4.1 Globally

More than 40 vaccines have been developed for the prevention of human diseases. Several vaccines protect against multiple serotypes of virus or bacteria (e.g. polio types 1, 2, and 3). Several vaccines are delivered in combination to protect against multiple diseases.

Most countries routinely use only a portion of vaccines available to them. The selection of vaccines for use in a national schedule is based on the local epidemiology and the risks associated with each specific vaccine-preventable disease.

In 1974, the World Health Assembly resolved to build on the success of the smallpox eradication program and ensure that all children benefited from the ability of vaccines to save lives. In 1977, the WHO set a goal of providing universal immunization for children by 1990, through the Expanded Programme on Immunization (EPI)[164].

In resource-poor countries, the WHO recommended the prioritization of childhood immunization and the protection of women of child-bearing age. For more than 20 years, the EPI targeted only six diseases: tuberculosis, polio, measles, diphtheria, pertussis and tetanus. Now WHO recommendations are part of an overarching strategy and vision for immunization that promotes routine immunization of all age groups and includes several additional target diseases (See **Table 28**).

Universal recommendations			
Antigen	Children	Adolescents	
BCG (tuberculosis)	√		
Hepatitis B	√	For high risk or not previously immunized	
Polio	√		
Diphtheria, Tetanus, Pertussis	√	Td booster	Td booster
Haemophilus influenzae type b (Hib)	√		
Pneumococcal conjugate	√		
Rotavirus	√		
Measles	√		
Human Papillomavirus		Girls only	

Regional recommendations			
Japanese Encephalitis Virus	√	booster	
Yellow Fever	√		
Some High-Risk recommendations			
Typhoid	Primary series and booster		
Cholera	Primary series and booster		
Meningococcal A	√		
Hepatitis A	Primary series		
Rabies	Primary series		
Recommendations for some immunization programs			
Mumps	√		
Rubella	√	Or adolescent girls and women of child-bearing age	
Influenza	√	Revaccinate annually	

TABLE 28. WORLD HEALTH ORGANIZATION RECOMMENDATIONS FOR IMMUNIZATION[165]

[163]Mast EE, Ward JW. Hepatitis B vaccine. pp 205-241. In Vaccines 5th edition, S Plotkin, W Orenstein and P Offit, Eds, Saunders Elsevier, China, 2008.
[164]World Health Organization. Immunization service delivery and accelerated disease control. Expanded programme on immunization. http://www.who.int/immunization_delivery/en/
[165]World Health Organization.Table 1. Recommended Routine Immunization – Summary of WHO Position Papers. October 21, 2010. http://www.who.int/immunization/policy/Immunization_routine_table1.pdf

4.2 US

In the US, immunization has been classified as one of the top 10 public health achievements of the 20th century. Vaccine-preventable diseases are now at a record low. In addition, for every dollar the US spends on immunization against 10 vaccine-preventable diseases (diphtheria, tetanus, pertussis, polio, hepatitis B, *Haemophilus influenzae* type b, measles, mumps, rubella, and varicella), it saves $5.30 and society saves $16.50[166]. Every 26 days, the US saves the equivalent of its entire investment in the smallpox eradication program from savings on treatment of disease alone[167].

In 1977, the US launched a national immunization initiative. Its goals were to achieve national vaccination coverage of 90% by 1979 and establish a permanent system to provide immunization services to the annual US birth cohort of 3 million. At that time, an estimated 20 million children were not fully immunized.

In 1991, a new objective was set: to ensure that 90% of children had completed the full series of vaccinations by their 2nd birthday. And in 1993, the Childhood Immunization Initiative was launched to improve the quality and quantity of vaccine delivery services, expand access to vaccines, enhance community involvement, improve the measurement of immunization coverage and surveillance of vaccine-preventable diseases, simplify the immunization schedule, and improve vaccines.

The number of vaccine-preventable diseases covered by the current childhood immunization schedule in the US has doubled, from eight to 16 diseases, in the last 20 years (See **Table 29**).

