

Global strategies, policies and practices for immunization of adolescents

A review

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Contents

1. Introduction	1
2. Reasons for targeting adolescents	3
3. Epidemiological considerations	6
4. Immunological considerations	8
5. Previous infant immunization	9
6. Undesirable effects of immunization	10
7. Service delivery	12
8. Consent	15
9. Cost-benefits and resource implications	16
10. Boosters and extra doses of vaccines already given as earlier immunizations	18
11. Immunizing against additional diseases	31
12. Immunization for international travel	35
13. Current policy and practice	36
14. Country schedules	39
15. Summary and recommendations	41
Annex 1: Adolescent immunization by WHO Region	42
Annex 2: Annotated bibliography	57

1. Introduction

The Expanded Programme on Immunization (EPI) has made major advances in the last two decades in terms of achieving high vaccine coverage among infants against the programme's target diseases (tuberculosis, tetanus, diphtheria, pertussis, polio, measles, yellow fever and, more recently, hepatitis B), on a world-wide basis. The Scientific Advisory Group of Experts (SAGE)¹ to EPI has indicated the need to expand immunization activities beyond infancy, either as part of routine immunization services, or as part of disease elimination or eradication measures. The adolescent age group (10 to 19 years) represents an important additional target group in this respect, since the success of EPI is now being seen to have important long-term effects on the traditional epidemiological patterns of major infectious diseases, often raising the average age of incidence.

In the pre-immunization era, a large proportion of adults had *disease-induced* immunity to the common infections. Many countries are now finding the majority of individuals have *vaccine-induced* immunity, which may or may not have the same long-term stability. Questions therefore arise as to the policy and strategy implications for post-infancy immunization programmes. Adolescence presents special challenges for immunization in relation to lifestyle and other social issues, whilst also offering special opportunities, such as vaccine delivery in the setting of educational institutions.

So far, a relatively small number of vaccines have had potential for administration to the adolescent age group. For many years, tetanus toxoid has been targeted at women of child-bearing age, many of whom are adolescent. More recently, measles vaccine (M) has been of particular interest, as well as the measles-containing vaccines measles-rubella (MR) and measles-mumps-rubella (MMR), and tetanus-diphtheria (Td) vaccines. Of more restricted potential are the hepatitis A, hepatitis B, influenza, pneumococcal and varicella vaccines. Principal barriers that have prevented such vaccines from wide administration to date (and are likely to remain impediments in the future) are the lack of awareness by the public, the cost of the interventions, and the lack of suitable infrastructure to reach the target group.

¹ Report of the meeting of the Scientific Advisory Group of Experts (SAGE). WHO, Geneva, 11-13 June 1997. WHO/GPV/97.05.

Countries differ greatly regarding disease control objectives, financial capacity and political commitment. For any vaccine, the age at which it should be administered is determined by a number of factors, such as the age-specific incidence of target diseases, age-specific responses to vaccines and risks of complications. As well, cost, supply, implications for the cold chain, training, compatibility with other vaccines and other services must all be taken into account. These factors, therefore, have to be considered in evaluating existing or new vaccines that may be appropriate for delivery to adolescents. Dealing with implementation issues in depth is largely beyond the scope of this paper.

Presently, immunization services for adolescents are patchy at best. Many such services are carried out through private practitioners and private clinics. By no means is this paper intended as a green light for massive mobilization in the area of adolescent immunization. Nor does it indicate encouragement to the private sector to move into this area without full consultation with health authorities. Rather, it is an encouragement to ministries of health and voluntary organizations to consider whether to provide certain vaccines within the national schedule, and if so, which ones and in what circumstances. The text reflects the fact that WHO does not yet have defined policies on the use of some of these vaccines in this age group. This paper discusses which vaccines are appropriate to administer to adolescents as well as the issues surrounding the choices.

2. Reasons for targeting adolescents

There are strong reasons for targeting adolescents for immunization. These may be related to a direct benefit to the adolescents themselves, or they may be part of wider disease control activities. Probably the most compelling reason is to maintain protection acquired by immunization earlier in life. Booster doses may be required for a number of antigens already given but whose protection is waning. The school-attending adolescent may represent the last convenient opportunity the immunization services have to boost a large proportion of the target group before the young people enter the diverse world of adults. For a variety of reasons, long-term disease control and elimination goals are likely to require supplementary immunization activities and additional doses of vaccine which involve adolescents.

In addition to established EPI vaccines, recent developments in vaccine technology have opened up new possibilities for vaccine-based protection against other diseases. For some of these, their best use may be in infant immunization programmes. However, for others, there may be strong reasons to target their use towards older age groups. Such reasons might include a better response to a particular vaccine at older ages, a heightened risk in the adolescent period due to a change in the age-specific epidemiology of a disease, or the emergence of a particular high-risk group.

Reasons for adolescent immunization (see summary, Table 1) fall into three broad categories:

- To boost immunity that is waning, thereby increasing the duration of effective protection derived from the vaccines already given earlier in life, especially in the absence of “natural” boosting from exposure to the infectious agent. This strategy mimics to some extent the boosting effect of infectious agents in the pre-vaccine era.
- To accelerate control or elimination efforts: Disease control initiatives frequently encompass immunizing across a wide age range, including adolescents, with the aim of increasing herd immunity, interrupting transmission or catching-up on cohorts missed in the past. For instance, measles elimination in certain countries has targeted individuals from 9 months to 14 years. Special activities may be mounted to respond to, or prevent outbreaks of target diseases. As with the rest of the population, adolescent individuals benefit from the protection afforded by vaccines in the face of outbreaks or seasonal rises in infectious disease such as yellow fever or influenza.

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- To counter a specific risk: As for all ages, travel represents a special need for adolescent immunization, indeed may be even more important on the basis that adolescent behaviour may place them at increased risk. Adolescents may enter a period of increased risk, for instance from hepatitis B virus, through embarking on a life style that involves drug taking or sexual experimentation with a number of partners. Special efforts may be appropriate to immunize them before they enter the risk period. One of the early danger periods in a child's life is exposure to high levels of transmission of infectious disease when entering child-care or school at around 4-5 years of age. The adolescent now risks exposure to new health threats by entering secondary or tertiary institutes of education, military training institutes and even young offenders' prisons. Specific measures may be needed such as immunization against meningococcal disease.

Table 1: Summary of recommendations for adolescent (10-19 years) immunization

Vaccine or antigen	Booster/extra doses	Special situations, outbreaks or mass campaigns	Where there is special risk to individuals
BCG	Revaccination not recommended	-	First dose in adolescence if no neonatal programme
Cholera	-	Possibility of outbreak response in the future	Travel to endemic areas an option
Diphtheria	As Td*	Td in outbreak control	-
Hepatitis A	-	In certain outbreak situations	Travel to endemic areas.
Hepatitis B	No booster dose currently recommended, although studies may show the need for boosters in the future.	Low prevalence countries may give primary immunizing course	High-risk life style. Travel to endemic areas. Certain medical conditions. Ethnic minorities Institutionalized individuals
Hib	-	-	-
Influenza	-	-	Seasonal: high risk individuals
Japanese Enc.	-	Possibly in the future if elimination starts	Travel to endemic areas
Measles	Extra doses in specific situations. As part of MMR or MR programme	As part of wide age group elimination campaign	-
Meningo-coccal	-	During outbreak response	Travel to sub-Saharan Africa. Immuno-deficient patients. Military recruits, high schools etc
Mumps	As part of MMR or MR programme	As part of measles outbreak prevention or elimination campaign	-
Pertussis	Acellular vaccine (aP)	-	-
Pneumo-coccal	-	-	Immuno-deficient patients
Polio	-	-	Travel to endemic areas. Individual never immunized before**
Rotavirus	-	-	-
Rubella	As part of MMR or MR or other CRS control strategy (eg monovalent vaccine to 11 year old girls)	As part of outbreak prevention. As part of measles or measles/rubella elimination campaign	-
Tetanus	As Td (or TT if not available) booster*.	Td or TT in high-risk areas during MNT elimination campaigns	As Td after trauma.
Typhoid	Vi or oral vaccine an option in endemic areas.	Use in outbreak situation a possibility in the future	Ty21a or Vi vaccine recommended for travel to endemic areas.
Varicella	-	-	Immuno-deficient patients
Yellow fever	-	Outbreak response	Travel to endemic areas

* Td/TT boosters are appropriate if adolescents have not already received boosters earlier in childhood. Those doses administered in adolescence should complete the 5-dose schedule.

** Some countries recommend inactivated (injectable) polio vaccine on this situation

3. Epidemiological considerations

For adolescents, the risk of death, disease and long term complications attributable to specific infection has to be judged against age-specific incidence. Table 2 shows typical country-specific information on morbidity from selected vaccine-preventable diseases in this age group that service providers require for decision-making. Clearly the details will vary from country to country. The aim of any particular vaccine also has to be carefully considered. If the intention is to protect the individual from a particular disease during adolescence, then targeting immunization earlier in adolescence is likely to be appropriate. Alternatively, if the intention is to confer protection for adult life (for example, a booster dose of measles vaccine for new entrants to university), then immunization later in adolescence may be acceptable.

Table 2: Morbidity from selected vaccine-preventable diseases among all individuals and adolescents 11-21 years of age, United States, 1990

Disease	Number of cases among all individuals	Number of cases among adolescents (%)
Diphtheria	2	0 (0.0%)
Hepatitis A	31 357	5 569 (18.0%)
Hepatitis B	11 860	1 385 (11.7%)
Measles	508	167 (32.9%)
Mumps	751	154 (20.5%)
Rubella	238	72 (30.3%)
Tetanus	36	1 (0.3%)
Varicella	unknown	unknown

Source: National Notifiable Disease Surveillance System, National Center for Health Statistics, Hyattsville, Maryland.

The intention of childhood immunization has always been to protect vulnerable individuals as early in life as possible from the negative health impact of the disease. An inevitable consequence of this is an alteration of the age-specific incidence of the disease in question, usually resulting in a shift in the age distribution to the right (to older individuals). In general this is desirable because the immune system and general health of the individual is more robust in later childhood and adolescence. For instance, measles case fatality rates are generally highest below one year of age. So if the peak incidence of the disease is delayed for several years, overall mortality will be reduced. The maternal morbidity and fetal loss associated with measles infection during pregnancy (Atmar 1992) and the trans-placental infection resulting from rubella infection in a non-immune adult warrant special considerations

Doses of vaccine given in adolescence must be monitored for coverage, as with any other dose of vaccine. It is essential, then, that surveillance systems also be capable of monitoring changes in the epidemiology of diseases in older children (including adolescents) as a result of immunization. An integral part of surveillance is the measurement of duration of immunity of childhood immunization, and the consequences for a child's immunization following the immunization of the mother in her own childhood.

