cost for the incinerators. At this time no extra expenditure on incinerators for soums was considered (eg, for small incinerators at around $400 each).
- ***Fuel costs for generators (cold chain):*** There are 73 soums with no electricity that rely on generators (with an estimated 50% of the unit's activity being immunization-related). These run for four hours a day at $1.25 per hour in diesel fuel costs. For another 53 soums there are larger generators that run from between 2 and 18 hours per day (with a 10 hour average used in the calculations) and cost an estimated $10 per hour in diesel fuel costs. These larger units have only 2% of their activities being immunization-related.
- ***Operational measles campaign costs:*** The per diem rate was the average of the two rates ($16 per day in Ulaanbaatar and $20 per day in other settings) ie, $18 per day. For the 2007 campaign the calculation assumed three health workers working for seven hours per day for 30 days. For the second campaign in 2011 it was assumed that 20 days work would be required.

Annex 4: Potential benefit of studying the use of hepatitis B immunoglobulin for infants of HBsAg positive mothers

A recent Cochrane systematic review [Lee et al 2006b] reported the following results:

> "Compared with placebo/no intervention, hepatitis B immunoglobulin or the combination of vaccine plus hepatitis B immunoglobulin reduced hepatitis B occurrence (hepatitis B immunoglobulin: RR 0.50, 95% CI 0.41 to 0.60, 1 trial; PDV [plasma-derived vaccine] plus hepatitis B immunoglobulin: RR 0.08, 95% CI 0.03 to 0.17, 3 trials)."
>
> "Compared with vaccine, vaccine plus hepatitis B immunoglobulin reduced hepatitis B occurrence (RR 0.54, 95% CI 0.41 to 0.73, 10 trials). Hepatitis B vaccine and hepatitis B immunoglobulin seem safe, but few trials reported on adverse events."

The conclusions of the authors' were that: "Vaccine, hepatitis B immunoglobulin, and vaccine plus hepatitis B immunoglobulin prevent hepatitis B occurrence in newborn infants of HBsAg positive mothers." This meta-analysis was also published in a major peer-reviewed journal [Lee et al 2006a]. These authors reported that "we identified no cost effectiveness studies assessing the effects of adding hepatitis B immunoglobulin to vaccine." Furthermore they stated that "as hepatitis B immunoglobulin may reduce the risk of hepatitis B infection, the need to carry out cost effectiveness studies based on randomised trials seems justified."

An earlier review in 1994 also favored the use of hepatitis B immunoglobulin (HBIG) with vaccine in protecting infants from hepatitis B infection [Andre & Zuckerman 1994].

Use of HBIG with hepatitis B vaccine for infants of hepatitis B carrier mothers is common in developed countries (where pregnant women are routinely screened for hepatitis B markers). But it also occurs in some developing countries. For example, researchers from Taiwan report several randomized clinical trials on hepatitis B immunoglobulin and vaccine that demonstrated an 80-90% protective effect among infants of mothers who were positive for either hepatitis B envelope antigen or hepatitis B surface antigen [Chien et al 2006].

In the Mongolia there are high rates of maternal infection with hepatitis B (eg, possibly around 15%) and so the use of HBIG may be worthwhile to prevent the infection of newborn infants. The HBIG administration could be done routinely or possibly after maternal screening for hepatitis B markers. For example, if the prevalence of maternal infection (HBsAg) is around 15%, and the cost per dose of HBIG is around $20, then maternal screening would be cost saving if the total cost of screening was under $17 per test [$20 – ($20 x 15%)]. Indeed, it is estimated that the cost of the screening test (supplies plus Labour) is likely to be under $5 per test, which would suggest that screening would be very cost saving relative to giving HBIG to all infants.

Nevertheless, there are uncertainties about the costs involved for the health system in Mongolia and uncertainties around the additional effectiveness of HBIG in the Mongolian setting. Various options to clarify the situation are:

1) To just use the efficacy data on HBIG from the Cochrane systematic review and to focus on calculating the prevalence of infection in pregnant women, the costs in Mongolia and to determine any practical issues with administering HBIG in selected hospitals in Mongolia (eg, to determine if there are any HBIG supply problems). From this work the cost-effectiveness of HBIG administration and the cost-effectiveness of maternal screening could be approximately determined (per case of infant infection avoided).

2) To conduct an actual trial of the efficacy of HBIG in the Mongolian setting with either randomization at the level of the infant or at the hospital level. Infants in the control arm would just receive vaccine within 24-hours of birth and those in the intervention arm would receive vaccine plus HBIG. This would be a more complex study but would be a valuable contribution to the international literature.

3) To discuss with local experts in Mongolia concerning the scope for HBIG production in the country (since this would maximize efficacy if there are significance genotypic differences between HBV in Mongolia and other countries). Of note is that Mongolia has some relevant industrial capacity as it produces some vaccines (eg, rabies and typhoid) and also immunoglobulin (for *Staphylococcus*). Mongolia has also made plasma-derived hepatitis B vaccine. One local expert has already suggested that Mongolia would have no difficulty in producing HBIG in the range of $15 to $20 per dose [Personal communication, Dr J Oyunbileg, Director of the Biotechnology Production, Research and Training Centre, Ministry of Health].

The benefits and costs of these and other possible approaches could be considered by the ICC and potentially after obtaining additional technical advice from WHO. The Government of Mongolia may also be interested in providing support for this type of research as it may ultimately involve a potential export opportunity of Mongolian produced HBIG (eg, for use for Mongolian people living in Inner Mongolia in China).