“In 1991, a new objective was set: to ensure that 90% of children had completed the full series of vaccinations by their 2nd birthday.

[166]Orenstein, WA, Rodewald LE, Hinman AR, et al. Immunization in the United States. pp 1479-1510. In Vaccines 5th edition, S Plotkin, W Orenstein and P Offit, Eds, Saunders Elsevier, China, 2008.
[167]Brilliant LB. The management of smallpox eradication in India: a case study and analysis. Ann Arbor, University of Michigan Press, 1985.

	Age of administration													
Antigen	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19-23 months	2-3 years	4-6 years	7-10 years	11-12 years	13-18 years
Influenza					Annually									
Inactivated Polio			√	√		√					√			
Pneumococcal conjugate			√	√	√	√				Pneumococcal polysaccharide high-risk				
Haemophilus influenzae type b			√	√	√	√								
Diphtheria, Tetanus, acellular Pertussis			√	√	√		√				√		Tetanus, diphtheria, acellular pertussis	
Rotavirus			√	√	√									
Hepatitis B	√	√				√								

TABLE 29. CHILDHOOD IMMUNIZATION SCHEDULE IN THE US (EXCLUDING CATCH-UP SCHEDULE)[168]

	Age of administration													
Antigen	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19-23 months	2-3 years	4-6 years	7-10 years	11-12 years	13-18 years
Measles, Mumps, Rubella						√					√			
Varicella						√					√			
Hepatitis A						√				high-risk				
Meningoccal conjugate										high-risk			√	
Human Papillomavirus													girls	

[168]Centers for Disease Control and Prevention. Vaccines & Immunizations. Recommendations and guidelines: 2011 child and adolescent immunization schedules for persons aged 0 – 6 years, 7 – 18 years, and "catch-up schedule".http://www.cdc.gov/vaccines/recs/schedules/child-schedule.htm

The Adult Immunization Schedule, in addition to providing for boosters of childhood vaccines, also provides for immunization against varicella zoster, an excruciatingly painful and potentially neurologically damaging condition (See **Table 30**).

Antigen	19-26 years	27-49 years	50-59 years	60-64 years	≥ 65 years
Influenza	1 dose annually				
Tetanus, Diphtheria, Acellular Pertusis / Tetanus, Diphtheria	1dose of Tdap then Td every 10 years				Td every 10 years
Varicella	2 doses if no evidence of immunity				
Human Papillomavirus	3 doses (females) if not yet received				
Herpes zoster				1 dose	
Measles, Mumps, Rubella	1 or 2 doses		1 dose high-risk		
Pneumococcal polysaccharide	1or 2 doses high-risk				1 dose
Meningococcal polysaccharide	1 or more doses high-risk				
Hepatitis A	2 doses high-risk				
Hepatitis B	3 doses high-risk				

TABLE 30. ADULT IMMUNIZATION SCHEDULE IN THE US[169]

[169]US Department of Health and Human Services and Centers for Disease Control and Prevention. Recommended adult immunization schedule United States 2011. http://www.cdc.gov/vaccines/recs/schedules/downloads/adult/adult-schedule.pdf

4.3 European Union

European countries do not have a unified vaccination policy. The number and types of vaccines used in European countries varies from one country to the other. However, the European Union's European Center for Disease Prevention and Control (ECDC) and the WHO's European Regional Office (EURO) do provide common guidance to member states on matters related to immunization. The EURO policy framework targets a number of diseases for prevention by vaccination.

Diseases typically targeted by immunization in Europe are shown by country in **Table 31** below.