In practice, strategies for adolescent immunization are likely to be derived from consideration of various epidemiological parameters, as well as considerations of logistics, cost and access to target groups.

4. Immunological considerations

Immunological considerations also need to be taken into account. In situations where adolescents typically acquire natural immunity to common infections, immunization in this age group is unlikely to be necessary. On the other hand, innovations in infant immunization may well change established patterns of immunity over a period of time. For example, mothers who were immunized with measles vaccine as infants now bear children with lower titres of measles antibody transferred across the placenta. Infants resulting from such pregnancies may well lose acquired antibody protection earlier than infants whose mothers had wild measles (and who passed higher titres of antibody across the placenta), thus making them both susceptible to measles infection earlier and available for measles vaccine at an earlier age. With the large number of new vaccines becoming available, population-based age-specific sero-epidemiological surveillance studies will be important in developing control strategies for some diseases for the foreseeable future. Such surveys are, however, not without their problems - for instance many vaccine-preventable diseases lack agreed serological markers of protection.

5. Previous infant immunization

The immunization needs of adolescents are influenced by their experience of immunization as infants 10 to 19 years earlier. In many countries, adolescents have received infant doses of vaccines against the original EPI target diseases. It is likely that current policy considerations will largely concern booster strategies for these vaccines. On the other hand, in countries where coverage has been low for some EPI vaccines over the past 10-19 years, more intensive adolescent immunization programmes may be justified as a “catch-up” strategy.

In the case of other vaccines such as hepatitis B that may have been introduced recently into infant immunization programmes, strategies for adolescent immunization must embrace the need for primary vaccination, at least for some years to come.

The infant and child immunization history of any given adolescent presenting as a potential recipient of vaccines may not always be available for a variety of reasons. It is often difficult to be sure what vaccines were on offer some years back, and even more difficult to ascertain what vaccines an individual received, especially if it is not customary to keep the infant immunization record card safe. It is important, however, that each person be screened for previous doses as part of routine immunization and a record made of doses administered.

6. Undesirable effects of immunization

A further consideration in planning adolescent immunization strategies may be the local epidemiology of teenage pregnancy. Administration should be avoided of those vaccines that are contraindicated in pregnancy because of known or suspected risks to the early stages of fetal development. It is possible that girls attending for vaccination may be unaware they are in the early stage of pregnancy, others may be reluctant to admit to the pregnancy (which may result in their exclusion from school) and therefore go ahead with vaccination, perhaps despite being warned of the danger.

Those of particular concern are the live attenuated measles, mumps, rubella, varicella and yellow fever vaccines that might theoretically damage the fetus. (Despite theoretical concerns with the rubella vaccine, no firm evidence exists to implicate it in producing fetal abnormalities). Administration of some of these vaccines to adolescents has been included in mass campaigns such as the MR campaign in England and Wales, the measles elimination campaigns of the Americas, and the yellow fever outbreak response campaigns of tropical Africa. Any sort of screening during mass campaigns is generally undesirable as it slows down the speed of vaccination. WHO has not formulated recommendations on this issue, but recognizes the potential difficulties. Bearing in mind the enormous cultural and contextual variations between countries, WHO encourages planners at national levels to decide whether to screen girls during campaigns with questions about the possibility of pregnancy. The practicality of such screening is daunting, and the consequences far-reaching.

In the Philippines, controversy arose in 1996 because of allegations that the tetanus toxoid administered to young women to prevent neonatal tetanus was actually a contraceptive. Local testing suggested the presence of a hormone, HCG, which can be a form of contraceptive. Confidence in vaccination was restored only after the vaccine had been tested in an international reputable laboratory and found to be free of the alleged contaminants.

While adolescents may experience similar or reduced levels of adverse events following immunization when compared with infants, they themselves are aware of the possibility of experiencing negative effects from vaccines. While infants have not been taught that injections hurt, adolescents know this only too well. When subjected to mass vaccination in a school setting, emotions may run high with fainting and other dramatic hysterical reactions (Al Otoum et al, 1999). Staff-patient communication therefore becomes important so that the issue of relative risk can be explained.

An infant who is HIV-infected is not likely to be severely immuno-compromised at the time of administration of scheduled infant doses of vaccine. An HIV-infected adolescent, on the other hand, may well be severely immuno-compromised, especially if the infection was acquired early in life. The same contraindications to immunization of the HIV-infected adolescent apply as for the HIV-infected infant (Clements et al, 1987). However, it should be anticipated that the protective efficacy of any vaccine given at a stage when the adolescent is severely immuno-compromised will likely be reduced or non-existent.

7. Service delivery

Access

Tetanus toxoid has been delivered successfully to women of child-bearing age for many years as part of the routine immunization services. In many ways this is a unique strategy, making use of the opportunity provided by the contact the mother has with the health services as she brings her infant for vaccination.

Infants and young children are almost always taken to health facilities for immunization by their parents. Older children and young adolescents may also be reached at school by mobile vaccination teams. In addition, both these groups can be reached in their communities by special activities such as National Immunization Days. Older adolescents may already be living away from their parents, and assumptions should not be made about parents or guardians being able to bring offspring for vaccination. Those who have also left school tend to be even harder to reach with services.

Mobilization

Older adolescents are generally more independent. They tend to resent being considered as passive recipients of medical procedures. On the positive side, they do not need to be taken to the vaccination post by an adult. But for adolescent immunization to be effective, education and motivation need to be provided so that there is a desire to seek and obtain the services. As immunization is often thought of as something that only infants, children and women need, strong and effective communication is needed to change this perception. Peers and adults such as parents, teachers and religious leaders can make a useful contribution to this process, as can creative communication methods with, for instance, the mass media.

Motivating adolescents requires an understanding that adolescents generally regard themselves as both healthy and impervious to disease. It is true that most are healthy during their adolescence. Accordingly, they question the need to take any medication to stay healthy (especially if it means that the medication - in this context, vaccination - results in unpleasant local or systemic effects). The onus is on public health workers to explain to adolescents what the benefits and costs of taking the recommended vaccines are (to them personally and to their communities).

Targeting at-risk groups

Some vaccines, especially hepatitis B, may be given only to special groups of adolescents who are perceived (by adults) to be “at-risk”, or who themselves believe that they are “at-risk”. If these strategies are not properly planned and implemented, many adolescents who do not subscribe to one label or another (for example as “gay” or as “promiscuous”) may be missed or may deliberately avoid the vaccination. Often groups particularly at risk are the most disconnected from any health services. For these reasons, it is clear that trying to control hepatitis B infection by targeting high-risk groups alone is bound to fail.

Strategies for reaching adolescents

The type of service delivery is important. If vaccines are being offered at health facilities, uptake will depend on whether these facilities are perceived to be of good standard and youth-friendly; and whether health care providers are believed to be competent, approachable and trustworthy. Because adolescents are generally healthy, and tend to dislike going to health facilities unless they absolutely need to (especially if these facilities are oriented towards children on the one hand or adults on the other), serious consideration must be paid to delivering vaccination in other settings. The choice of the vaccination delivery setting and the vaccination provider will obviously vary depending on the situation, and might include a secondary school, a vocational training centre, a popular community centre, or a place of worship.

Approaches for delivering vaccines to adolescents have to be considered as separate issues from the well-established strategies for infant programmes. Without extensive publicity, it is unrealistic to expect healthy individuals to attend for vaccination at pre-determined times. Even with systems designed to track and call individuals for vaccination when needed, compliance can be limited. Thus alternative strategies probably have to be considered for adolescents. In many countries, adolescent immunization programmes are centred on schools. However, a programme that relies on contact with adolescents in education assumes that virtually all adolescents are in full-time education – an assumption that would not be valid in every country. The challenge for many developing countries will therefore remain how to reach a significant proportion of adolescents with immunization services.

In some countries (particularly in Africa), there is not always a clear correlation between age and academic levels in school. Thus school-based programmes have to be clear as to whether target groups are defined by biological age or school year.

It is clearly difficult to achieve high adolescent coverage in most settings in developing countries. In contrast, countries such as New Zealand, with virtually complete school attendance rates, have achieved nearly 100% coverage with rubella vaccine by immunizing 11-12 year old girls in the school classroom.

Where adolescents are targeted with vaccines in schools, it seems unfortunate if the opportunity cannot be taken to make such programmes less vertical by incorporating other health activities into such them. Indeed, some of the most successful adolescent programmes have offered services packaged together to make an attractive “bundle” of services for young people. Programmes giving advice on sexual health issues are an obvious example, possibly including, where acceptable, access to contraception.

Advice could also be offered on tobacco, alcohol and drug abuse, as well as healthy lifestyle advice.

Record-keeping

It is important that whatever vaccines are given are recorded by the clinic as well as on a record given to the individual. This may have to be on a card other than the infant card which is unlikely to have suitable space for such entries, if indeed the card exists at all by the adolescent period.

8. Consent

The mother's action in bringing the infant for immunization is often assumed to represent parental consent. While infants and young children naturally fall under the legal protection of their parents, adolescents begin to emerge, in legal terms, as individuals capable of controlling their own lives. Parental consent may no longer be valid for this age group in many countries, and consideration must be given to seeking informed consent from the adolescents themselves prior to immunization. This carries with it the need to explain possible risks associated with the vaccine. It should be seen as a positive interaction by both parties, as it is a moment when the adolescent assumes a measure of control over what happens to his/her own body. Any suggestion of coercion by schools in school-based interventions must be seen as highly inappropriate in this setting, however desirable it might be to achieve high acceptance from the disease control perspective.

9. Cost-benefits and resource implications

Given the ever-widening range of infections against which vaccines are becoming available, it is increasingly important to consider carefully the costs, risks and benefits of immunization, and who is going to pay for any new vaccine service. Administering any vaccine on a community basis will have opportunity costs in relation to other health sector activities, which can only be justified from epidemiological evidence of risk of a given vaccine-preventable disease. Immunization is unlikely to be indicated against diseases for which there is little risk (other than for especially high-risk individuals) unless either the disease in question is very serious, or is the subject of current elimination or eradication activities.

As in any preventive health measure, for every possible vaccine that might be administered to adolescents, the cost of the vaccine, its distribution and storage, its delivery and administration and the potential to achieve worthwhile coverage has to be balanced against the costs of not using the vaccine. The latter comprises such factors as the costs of treatment of cases, and of lives lost or seriously impaired as a result of infection. Also to be considered is the adolescent's possible role, if infected, of transmitting the infection to younger siblings or elderly relatives who may be at higher risk from the disease than the adolescent himself. These costs and benefits cannot be generalised, since they will depend not only on the local epidemiology of the disease in question, but also on local costs of, for example, hospitalisation of cases and competing health interventions.

In considering possible choices between different vaccines that could, in principle, be included in a particular adolescent programme, the costs and benefits for each candidate vaccine should be carefully estimated in the light of local circumstances as a basis for prioritising particular vaccines.

Whether a given vaccine should be targeted at adolescents or to other (possibly more accessible) sectors of the population such as infants may be the basic question health planners have to face in allocating resources and providing services. Scenario 1 below highlights this situation.

Hypothetical scenario 1. Neonatal tetanus

Epidemiological picture: In several rural districts of a small country in Southern Africa, cases of tetanus associated with illegal abortions have been rising steadily, as have cases of *tetanus neonatorum*.

Immunological picture: A significant proportion of infants and children do not complete the 3 recommended doses of DTP. Girls and young women in their teenage years who have unwanted pregnancies often do not attend ante-natal clinics, and so do not get the boosters that clinic attendees do. Because of the prevailing policy on termination of pregnancy, many of these girls/young women secure illegal and unsafe abortions.

Logistical and resource considerations: In these subsistence farming communities, school enrolment is low, and even among those who have been enrolled, it is not unusual for both girls and boys to drop out of school after 3-5 years of schooling.

In consultation with the district medical officer, the national immunization programme staff recommended efforts to improve the levels of vaccination coverage in infancy/childhood. In conjunction with the national safe motherhood programme, they recommended a campaign to sensitise health care providers to the needs of unwed mothers, and to launch a community education programme on the importance of obtaining care in the antenatal period. The national immunization programme staff concluded that before giving serious consideration to establishing a new programme to vaccinate older children and adolescents with DTP, every effort must be made to improve the vaccination coverage with existing programmes. It was agreed that the situation would be reviewed in one year's time.

10. Boosters and extra doses of vaccines already given as earlier immunizations

Up to nine vaccines are offered in infant immunization if countries follow the classical EPI recommendations. Vaccines against these diseases (tuberculosis, diphtheria, tetanus, pertussis, polio, measles, hepatitis B, Hib and yellow fever) will therefore be considered individually. However, the extent to which it is appropriate to refer to “extra doses” or “booster doses” in adolescence will depend on the how well the infant vaccination programme performed some 10-19 years previously. It may be appropriate in some settings to implement a booster dose policy during adolescence for a fixed duration “catch-up” period only, to cover a cohort of children who were not fully immunized in infancy.

Diphtheria

The duration of immunity against diphtheria may depend on exposure to diphtheria organisms (Simonsen 1989) and thus varies geographically. Data on the persistence of immunity in developing countries are scarce. But even where vaccination coverage rates have been high for 5 to 10 years, diphtheria outbreaks have been reported. These are characterized by high case fatality rates, a large proportion of patients with complications, and occurrence in both younger and older age groups (Galazka 1995). Epidemics in previously well-controlled settings in eastern Europe have raised awareness of the need for wider vaccination strategies. Consequently several countries have introduced one or two diphtheria toxoid booster doses at ages beyond infancy. Careful analysis is needed to assess when additional dose(s) should be added to the routine schedule. The distribution of diphtheria cases and serological studies can identify age groups or geographical areas at increased risk of diphtheria. The appearance of diphtheria in older age groups (as happened, for instance, in the former USSR in the mid-1990s) may be an early signal to indicate the need to consider the introduction of booster doses (Prospero 1997).

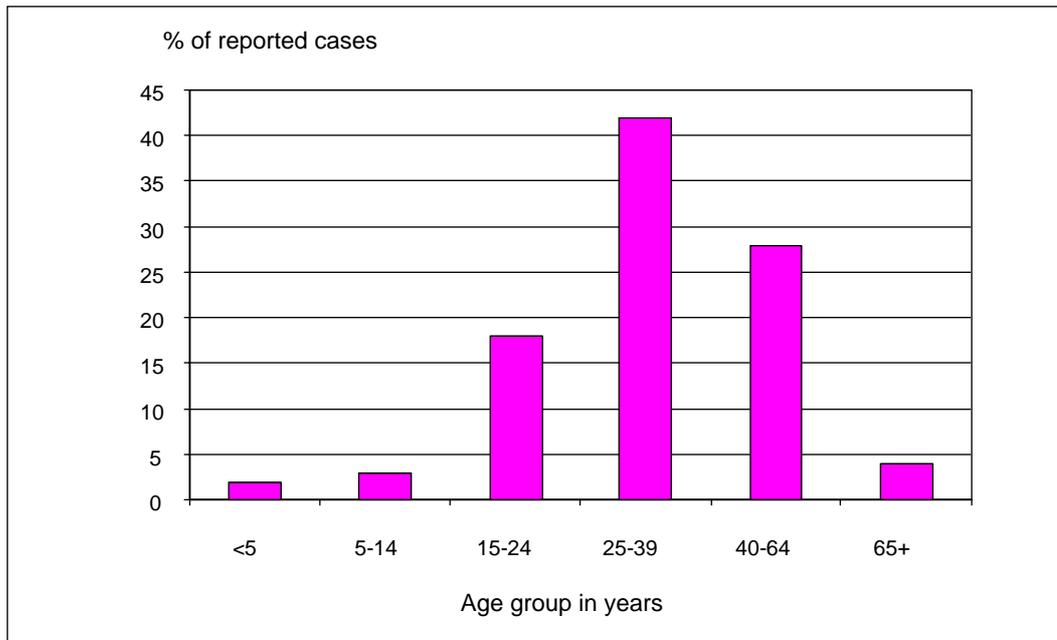
Diphtheria vaccine is commonly combined with tetanus toxoid. The childhood version of this combined vaccine is referred to as DT. A lower dose of the diphtheria component of the vaccine is recommended for persons over the age of 7 years, to minimise adverse reactions, and the corresponding combined vaccine is known as Td. Since both tetanus toxoid (see below) and diphtheria toxoid can reasonably be given on a booster basis around every ten years, there is little reason to use monovalent diphtheria vaccine.

Summary: WHO recommends giving a booster dose of Td during adolescence, assuming that several doses of tetanus and diphtheria toxoids as DTP or DT have been given in infancy and early childhood. Td should be given in the face of an epidemic of diphtheria.

Hepatitis B

This vaccine became available in 1982 and has been administered so far to almost 400 million people. It can be used effectively through routine infant immunization, but is effective at any age. If given prior to exposure, it can prevent infection in almost all individuals, and will reduce dramatically rates of liver cancer later in life (WHO 1996). By 1998, around 100 countries had a policy for using hepatitis B vaccine routinely in their national immunization programmes, following the World Health Assembly's 1992 resolution that the vaccine should be adopted on a global basis.

Figure 1: Age distribution of hepatitis B reported cases, United States, 1996



Source: National Notifiable Disease Surveillance System, Centers for Disease Control and Prevention.

Some countries, particularly with lower prevalence rates, have offered primary immunization of adolescents (figure 1) as a strategy to preventing sexual transmission rather than perinatal and childhood infection (Mast 1998). Given that the majority of today's adolescents will not have received this vaccine in infancy, a short-term programme of primary immunization for adolescents may also be indicated as a catch-up strategy. However, immunization of adolescents in this way may be with or without a supporting neonatal immunization programme. Although individuals may benefit from the protection afforded by the vaccine, such a strategy is unlikely to have any impact on controlling the disease in highly endemic countries where, without immunization, the majority of individuals are already infected before adolescence. In addition, targeting only high-risk adolescents or adults is unlikely to achieve the levels of coverage necessary for successful control. For these reasons, WHO strongly

recommends universal immunization of neonates using HB vaccine as the optimal strategy to control the disease in countries with intermediate or high endemicity (HbsAg prevalence of more than 2%)

Although a proportion of children immunized as infants may subsequently experience slightly reduced protection, the risk of chronic carriage of infection and the associated risk of liver cancer are greatly reduced (Hall 1994). The longest follow-up of immunized children is still less than 15 years and continuing study is needed (Hall 1993). There is no indication at this stage for a booster dose, although studies may demonstrate a need in the future.

Special conditions warranting administration of the vaccine to high risk adolescents include: travellers to endemic countries; those injecting recreational drugs; males having sex with males; those in intimate contact with hepatitis B surface antigen positive individuals; health workers exposed to blood; those undergoing haemodialysis; those institutionalised in long term custodial care; and certain medical conditions such as haemophilia where sufferers are recipients of blood products.

Hypothetical scenario 2. Hepatitis B vaccine

Nation-wide studies conducted in the mid-1990s, by the Health Ministry of a large East Asian country revealed that the prevalence of Hepatitis B antibodies (HbsAg) was around 10%. After much discussion, a decision was taken at the highest level, to institute a policy of routine Hepatitis B vaccination, into the country's infant/childhood immunization schedule (in keeping with WHO's recommendations). Using existing vaccine delivery systems and mechanisms, the programme was put in place with relative ease.

At a review meeting held two years after the establishment of the policy, there arose a question of providing the vaccine to older children and adolescents (who had completed their vaccination schedules when the hepatitis B vaccine was not a part of it). The need to do it was agreed upon, and a task force was set up to examine the financial implications and possible vaccine delivery mechanisms for this. The task force met several times over a period of 6 weeks and recommended to the Health Ministry that all children in secondary school (classes 8-12) be vaccinated, as part of a national campaign. The task force recommended that the vaccination be provided in the school setting free of charge. It added the strong recommendation that the "catch up" immunization campaign should be preceded - and accompanied - by a carefully planned communication campaign aimed at motivating students to obtain these vaccinations. It noted that this approach would miss out children and adolescents who had dropped out of school, and suggested that a complementary communication campaign be put in place to motivate community leaders and parents, to take or send their children/adolescents to designated schools on certain allocated days, to obtain the vaccine.

Summary: Certain low-prevalence countries give primary immunizing courses to adolescents. WHO does not recommend an adolescent booster dose for HBV, although studies may show the need for one in the future. Catch-up campaigns may be useful to immunize those too old to have benefited from the introduction of the vaccine in the infant schedule. Individuals at risk who may benefit from the vaccine include travellers to endemic countries; those injecting recreational drugs; males having sex with males; those in intimate contact with hepatitis B surface antigen positive individuals; health workers exposed to blood; those undergoing haemodialysis; those institutionalised in long term custodial care; and certain medical conditions such as haemophilia where sufferers are recipients of blood products.