Country / year last updated	BCG (tuberculosis)	Diphtheria, Tetanus, Acellular Pertussis	Haemophilus iinfluenzae type b	Inactivated Polio	Hepatitis B	Pneumococcal Conjugate	Measles, Mumps, Rubella	Diphtheria, Tetanus	Diphtheria, Tetanus-Inactivated Polio	Tetanus	Diphtheria, Tetanus, Acellular Pertussis	Varicella	Human Papillomavirus	Rotavirus	Meningococcal C
Austria/08		√	√	√	√	√	√		√		√	√	√	√	
Belgium/11		√	√	√	√	√	√				√		√	√	√
Bulgaria/10	√	√	√	√	√	√	√	√							
Croatia/08	√	√	√	√	√		√	√							
Cyprus/09	√	√	√	√	√	√	√					√			√
Czech/10	√	√	√	√	√	√	√			√					
Denmark/09		√	√	√	√	√	√				√		√		
Estonia/09	√	√	√	√	√		√	√							
Finland/11	√	√	√	√		√	√				√			√	
France/10	√	√	√	√	√	√	√	√					√		√
Germany/10		√	√	√	√	√	√				√	√	√		√
Greece/07	√	√	√	√	√	√	√	√				√			√
Hungary/10	√	√	√	√	√	√	√				√				
Iceland/10		√	√	√			√				√				√
Ireland/10	√	√	√	√	√	√	√	√					√		√
Italy/08		√	√	√	√	√	√				√	√			√
Latvia/11	√	√	√	√	√	√	√	√				√	√		
Lithuania/08	√	√	√	√	√		√	√							
Luxemburg/08		√	√	√	√	√	√				√		√	√	√
Malta/10	√	√	√	√	√		√	√							
Netherlands/06		√	√	√	√	√	√	√							√
Norway/10	√	√	√	√	√	√	√	√					√		
Poland/07	√	√*	√	√*	√		√	√							
Portugal/09	√	√	√	√	√		√	√					√		√
Romania/10	√	√	√	√	√		√	√							
Slovakia/11	√	√	√	√	√	√	√	√							
Slovenia/09	√	√	√	√	√		√			√	√		√		
Spain/08		√	√	√	√		√	√				√	√		√
Sweden/10	√	√	√	√	√	√	√				√		√		
Switzerland/08	√	√	√	√	√	√	√	√				√	√		√
Turkey/10	√	√	√	√*	√	√	√	√							
United Kingdom/11	√	√	√	√	√	√	√	√					√		√

TABLE 31. CHILDHOOD VACCINES USED IN EUROPEAN COUNTRIES (LAST UPDATE OF SCHEDULE RANGE FROM DEC 2006 – JULY 2011)[170]

[170]Euvacnet. National childhood vaccination schedules. http://www.euvac.net/graphics/euvac/vaccination/vaccination.html

4.4 Australia

The Australian childhood immunization schedule closely resembles that of the US (See **Table 32**).

	Age of administration												
Antigen	Birth	1 month	2 months	4 months	6 months	12 months	18 months	24 months	4 years	10 years	12 years	13 years	15-17 years
Hepatitis B	√		√	√	√*	√*				√			
Rotavirus			√	√	√								
Diphtheria, Tetanus, Acellular Pertussis			√	√	√				√				Tetanus diphtheria, acellular pertussis
Haemophilus influenzae type b			√	√	√	√							
Pneumococcal conjugate			√	√	√								
Pneumococcal polysaccharide							high-risk						
Inactivated Polio			√	√	√				√				
Influenza													Aboriginal high-risk
Measles, Mumps, Rubella						√			√				
Varicella							√			√			
Hepatitis A						high-risk							
Meningococcal C conjugate						√							
Human Papillomavirus											girls		

TABLE 32. AUSTRALIAN CHILDHOOD IMMUNIZATION SCHEDULE[171]

The adult Australian immunization schedule provides for pneumococcal and influenza vaccines. Influenza is not part of the routine childhood immunization schedule (See **Table 33**).