Measles

Despite the widespread availability of safe and effective measles vaccines since 1963, measles still accounts for approximately 1 million deaths annually. Measles was the eighth leading cause of death worldwide in 1990, representing 2.7% of disability-adjusted life years. Measles remains highly endemic in several countries in Europe, Asia, and Africa, irrespective of the level of economic development. However, measles-related deaths occur almost exclusively in developing countries. Failing to immunize infants against measles remains one of the major challenges of the global measles control efforts. Increasing vaccine coverage in infancy may lead to a distribution shift of cases to older ages in many populations.

One dose of measles vaccine in infancy protects around 80-90% of recipients for more than 20 years. Thus there is need for a true “booster” dose in only a small percentage of children, insufficient to justify a booster dose routinely. A small percentage of immunized infants have been documented to experience “waning immunity”. When these “immunization failures” are added to those who “failed to be immunized”, some countries have considered there to be sufficient numbers unprotected to justify adding extra doses of vaccine to their routine schedule. The extra doses are not, however, true booster doses. Timing of the extra dose varies depending on the epidemiology of the disease and opportunity to access the target group. Occasionally the extra dose is given in adolescence, but currently the trend is to schedule it around the time of school entrance.

The measles-mumps-rubella triple vaccine (MMR) is given in many countries in childhood or adolescence as an extra dose of measles vaccine. In others, MMR or MR may be a primary immunization (see below). The appropriate age for administration has to be considered in the light of epidemiological and other factors relating to all three diseases, as well as past patterns of primary measles immunization.

Increasing numbers of countries are embarking on aggressive measles control programmes involving campaigns. A decision to eradicate measles from the globe may be made in the near future, in which case new strategies are likely to evolve that involve vaccination of adolescents. Countries in the Americas with long-standing measles immunization programmes have targeted individuals up to 14 years of age for immunization in mass campaigns, although the target age group may be younger in some regions.

Hypothetical scenario 3. Measles vaccine

Measles vaccine was introduced 15 years ago in a developing country. Since then, immunization coverage in children less than 1 year of age gradually increased and coverage has been above 80% at national level for the last 6 years. Current immunization policy recommends one dose of measles vaccine at 9 months of age. A routine measles surveillance system was established and all health facilities were requested to report the number of cases by month and location.

Figure A: Measles incidence and vaccine coverage in an hypothetical developing country, 1960-94

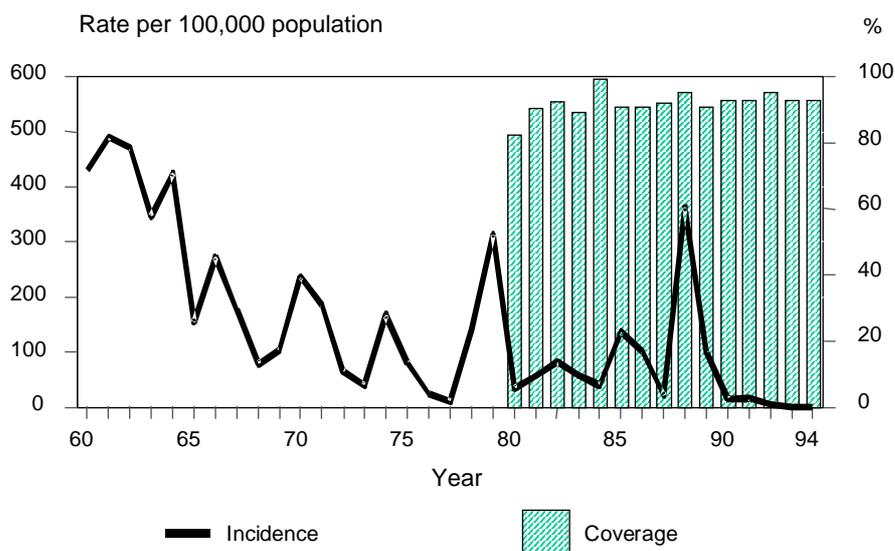
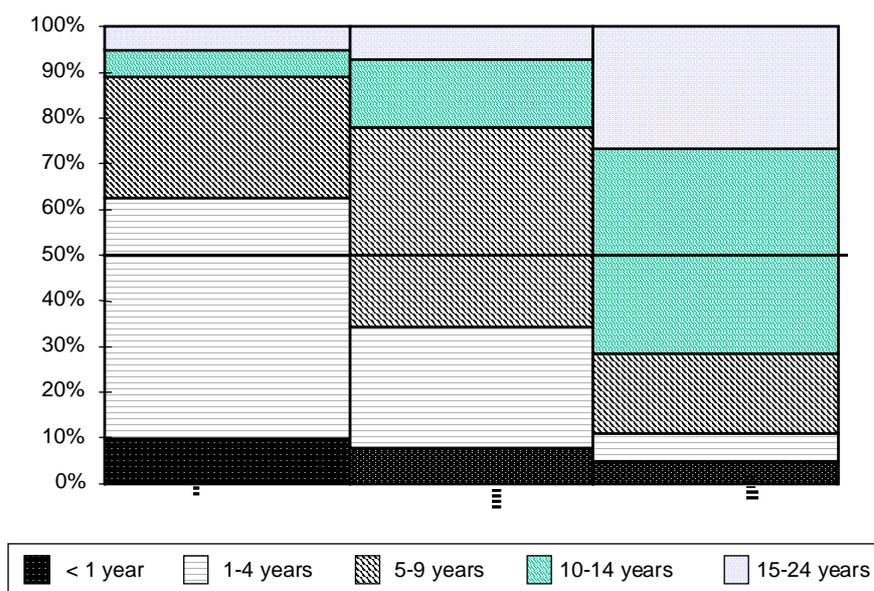


Figure B: Age distribution measles cases during epidemic years, hypothetical developing country, 1981, 1985, 1992

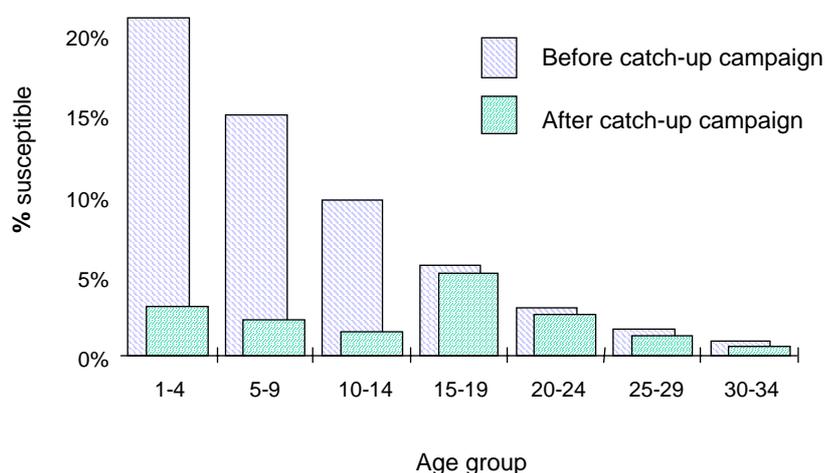


However, completeness and timeliness of the reports has been uneven throughout the country and varies from month to month. Information on age-distribution of the cases is available only from outbreak investigations and records at some major hospitals. Figure A illustrates measles trends in this country during the last three decades and Figure B shows the age-distribution of the cases from an outbreak report.

Measles mortality has declined dramatically and no measles deaths have been reported during the last 4 years. Outbreaks investigated during the previous two years revealed an increased proportion of cases in older children, mainly among children 5 to 14 years of age.

Because vaccination had been successful, the number of measles cases had decreased. This reduced the chances of unvaccinated children coming into contact with the measles virus. This in turn increased the age at infection, but left some susceptible individuals in older age groups. But analysis of the available data showed there were still many individuals unprotected against measles.

Figure C: Predicted susceptibility in developing country under analysis



The Ministry of Health decided to revise the current measles immunization strategies using as a framework the WHO recommended strategies for measles elimination and the recent measles elimination goal established for the region as follows:

- Routine immunization coverage levels will be raised in each district. Specific efforts will be made to identify the reasons for low coverage in relevant districts. Strong emphasis will be placed on the importance of immunizing all newborns as a key strategy for any accelerated measles control or elimination effort.
- A one-time measles campaign (“catch-up) targeting children 9 months to 14 years of age will be carried out to immunize susceptibles accumulated since vaccine introduction. This new strategy means that all children and a proportion of the adolescents in the country will be immunized regardless of their measles vaccination status or history of measles.

-
- All children in the target age group will be immunized (aiming at a coverage level of at least 95%). School-age children who do not attend schools and those living in hard to reach areas will receive special attention during the catch-up campaign. For those attending schools, the commission recommends that co-ordination with the Ministry of Education will ensure that all pupils in the target age group are immunized during the campaign.
 - A system to monitor the number of susceptibles will be put in place (Figure C). This will identify the susceptibles left after the catch-up campaign and the new susceptibles entering into the population (unprotected newborns).
 - High-risk groups will be identified and immunized.

Immunization in the face of a measles outbreak has been practised for years, including adolescents in some instances. Currently, the stress is on outbreak prediction and prevention, seeking to identify when the next cyclical epidemic will strike a country and immunizing ahead of it. In this case, adolescents may be targeted for immunization along with other age groups.

Older adolescents starting tertiary education or residential training may be required to receive measles vaccine as they enter these institutions, regardless of previous vaccination status. Outbreaks that were previously common in such settings are now much reduced through this policy.

Summary: WHO recommends that routine infant immunization with measles vaccine forms the backbone of measles control and elimination efforts. One dose of measles vaccine at 9 months of age remains the key strategy for measles control and elimination. Sustained high immunization coverage decreases measles mortality and morbidity, lengthens inter-epidemic periods, increases the age at measles infection and, increases the proportion of susceptible individuals in older age-groups. To eliminate the measles virus, a two-plus dose strategy is required, a supplementary dose of measles vaccine should be given to all children and adolescents in those age-groups where most susceptibles have accumulated. Secondary and tertiary education institutions may offer an extra dose in late teens to avoid outbreaks among students. An increasing number of polio-free countries with good levels of measles control have implemented strategies aiming at measles elimination, often including adolescent age groups.

Pertussis

Although the majority of adolescents have received one or more doses of DTP in infancy, there is evidence that protective immunity to pertussis may wane. Thus a high susceptibility among adolescents and adults may result from both waning immunity following vaccination and a reduced boosting effect from exposure to natural infection (Farizo 1992).

The duration of immunity following pertussis immunization is not precisely known. Epidemiological investigations with whole-cell pertussis vaccine suggest that the efficacy of the vaccine falls with time after immunization (Blennow et al, 1988, Jenkinson 1988). The duration of protection against pertussis after the primary series of DTP vaccine is uncertain, but probably extends only a few years.

An increasing proportion of pertussis cases among adolescents and adults may reflect decreasing levels of immunity in these groups, related to the reduced circulation of pertussis organisms in well vaccinated populations, with subsequent less frequent exposure to the pertussis bacterium and less natural boosting. Even infection with *Bordetella pertussis* may not assure a long-lasting immunity; some serological observations suggest that past infection may not provide protection, and that the widely held belief that infection with *B. pertussis* confers lifelong immunity is probably wrong (Schmitt-Grohe et al, 1995). While pertussis has traditionally been thought of as an infant or childhood illness, recent attention has shifted more to the occurrence of respiratory illness caused by *B. pertussis* in adolescents and adults (Farizo 1992).

Recent field trials conducted in Italy (Greco et al, 1996), Sweden (Gustafsson et al, 1996), and Germany (Schmitt et al, 1996) indicate that acellular pertussis vaccines cause significantly lower rates of reactions than whole cell pertussis vaccines, and that acellular vaccines are 70% - 90% effective in preventing severe pertussis cases. Acellular vaccines are being introduced into infant immunization schedules in several industrialized countries. Little is known concerning the duration of protection of acellular pertussis vaccine (aP) and whole-cell pertussis vaccine (wP) in populations without intercurrent pertussis infections and *B. pertussis* carriage. Similarly, the possible effect of the respective vaccines on pharyngeal colonisation of *B. pertussis* and on mild pertussis amongst adolescents and adults needs to be better established, considering the possible role of young adults in the epidemiology of this disease. Enhanced surveillance is obviously required to assess the true long-term protection provided by wP as well as aP vaccines.

Areas clearly in need of further research include: the duration of protection following primary immunization with wP or aP vaccines; the possible interference between aP and other vaccines when used in combinations; the possible ability of aP to induce a herd effect; and the epidemiology of pertussis in the adult population.

There are raised hopes that the advent of the less reactogenic acellular pertussis vaccines may provide an opportunity to give a late booster dose to stimulate antibody levels in adolescents and adults in an effort to reduce transmission of pertussis infection from older members of the community to infants (Cherry 1993). The value of such a strategy is not yet, however, universally agreed upon. Nor is the vaccine licensed for use yet beyond 6 years of age. A final conclusion has not been reached as to

whether immunizing adolescents with one or more doses of pertussis vaccine will be the supplementary strategy of choice to further reduce cases in infants and older individuals. Hypothetically a Tdap triple vaccine, in which the pertussis component was acellular, might therefore be appropriate as a booster in adolescence, rather than Td alone, if such a vaccine existed.

Summary: WHO is not currently in a position to make a recommendation regarding the use of pertussis vaccine in adolescents.

Polio

Most countries now use oral polio vaccine (OPV) both as part of the infant schedule and in eradication initiatives. OPV is the vaccine of choice for eradication because of its low cost, easy administration, high levels of induced immunity and dissemination of the vaccine virus between individuals (Hull et al, 1996). Experience shows that interrupting transmission requires more than routine vaccination (Foege 1996).

Polio is targeted for eradication by the year 2000. But immunization using OPV in the under 5 year old age group will continue for several years thereafter to ensure eradication is complete and until all countries and regions are certified as polio-free, with international consensus on curtailing immunization.

If an individual has seroconverted to polio vaccine, immunity is probably long-lasting and is likely to be boosted by exposure to the wild infection in areas where the virus still circulates. However, even among those who receive three or more doses of OPV, seroconversion is less than 100%. It makes sense, therefore, to offer another dose of polio vaccine as a once-only dose to those travelling to polio-endemic areas of the world, assuming a history of previous vaccination. Any unimmunized individuals intending to travel to such an area would require a complete course of vaccine. Countries vary about whether to recommend IPV or OPV in these circumstances. Eventually it is anticipated that immunization against polio will no longer be required some years into the 21st century.

Summary: WHO recommends one additional dose of polio vaccine should be offered to previously vaccinated persons travelling from industrialized countries to endemic areas. For unvaccinated travellers and those with no previously documented polio vaccination, a full course should be offered. Booster doses are not required for the adolescent living in endemic countries – natural boosting with wild virus is likely to be a continual process that maintains immunity.

Tetanus

There are two distinct aims of vaccination using tetanus toxoid-containing vaccines (TT, DT, Td): preventing neonatal tetanus (NT) and maternal tetanus by vaccinating women before or during pregnancy, and preventing tetanus in the general population. For the latter, maintaining protection in the entire population is essential, and has been targeted by EPI through at least three doses of tetanus toxoid during infancy. National immunization schedules as well as maternal and child health (MCH) services have targeted pregnant women with tetanus toxoid, the strategy being:

- five doses spread over an adequate time period for previously unimmunized women,
- two doses of TT for women who received 3 doses of tetanus toxoid-containing vaccine in infancy (DTP or DT),
- one dose for women who also received a childhood booster of tetanus toxoid-containing vaccine (DTP, DT or Td) in addition to the three primary doses,
- no further vaccination for women who were also boosted in adolescence with TT or Td.

The primary immunizing course of three doses of DTP is given in the first months of life. At least three more doses of vaccine containing tetanus toxoid (TT or Td) should be given before childbearing age in females for full protection (Galazka 1993). The optimal time for boosting boys and girls is considered by WHO to be at 6, 7 and 8 years of age (a year between each dose) at school. These are most easily given as Td, but certainly all doses given after the seventh birthday should be Td. If a child enters adolescence without the three booster doses complete, the missing doses should be given as early in adolescence as possible, so maximising the chance of delivering it before girls become pregnant for the first time. Some countries target school leaving (at around 12 years) for the final booster dose of Td when school attendance is still above 90% for boys and girls.

As females who have already received primary immunizing doses of DTP and booster doses of DT or Td reach childbearing years, the global pool of women in the reproductive age group who are not immune to tetanus will diminish dramatically. The same schedule will protect men at risk from tetanus through exposure to infection in the course of their work.

School-based programmes for administering booster doses of tetanus toxoid may be the best strategies to cover the gaps in immunity against tetanus created by the respective strategies of primary immunization with three doses of DTP during infancy and TT to women of childbearing age. Some key countries with high-risk populations for unsafe birth practices have high levels of school attendance in urban areas, making this strategy workable. However, any school-based programme depends for its success on high female enrolment and low dropout rates – situations not readily found in high-risk rural areas.

As tetanus and diphtheria toxoids are frequently combined in the same vaccine, and since the duration of vaccine-induced immunity is similar in both cases, it makes good sense to use Td rather than either toxoid separately. Additional programmatic advantages include the safety of Td in all age groups including pregnant women.

As a first priority, TT will be replaced by Td in all countries that have had DTP-3 coverage of 70% or more for at least 5 years. Where school-based boosters of DT are given, evaluation of the use of Td to replace the first dose of DT should be considered². It is also appropriate to use Td following trauma in adolescents whose immunization history for tetanus is inadequate or uncertain.

Additional evidence from Nigeria points to the risk to young women from unsafe abortion practices (Brabin et al, 1995). Vaccinating adolescent girls before first conception can be expected to reduce tetanus-related maternal deaths where abortion rates are high.

The 'high risk approach' to control neonatal tetanus is increasingly being used in developing countries where neonatal tetanus remains a serious public health problem. The high-risk approach consists of supplementary immunization rounds delivering two doses of TT to all women of childbearing age in areas identified as being at "high-risk".

Summary: WHO recommends Td or TT should be given to those female adolescents targeted in neonatal tetanus *elimination campaigns* in areas at high risk for the disease. As part of *routine* immunization, women (including adolescents) at risk for tetanus or neonatal tetanus should receive at least two doses of tetanus toxoid (as Td or TT) vaccine at least four weeks apart, with the last dose at least 2 weeks before delivery. A *booster* dose of Td should be offered to all adolescents who have not already received five doses of vaccine containing tetanus toxoid as resources and opportunities permit. A booster dose of Td should be used instead of TT following *trauma*.

Tuberculosis

BCG has been administered for many years in both developing and industrialized countries, despite considerable controversy as to its effectiveness. WHO has supported its use in newborns, principally for the protection of infants against TB meningitis and miliary TB in the first year of life, both well-substantiated benefits. In addition to a dose given at birth, several countries, especially in Eastern Europe, administer multiple doses of BCG, for example at one year, before or at school enrolment, or on graduation. Repeat doses are usually given to tuberculin negative children or to children not showing an immunization scar. However, there is no definite evidence that repeated BCG vaccination confers additional protection against tuberculosis.

There are no reports of prospective, randomized, controlled trials that have assessed the efficacy of BCG revaccination. Retrospective observations made in Hungary and in Poland, although suggesting some beneficial effect, were possibly design-flawed studies, and other factors may have been responsible for the decline of tuberculosis in the analysed periods (Kubit et al, 1983, Lugosi 1987). In Chile, where BCG vaccination was given at 6 years and 14 years of age, there was no difference in the proportions of young adults with 1, 2 or 3 scars between tuberculosis

² Recommendations from the Scientific Advisory Group of Experts (SAGE). Wkly Epidem Rec 1998, 73, 282-3

patients and controls, suggesting that there is no benefit from repeated vaccination (Sepulveda et al,1992). In a study in northern Malawi, no evidence was found for a reduction in pulmonary tuberculosis associated with repeated BCG vaccination (Karonga Prevention Trial 1996). A possible association between revaccination and an increased risk of tuberculosis among HIV-infected persons has been suggested (Rieder 1996). There have been reports of severe reactions in adults with symptomatic AIDS who received BCG vaccine (Centers for Disease Control, 1985).

There is therefore no reason at present to recommend any booster policy for BCG vaccine, and hence no need to use it in adolescence in areas where it has already been given in infancy.

In general, the International Union against Tuberculosis (IUAT) (Intern Union Tuberc 1994) suggests the continued use of BCG in infants where:

- the average notification rate of sputum smear-positive pulmonary tuberculosis is more than 5 cases per 100 000 population during the previous 3 years; or
- the average annual notification rate of tuberculous meningitis in children under 5 years of age is at least one case per 10 million general population over the previous 5 years; or
- the average annual risk of tuberculous infection is at least 0.1%.