Antigen	15 - 49 years	50 years and over	65 years and over
Influenza	high-risk Aboriginal	Aboriginal	√
PPV23	high-risk Aboriginal	Aboriginal	√

TABLE 33. AUSTRALIAN ADULT IMMUNIZATION SCHEDULE[172]

[171]Australian government. Department of Health and Ageing. National Immunisation Program Schedule (Valid from 1 July 2007). http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/E875BA5436C6DF9BCA2575BD001C80BF/$File/nip-schedule-card-july07.pdf
[172]Australian government. Department of Health and Ageing. National Immunisation Program Schedule (Valid from 1 July 2007). http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/E875BA5436C6DF9BCA2575BD001C80BF/$File/nip-schedule-card-july07.pdf

4.5 Japan

Like in many industrialized countries, vaccines in the childhood immunization schedule in Japan are provided at no cost in public health centers. But Japan has been slow to adopt many of the newest vaccines from the last 10 – 15 years and its immunization schedule resembles the schedule of a country of much lower economic status. A table of Japan's childhood immunization schedule relative to countries in the region with comparable or much lower levels of wealth is shown in **Table 34** below.

	Japan	Australia	Korea, South	Singapore	Indonesia	Thailand	USA
Gross National Income / capita (US$)	37,780	43,770	18,830	37,220	2,230	37,760	47,240
BCG (tuberculosis)	√		√	√	√	√	
Diphtheria, Tetanus, Pertussis					√	√	
Diphtheris, Tetanus, Acellular Pertussis	√	√	√	√			√
Oral Polio	√			√	√	√	
Inactivated Polio		√	√		√		√
Haemophilus influenzae type b	√	√					√
Hepatitis B		√	√	√	√	√	√
Measles					√	√	
Measles, Rubella or combination	√						
Measles. Mumps, Rubella		√	√	√		√	√
Japanese Encephalitis Virus	√		√			√	
Tetanus					√		
Diphtheria, Tetanus	√				√		
Tetanus, Diphtheria			√			√	
Tetanus, Diphtheria, Acellular Pertussis				√			√
Pneumococcal conjugate		√		√			√
Varicella		√	√				√
Meningococcal C conjugate		√					
Meningococcal A,C,W,Y conjugate						high risk	√
Human Papillomavirus	√	√					√
Rotavirus	√	√					√
Hepatitis A		high risk					√
Typhoid			high risk				
Influenza	√	high risk	high risk	√			√

TABLE 34. JAPAN'S CHILDHOOD IMMUNIZATION SCHEDULE COMPARED TO OTHER COUNTRIES IN THE REGION AND THE US[173]

[173]World Health Organization. WHO Vaccine Preventable Diseases Monitoring System. http://apps.who.int/immunization_monitoring/en/globalsummary/countryprofileselect.cfm

4.5.1 Current situation in Japan

Japan was one of only a few pioneering countries in vaccine development. Several vaccines were developed first in Japan and later produced or further adapted in other countries. Ironically, Japan has lagged behind most countries of similar economic development in both vaccine policy and implementation. Over the last several decades, the US and countries in the European Union have outpaced Japan in developing policies and practices for the introduction of new vaccines.

Initiatives, such as the Childhood Immunization Initiative of the early 1990s, helped the US to develop systems to efficiently achieve public health objectives for disease prevention. These systems include the provision of vaccines for children who are uninsured or otherwise would not have access to immunization.

Likewise, the WHO's Vision and Immunization Strategy, launched at the start of the 2000s, was developed to assist developing countries to further develop policies and immunization objectives. At the start of the 2000s, many developing countries had not updated their immunization programs and policies from the 1970s when they were first launched. The WHO's overarching strategy for immunization has evolved to include several new vaccines that have become available since the 1970s. It also includes new target groups, such as adolescents and adults, for specific immunizations.

The relatively high incidence of deafness from mumps in Japan, when the US and countries in Europe have virtually eliminated the disease, highlights the divergence in immunization policy and implementation between Japan and countries of similar economic status. In the absence of a renewed or reinvigorated emphasis on immunization in Japan, the contrast in public health outcomes may become increasingly apparent. With clear objectives, solid policies, and robust implementation systems, Europe and the US have been very quick to adopt recently licensed vaccines. These investments in prevention are expected to have net advantages over curative care that would otherwise be required, particularly at a time of budgetary constraint and austerity.

Therefore, Japan has recently undertaken to reform vaccine policy and practice, as evidenced by the activities of the Vaccine Committee of the Ministry of Health, Labor and Welfare.