Some countries have identified high-risk sections of the population (such as those immigrants coming from high -incidence countries) and offer neonatal BCG to only this group.

The current resurgence of tuberculosis and the emergence of multi-drug-resistant strains of *Mycobacterium tuberculosis* may indicate a need for the broader use of BCG (Colditz et al, 1995) in populations not vaccinated in infancy. In such situations, there is no evidence that testing prior to vaccination is necessary. Some countries with low prevalence rates of tuberculosis have discontinued routine neonatal immunization with BCG, but offer a dose to adolescents instead. The protection offered by this strategy against adult forms of the disease is uncertain.

Summary: WHO recommends that in all countries at high risk of tuberculosis infection, infants should be immunized as soon after birth as possible with a single dose of BCG to protect against severe forms of tuberculosis in infants and young children. Other protective benefits of this vaccine are uncertain. Where there is a definable high-risk sub-population, countries may offer BCG only to infants in this group. (Where there is no neonatal BCG programme, certain countries give the vaccine to adolescents as a first and only dose.) Booster doses of BCG are not recommended by WHO.

Yellow fever

All countries at risk of yellow fever are recommended to incorporate yellow fever vaccine in their routine childhood immunization schedule. One dose of yellow fever vaccine can be given at the same time as measles vaccine at around nine months. Re-immunization is not indicated in endemic countries as the vaccine is thought to produce virtually life-long immunity. Adolescents are likely to be part of the target group for immunization in widespread efforts to control yellow fever through immunizing large population groups covering wide age ranges (the so-called “big bang” strategy) and in mass campaigns as part of outbreak response measures. There are separate considerations for the purposes of international travel (see below)³.

Summary: WHO recommends that travellers to endemic areas should have an up-to-date dose of yellow fever vaccine to meet international health regulations. Adolescents may be included in yellow fever outbreak control immunization.

³ International Travel and Health. Vaccination requirements and health advice. WHO, Geneva, 1997

11. Immunizing against additional diseases

New vaccines are continuously under development, some of which may have contributions to make to adolescent health in particular settings. Of the vaccines in this section, only Hib has been recommended for use in routine immunization schedules by WHO, but some countries may have reason to recommend their use among adolescents, depending on the local epidemiology of the diseases concerned and resource implications.

Cholera

Cholera vaccine is no longer required as a condition of entry to a country. Traditional parenteral vaccine offers only incomplete, short duration protection. Two new cholera vaccines (live and killed vaccines) given orally have been developed and shown to be safe and effective. These two vaccines have been licensed and are commercially available in some countries, making possible their use as an option for travellers to endemic areas.

The killed vaccine confers high grade (85-90%) protection for six months after the second dose. Protection remains as high as 62% three years later in vaccinees more than 5 years old (Clemens et al, 1990). The live vaccine conferred high protection (95%) in adult volunteers in the US after one oral dose. When evaluated in a developing country with few cholera cases, there was unexpectedly low protection. Further studies will be needed before the live vaccine could be recommended for wide use in endemic countries.

Haemophilus influenzae B

The risk of Hib infection is almost entirely limited to children less than 5 years old. The risk of disease in adolescents is extremely low and thus immunization is not indicated for them.

Hepatitis A

The relatively recent availability of a vaccine against hepatitis A raises the possibility of its use among adolescents. However the vaccine is unlikely to be used in many countries until its cost decreases and a higher priority is given to the disease. It should, however, be used rather than immuno-globulin in adolescents particularly at risk, for example in connection with international travel. In certain outbreak situations where there is a clearly defined risk group, immunization is recommended, including for those of adolescent age if relevant. In the United States, high-risk adolescents

are targeted for the vaccine if they plan to travel to or work in endemic countries, have chronic liver disease, are receiving blood clotting factors, or are injecting recreational drugs.

In environments of deprivation, exposure to the disease is commonplace. As populations become more affluent and the environment improves, exposure to the infection diminishes and natural immunity is no longer commonplace. An upturn in socio-economic conditions has greatly increased susceptibility among adolescents with resulting higher attack rates of clinical disease. As a result, wealthier developing countries have expressed interest in using the vaccine as a routine adolescent vaccine. Poorer developing countries are likely to give higher priority to other diseases.

Influenza

Adolescent individuals may benefit from influenza vaccine each season if they have special medical conditions such as chronic lung or cardiovascular disorders (eg asthma or cystic fibrosis), reside in long-stay care facilities that house persons of any age who have chronic medical conditions, or suffer from certain metabolic disorders.

Japanese encephalitis

Universal primary immunization is recommended for children between 1 and 4 years of age in endemic areas. Booster doses are not usually given beyond ten years of age. Adolescents travelling to endemic areas should be immunized. However, efforts are being made to strengthen surveillance for this disease, and together with the potential for the availability of a lower-cost vaccine, there is the possibility that elimination may be a realistic goal in the near future. If this were the case, adolescents may well be targeted as part of a Japanese Encephalitis elimination programme.

Meningococcal meningitis

In industrialized countries, this disease is relatively uncommon, with overall rates in the range of 1-3 cases per 100 000 population per year.

Countries in the African “meningitis belt” experience recurrent outbreaks of serogroup A with comparatively very high incidence rates. Such countries often perform large mass immunization campaigns in response to these epidemics that nearly always include adolescents. Even in these areas, however, concern about the duration of protection provided by meningococcal polysaccharide vaccines, and the practical difficulty of delivering the vaccine to this age group, suggest that routine immunization of adolescents may not be the optimal public health strategy to control the disease.

The risk of meningococcal disease is increased in certain groups including those with no spleen or complement deficiencies. The vaccine should be offered to adolescents (and persons in other ages) in these high-risk groups.

Outbreaks of meningococcal disease may occur at schools, colleges, universities and other places where large numbers of adolescents and young adults congregate. In the face of such outbreaks, health authorities frequently embark on immunization programmes for these age groups, even though the cost-efficiency may be low and the duration of protection may be limited.

A mono-valent serogroup C conjugate vaccine is being introduced into routine immunization and mass campaigns targeting children and adolescents in the United Kingdom.

Mumps

Where MMR vaccine is used among adolescents who did not receive it in earlier childhood, the mumps component may well represent a primary dose. In such situations the use of MMR in adolescence is indicated, particularly in view of the risks to adolescent males of orchitis and possible infertility following natural infection in this age group. It is unlikely that monovalent mumps vaccine will find widespread use. A large body of literature (Galazka et al, 1999) confirms the use of mumps vaccine in at least 82 countries for a number of years. Some countries have already included mumps vaccine in measles elimination campaigns. One dose in childhood (usually as part of MMR) is sufficient to provide immunity for at least 20 years.

Pneumococcal disease

The risk of serious pneumococcal disease is relatively low in this age group, and the vaccine is not recommended for routine use for adolescents in any country. However, the risk of disease is increased in certain groups including those with anatomical or functional asplenia, nephrotic syndrome, advanced immuno-suppression, and HIV infection. The vaccine should be offered to adolescents in these groups.

Rotavirus

As this infection involves, to a great extent, children in their first two years of life, there is no indication to administer the vaccine to adolescents.

Rubella

Rubella is a serious risk to the unborn fetus (Congenital Rubella Syndrome - CRS), and hence the protection of females before pregnancy remains an important public health objective. For this reason, women of childbearing age (many of whom are adolescents) are the primary targets. Around 80 countries now use rubella vaccine on a national basis. Specific campaigns with monovalent rubella vaccine targeted at adolescent girls has been a feature of many industrialized country immunization schedules. With increasing coverage at younger ages with MR or MMR, such campaigns are likely to diminish. In contrast, many countries mainly in Europe and America include rubella vaccine in their campaigns aimed at measles elimination.

The English-speaking Caribbean is an example of countries embarking on a campaign to eliminate CRS. This was the logical sequence to the elimination of measles using MMR vaccine. Since nearly all children were immunized using MMR over a ten-year period, the islands embarked on a campaign to immunize male and female adolescents and young adults (13-29 years or 13-39 years) with the aim of stopping rubella transmission and the elimination of CRS (Hinman A et al 1998).

With many women bearing children into their 40s, protection against CRS needs to be offered well beyond the teen years. It is not clear how long vaccine-induced immunity lasts. While studies confirm demonstrable antibodies up to 15 years after immunization, it may be appropriate to carry out *ad hoc* screening for antibodies on any women intending to become pregnant more than 15 years after her last dose of rubella vaccine. Alternatively a time may come when another dose of rubella vaccine might be given around 19 years, sustaining antibody levels through childbearing years.

Typhoid

In most endemic countries, the age distribution of the cases of typhoid fever is 4-19 years. Thus, in countries at high risk of typhoid fever with reported cases of antibiotic resistance, this target population could be considered for immunization either with oral Ty21a or with injectable Vi. WHO recommends that immunization of school-aged children with typhoid vaccine be limited to geographical areas where typhoid fever is a recognised public health problem and areas where antibiotic resistant *S. typhi* strains are particularly prevalent. The use of typhoid vaccines in school children should be harmonized with the school-based immunization of Td. Although not yet operationalized, there is the possibility that typhoid vaccines will be used in outbreak situations in the future. The vaccine is recommended for travellers to endemic areas⁴.

Varicella

The risk of *varicella* (chickenpox) disease is increased in certain groups including those with advanced immuno-suppression, and HIV infection. The vaccine should be offered to adolescents in these groups⁵. Unlike the situation if the vaccine is administered to children, there is no risk of an epidemiological shift, as childhood exposure to the organism remains unaffected. Certain industrialized countries recommend the vaccine be offered to all adolescents who have not been vaccinated and do not have a reliable history of chicken pox. The vaccine should not be offered to pregnant individuals or those planning a pregnancy within the next month.

⁴ Recommendations from the Scientific Advisory Group of Experts (SAGE). *Wkly Epidem Rec* 1998, 73, 284.

⁵ Varicella vaccines. WHO Position paper. *Wkly Epidem Rec* 1998, 73, 241-248.

12. Immunization for international travel

Adolescents can largely be treated on the same basis as adults regarding immunization for travel, taking into account previous exposure, vaccination history and medical conditions. However, many adolescents undertake travel of a more adventurous “back-packing” style, which may expose them to greater risks than other visitors to particular countries. Yellow fever is the only vaccine required under international regulations for travellers to endemic countries, and applies to adolescents as for others.

13. Current policy and practice

Tables A-F (Annex 1) are summarized in table 3 based on information collected by questionnaire to determine the latest situation on a country-by-country basis. This was largely handled through WHO's Regional Offices (Americas, Europe, Africa, Eastern Mediterranean, South-East Asia and Western Pacific). Where data from direct enquiries were incomplete, they were supplemented with data routinely reported to WHO as of August 1999. Data on secondary school enrolment ratios (males and females) was taken from UNICEF/UNESCO (UNICEF 1998). These figures represent the number of children enrolled in secondary school divided by the population of the notional target age group.

Reporting was incomplete from many countries, and that which was obtained varied considerably depending on the source. Ministries of Health may well be unaware of services to adolescents provided by voluntary organizations or the private sector. Thus despite efforts to obtain it, the information is certainly incomplete. In addition, it is likely that the situation is changing rapidly in many countries. Therefore the information in tables A-F (Annex 1) and summarized in table 3 should be regarded with due caution in terms of its accuracy for any given country. It does, nonetheless, reflect a real trend in service provision for adolescents.

Table 3: Summary of adolescent immunization by WHO Region - number of countries known to be offering vaccines for entire population or sub-group, regardless of coverage levels

WHO Region (number of countries)	Vaccines						
	BCG	Td	TT	OPV	HBV	MMR	Other
AFR (48)	1	5	28	5	1	2	-
AMR (46)	3	17	14	14	3	11	Rubella (6), M (1), Mening (1), Typh (1)
EMR (24)	2	8	10	2	2	2	Rubella (3), M (1), Mening (1)
EUR (51)	13	27	6	16	8	16	Rubella (3), M (1), IPV (1)
SEAR (10)	-	-	6	-	-	-	Rubella (1), M (1)
WPR (36)	5	7	13	3	3	3	Rubella (1), Hib (1)

African Region

Twenty eight out of 48 countries in the Region reported conducting tetanus toxoid administration for childbearing aged women. The actual figure is likely to be close to 100% of countries. This represents a major success for the Region in targeting elimination of neonatal tetanus. With this notable exception, there are few national programmes for adolescent immunization in place in Africa. Overall secondary school enrolment for sub-Saharan Africa is 27% for males, 22% for females, making this target group difficult to access through school-based programmes. In South Africa, long term plans include the development of a school-based vaccination programme for hepatitis B, measles, rubella, tetanus and diphtheria vaccines. Currently some vaccinations do occur in this age group, mainly carried out by private immunization companies who offer the vaccines to pupils for a fee. This unexpected development responding to market forces is potentially destabilizing for vaccine prices. In addition, increased resources are required to ensure that those vaccines given in the private sector are appropriate, potent, safe and reported.

Region of the Americas

This Region shows the most advanced approach to adolescent immunization in that 17 out of 46 countries are already using a Td booster. Exceptionally, OPV is administered in 14 countries, ensuring the Regional eradication of polio is sustained. Only three countries use resources to provide a booster dose of BCG. New vaccines (typhoid and meningococcal) are being introduced to this age group in two countries, potentially paving the way for other vaccines in the near future. The successful measles and rubella elimination initiatives are encouraging a reported 11 countries to administer doses of MMR in the adolescent period, with an additional 3 countries giving only monovalent rubella vaccine. Again the actual number of countries is likely to be higher than this.

Eastern Mediterranean Region

As well as successful tetanus toxoid programmes which include the adolescent female, eight of 24 countries have also introduced Td boosters

European Region

Also successful in introducing Td in 27 countries, the European Region has the potential to expand its adolescent immunization with strong infrastructures at country level. Thirteen countries still give an adolescent dose of BCG, the majority of which are booster doses.

South-East Asia Region

Tetanus toxoid is successfully delivered in the majority of countries. However, for other vaccines, the less developed infrastructure of the health and education services as well as scarcer resources puts the SEA Region at considerable disadvantage.

Western Pacific Region

This is another Region with potential for development of adolescent immunization. With some highly industrialized nations in the Region, 7 out of 36 countries already report a booster of Td.

14. Country schedules

Countries choose particular schedules for epidemiological, immunological, organisational and practical reasons. Health care, social and economic systems vary from country to country, and vaccination schedules are tied to other events, patterns of schooling and medical insurance systems. Administering vaccines to adolescents may be a costly activity that does not reflect health priorities in some settings. Careful consideration of the local epidemiology of the target disease and the purpose of additional doses is therefore important. Countries are likely to be faced with variable pressures driving them towards adopting expanded targets (Table 4). With such a wide range of possibilities to choose from for adolescent immunization, national programmes need to rationalize decisions and set their own priorities.

Table 4: Factors that promote or limit expanding immunization target age groups and vaccines

Disease factors	<ul style="list-style-type: none">• Epidemiology of the target disease including shifts in age-specific incidence
Programmatic factors	<ul style="list-style-type: none">• Coverage levels already achieved• Adequate health infrastructure• Opportunities for reaching target age group e.g. high school attendance rates• Ability to communicate health messages to the target group
Political/social factors	<ul style="list-style-type: none">• Internal or international goals e.g. disease eradication goal• Public pressure• Social factors e.g. acceptability of immunization by the public including “risk perception”
Resources/ financial factors	<ul style="list-style-type: none">• Availability of resources• Cost/benefit

Programme managers wanting to explore whether adolescent immunization is appropriate for their country, or needing to respond to external pressure should:

1. Establish a sound and successful infant immunization programme before embarking on expanding the number of vaccines administered or the target ages.
2. Identify one antigen (or combined antigen) for which a strong case can be made for its introduction during adolescence e.g. Td, and collect the information outlined in each of the boxes in table 4 above. For instance, define the epidemiology of the target disease in the country or locality in question. In particular the age-specific disease incidence should be established. Has there been a shift in age-incidence towards older ages in the recent past? Are vaccines for travellers sold at relatively high prices? Who pays for adolescent health services - the health or the education budget? Or will the individual be charged?
3. On the basis of the information collected, create an action plan for its introduction. Cover the points mentioned in this document in sections 2-9.
4. Delay introducing other vaccines until the evaluation of the introduction of the first antigen is complete.

15. Summary and recommendations

A summary of current recommendations from the paper is provided in table 1. From this review, it is clear that booster doses of certain vaccines such as Td are highly appropriate for adolescents everywhere. It is unlikely, however, that delivery of these antigens will be achieved in many countries yet because of financial and other constraints. Countries are targeting adolescents for additional antigens as part of outbreak prevention, elimination or eradication campaigns. On an individual basis, many adolescents are benefiting from protection in special circumstances such as travel to endemic areas.

However, the decision about whether ministries of health should invest in the purchase of vaccine for adolescents and its associated delivery costs is complex. Not only must the advantages of a particular vaccine be evaluated, the opportunity cost must be assessed when compared with other possible medical services or interventions.

Planning the immunization of adolescents involves careful weighing of the advantages and disadvantages. Currently only a few vaccines lend themselves to widespread use in adolescents. Many more are useful in certain circumstances. The real opportunities of reaching adolescents in, for instance, the school setting, must be weighed with the difficulty of reaching a high proportion of the target group. Promotional messages must convince the audience that a given vaccine is safe and effective and relevant to themselves. Adolescents are, in general, questioning and discriminating individuals who are unlikely to comply with arbitrary and unjustifiable recommendations that they should be vaccinated. They will expect to interact meaningfully and rationally with health service providers, in many cases enjoying learning to take responsibility for matters affecting their own health. Providers need to be aware of their clients' expectations in these matters.

Future trends in this field are uncertain against a background of the changing economic climate, emerging and changing diseases, and by the sometimes-unpredictable developments in vaccine technology. How, for instance, might a vaccine against HIV infection be used in the adolescent age group? Vaccines against Epstein-Barr virus, Lyme Disease, cytomegalovirus, chlamydia and herpes virus may be possible one day. But speculation about anything other than the broad principles of future adolescent immunization is, for the moment, unlikely to be fruitful.

Annex 1:

Adolescent immunization by WHO Region

Key to tables A-F

WCBA:	Women of childbearing age
Questionnaire:	Data taken from country questionnaires through WHO Regional Offices 1997/8
Data in bold:	Supplementary information routinely supplied to WHO as of August 1999
YFV:	Yellow fever vaccine

Table A: Adolescent immunization in the WHO African Region (*continued/...*)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Ghana										
Guinea				WCBA						
Guinea Bissau				WCBA						
Kenya				WCBA						
Lesotho				WCBA						
Liberia				WCBA						
Madagascar				WCBA						
Malawi				WCBA						
Mali										
Mauritania				WCBA						
Mauritius										
Mozambique										
Namibia				WCBA	10 yrs					
Niger										
Nigeria										
Reunion										
Rwanda				WCBA						
St Helena										
Sao Tome										
Senegal										
Seychelles				WCBA	15 yrs					
Sierra Leone										
South Africa										

Table A: Adolescent immunization in the WHO African Region (continued/...)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Swaziland				WCBA						
Togo				WCBA						
Uganda				WCBA						
UR Tanzania				WCBA						
Zambia				WCBA						
Zimbabwe				WCBA						

Table B: Adolescent immunization in the WHO Region of the Americas

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Anguilla	questionnaire	-	11-12, schools	-	11-12, schools	-	11-12, schools	-		
Antigua	questionnaire	-	15-19, schools	-	15-19, schools	-	15-19, schools	-	-	-
Argentina									70	75
Bahamas	questionnaire	-	-	10-11, schools	-	-	10-11, schools	-	95	95
Barbados	questionnaire	11-12, schools	11-12, schools	-	11-12, schools	-	-	-	90	80
Belize	questionnaire	-	-	-	-	-	-	-	46	52
Bermuda	questionnaire	-	15-16, schools	-	10, schools	10, schools (from 1997)	10, schools	-		
Bolivia	questionnaire	-	10-14, colleges	-	-	-	-	-	40	34
Brazil	questionnaire	-	-	-	-	-	-	YFV		
Canada									106	106
Cayman Is.	questionnaire	-	14-16, schools	-	14-16, schools	17-19, health centres	14-16, schools	-		
Chile	questionnaire	-	-	-	-	-	-	-	66	70
Colombia	questionnaire	-	-	-	-	-	-	rubella camp'gn 96, 10-12; 97 14-15	57	68
Costa Rica	questionnaire	-	from 10, schools	-	-	-	-	-	47	51
Cuba	questionnaire	-	-	14, schools	-	14, schools	-	typhoid 10,13, 16 schools	70	79
Curacao	questionnaire	-	10, schools	-	10, schools	-	10, schools	-		
Dominica	questionnaire	-	10-13, schools	-	10-13, schools	-	-	rubella, 10-13 girls, schools		
Dominican Republic	questionnaire	-	-	-	-	-	-	(only campaigns)	34	47

Table B: Adolescent immunization in the WHO Region of the Americas (continued/...)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Ecuador									54	56
El Salvador	questionnaires	-	7-14, schools	WCBA	-	-	5-14 schools	rubella 11-19, h/centres	27	30
French Guiana			Every 10 yrs		Every 10 yrs			Measles 6-11 yrs		
Grenada	questionnaire	-	12 yrs	-	-	-	-	-		
Guadeloupe										
Guatemala	questionnaire	-	-	WCBA	-	-	-	-	25	23
Guyana	questionnaire	-	11-14, schools	-	11-14, schools	-	-	-	56	59
Haiti									22	21
Honduras	questionnaire	-	-	-	-	-	15, schools	-	29	37
Jamaica	questionnaire	-	-	WCBA	-	-	-	-	62	70
Martinique										
Mexico	questionnaire	-	11-13 in Oct 97	-	-	-	-	measles 6-14 in 1993	57	58
Montserrat	questionnaire	-	tetanus > 14, schools, then every 10 yrs	-	> 14, schools	-	-	-		
Neth. Antilles					10 yrs					
Nicaragua	questionnaire	-	-	from 10, schools	-	-	-	measles, < 15, schools	40	47
Panama	questionnaire	-	12, schools	WCBA	-	-	-	rubella, 12, girls, schools	60	65
Paraguay	questionnaire	-	-	-	-	-	-	meningitis A,C 18 yrs. YFV	38	40
Peru	questionnaire	-	-	WCBA	-	-	-	-	-	-

Table B: Adolescent immunization in the WHO Region of the Americas (continued/...)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Puerto Rico										
St Kitts & Nevis	questionnaire	-	-	11-17, schools	11-17, schools	-	-	-	-	-
St Lucia	questionnaire	-	-	11-12, schools	11-12, schools	-	-	rubella, 11-12, girls, schools	-	-
St Vincent & Grenadines	questionnaire	10, schools	-	10-15, schools	10-15, schools	-	17-19 on request	-	-	-
St. Maarten	questionnaire	-	4-18, schools	-	-	-	4-18, schools	-	-	-
Suriname	questionnaire	-	-	-	-	-	-	rubella,8,schools	-	-
Trinidad & Tobago	questionnaire	-	-	11-12, schools	-	-	-	-	74	78
Turks & Caicos	questionnaire	-	-	-	-	-	college entry	-	-	-
United States									98	97
Uruguay	questionnaire	-	-	WCBA	-	-	-	measles in 1994	74	88
Venezuela	questionnaire	7-12, schools, 96	-	7-12, schools	-	-	-	-	29	41
Virgin Is UK	questionnaire	-	-	-	-	-	-	-	-	-
Virgin Is USA										

Table C: Adolescent immunization in the WHO Eastern Mediterranean Region

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Afghanistan				WCBA					32	11
Bahrain	questionnaire	-	14, schools	WCBA	-	-	-	rubella, 13, schools	97	100
Cyprus	questionnaire	-	14, schools	-	-	12 & 16, schools	11, schools	-	96	98
Djibouti	questionnaire	-	-	-	-	-	-	-	15	10
Egypt	questionnaire	13, schools	10, schools	WCBA	-	-	-	-	82	71
Iran			14-16 yrs						76	62
Iraq	questionnaire	-	-	-	-	-	-	rubella, girls 11-15, schools	53	34
Jordan	questionnaire	-	15, schools	-	-	-	-	-	52	54
Kuwait	questionnaire	-	10 & 18, schools	WCBA	-	-	-	rubella, girls 12, schools	65	64
Lebanon									75	83
Libya	questionnaire	-	-	-	-	-	-	-	95	95
Morocco	questionnaire	-	-	-	-	-	-	-	43	32
Oman	questionnaire	12, schools	12, schools	18, schools	18, schools	-	-	measles 14, schools	67	61
Pakistan				WCBA						
Qatar										
Saudi Arabia	questionnaire	-	-	16, schools	-	-	13-14, in schools	meningococcal meningitis A&C every 3 yrs	57	47
Somalia	questionnaire	-	-	WCBA	-	-	-	-	-	-
Sudan				WCBA					24	19

Table C: Adolescent immunization in the WHO Eastern Mediterranean Region (continued/...)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Syria	questionnaire	-	-	-	-	-	-	-	50	41
Tunisia	questionnaire	-	12 & 18, schools	WCBA	12 & 18, schools	-	-	(formerly measles, 12 & 15, schools)	58	53
UAE									88	97
UNRWA										
West Bank & Gaza				WCBA		Contacts of HbsAg				
Yemen				WCBA					37	9

Table D: Adolescent immunization in the WHO European Region (*continued/...*)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Georgia									82	76
Germany	questionnaire	-	15-16 yrs	-	11-18 yrs	11-15 yrs	-	(up to private practitioners)	101	100
Greece									99	96
Hungary	questionnaire	-	11, schools	-	-	-	11-12 yrs	measles 11, schools	79	83
Iceland									105	105
Ireland			11-12 yrs						110	115
Israel	questionnaire	-	-	-		11-12 yrs	-	rubella 12-13 in schools	83	89
Italy			14-15 yrs						81	82
Kazakstan			14-15 yrs						89	92
Kyrgyzstan									84	89
Lithuania			15-16 yrs		11-12yrs		11-12 yrs		80	84
Luxembourg									78	78
Latvia	questionnaire	-	14, schools	-	14, schools	-	-	Rubella 12, schools	84	89
Malta	questionnaire	12-13, schools	14-16 yrs	-	14-15 yrs	9-10, schools	11-12, schools		93	83
Moldova		11-12yrs	14-15 yrs						71	74
Monaco									-	-
Netherlands	questionnaire	-	-	-	-	-	-	-	129	118
Norway	questionnaire	14-16 in schools	-	-	-	-	12-13, in schools	IPV 14-16, schools	118	114
Poland									95	96

Table D: Adolescent immunization in the WHO European Region (*continued/...*)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Portugal	Questionnaire	11-12 yrs	-	11, schools & health centres	-	11-13, health centres	11-13, health centres		63	74
Romania									77	78
Russian Fed			11-12 yrs						84	91
San Marino									-	-
Spain	questionnaire	-	14, schools	-	-	12-13, schools	11, schools	-	107	120
Slovak Republic	questionnaire	-	-	13, clinics	11, clinics	(high risk only)	11, clinics	-	88	93
Slovenia	questionnaire	-	14-15 yrs	18, schools	14, schools	-	-	-	89	91
Sweden	questionnaire	-	10, schools	-	-	-	12, schools		99	100
Switzerland	questionnaire	-	11-15, schools	-	11-15 yrs	11-15 in schools	11-15 in schools	-	93	89
Tajikistan	questionnaire	-	15-16 yrs	-	-	-	-		83	75
Turkmen-istan		14-15 yrs	15-16 yrs						-	-
Turkey	questionnaire	-	10, schools	14, schools	-	-	-		76	50
Ukraine		14-15 yrs	11, 14, 16 yrs		14-15 yrs			Rubella 15 yrs	88	95
United Kingdom	questionnaire	10-14, schools & GPs	13-18, schools & GPs	-	13-18, schools & GPs	-	-		93	95
Uzbekistan		14-15 yrs	15-16 yrs						99	87
Yugoslavia	questionnaire	10, schools	14, schools	18, schools	-	-	12, schools	-	61	63

Table E: Adolescent immunization in the WHO South-East Asia Region

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Bangladesh	questionnaire	-	-	-	-	-	-	-	25	13
Bhutan	questionnaire	-	-	-	-	-	-	-	7	2
India	questionnaire	-	-	10 & 16	-	-	-	-	59	38
Indonesia	questionnaire	-	-	Women in high risk areas	-	-	-	-	49	41
Korea DPR	questionnaire	-	-	-	-	-	-	measles, 17	-	-
Maldives	questionnaire	-	-	14-15 women	-	-	-	Measles 14	49	49
Myanmar	questionnaire	-	-	-	-	-	-	-	23	23
Nepal	questionnaire	-	-	Women of child-bearing age	-	-	-	-	46	23
Sri Lanka	questionnaire	-	WCBA	-	-	-	-	rubella, 11-15	71	79
Thailand	questionnaire	-	-	Women in high risk areas	-	-	-	-	38	37

Table F: Adolescent immunization in the WHO Western Pacific Region

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
American Samoa										
Australia			14 yrs			10-16 yrs			83	86
Brunei Darussalam					Pregnancy					67 73
Cambodia									31	18
China									60	51
CN Marianas				WCBA						
Cook Islands				Pregnancy					-	-
Fed S Micronesia			11, 16 yrs			10 yrs				
French Polynesia										
Fiji									64	65
Guam			Boosters every 10yrs							
Hong Kong										
Japan								DTP 11-12 yrs		
Rubella 12 yrs	98	99								
Kiribati				Pregnancy					-	-
Korea, Republic of									100	99
Laos									31	19
Macao			10 yrs and boosters every 10 yrs						DTP 10 yrs	
Malaysia		11 yrs if no scar		WCBA				Rubella 11yrs	58	64

Table F: Adolescent immunization in the WHO Western Pacific Region (*continued/...*)

Country	Data source	VACCINES							Secondary school %	
		BCG	Td	TT	OPV	HBV	MMR	Other	Males	Females
Marshall Is.				Pregnancy					-	-
Micronesia									-	-
Mongolia		15 yrs							50	70
Nauru		16 yrs							-	-
New Caladonia										
New Zealand					11 yrs		11 yrs		111	114
Niue				14 yrs			11 yrs		-	-
Palau									-	-
Papua New Guinea		13 or school leaving		Pregnancy					17	11
Philippines									-	-
Rep Korea										
Samoa			14 yrs	Pregnancy					-	-
Singapore		12, 16 yrs	12 yrs		12 yrs		12 yrs	DTP 12 yrs Rubella 12 yrs	69	71
Solomon Is.									21	14
Tokolau				Pregnancy						
Tonga								Measles 2-15 yrs	-	-
Tuvalu				Pregnancy					-	-
Vanuatu				Pregnancy					23	18
Viet Nam				Pregnancy						
Wallis & F			16, 21 yrs		11,16,21 yrs	11,16,21 yrs		Hib 16, 21 yrs DTP 11,16,21 yrs	-	-

Annex 2:

Annotated bibliography

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