

WHO Position paper on Mumps vaccines, Feb 2007

## **Selected references**

Mumps vaccines;  
studies on immune responses, efficacy and effectiveness

**Cohen C, et al. Vaccine effectiveness estimates, 2004-2005 Mumps outbreak, England. *Emerging Infect Dis.* 2007, 13; 12-17. (NOT YET (Jan 9 2007) IN MEDLINE).**

**Harling R, White JM, Ramsay ME, Macsween KF, van den Bosch C. The effectiveness of the mumps component of the MMR vaccine: a case control study. *Vaccine.* 2005 Jul 1;23(31):4070-4.**

In 1998/1999, an outbreak of mumps occurred among children of a religious community in North East London. A case control study was conducted to assess the effectiveness of the mumps component of the MMR vaccine. One hundred and sixty-one cases of mumps were identified and 192 controls were selected. Fifty-one percent of cases and 77% of controls had a history at least one MMR vaccination. The observed effectiveness of any MMR vaccination adjusted for age, sex and general practice was 69% (95% CI: 41-84%). This is consistent with the results of other observational studies of mumps containing vaccines, but lower than the immunogenicity of mumps vaccines reported by clinical trials. This discrepancy is because observational studies tend to underestimate vaccine effectiveness, and because immunogenicity is not necessarily an accurate biological marker of vaccine effectiveness. Two doses of vaccine were more effective (88% (95% CI: 62-96%)) than a single dose (64% (95% CI: 40-78%)). The current two-dose vaccination programme remains the best method for controlling mumps infection in the community.

**Ong G, Goh KT, Ma S, Chew SK. Comparative efficacy of Rubini, Jeryl-Lynn and Urabe mumps vaccine in an Asian population. *J Infect.* 2005 Nov;51(4):294-8.**

**OBJECTIVE:** The comparative efficacy of the three mumps vaccine strains (Jeryl-Lynn, Urabe and Rubini) was conducted in an Asian population from data arising from an epidemiological investigation of seven institutional outbreaks of mumps in Singapore. **METHODS:** Demographic information (gender, age, ethnic group), clinical presentation and vaccination history (date and place of mumps vaccination, type of mumps vaccine received) of all children who attended the six childcare centres and one primary school where outbreaks of 20 or more cases of mumps occurred in 1999 were collected. The attack rate of the unvaccinated group and the attack rates of the vaccine groups (for each vaccine strain) were determined and the vaccine efficacy of the three vaccines calculated. **RESULTS:** The vaccine efficacy of the Jeryl-Lynn strain, Urabe strain and Rubini strain mumps vaccine were 80.7, 54.4 and -55.3%, respectively. **CONCLUSION:** Rubini strain mumps vaccine conferred no protection and has since been deregistered in Singapore.

**Tischer A, Gerike E. Immune response after primary and re-vaccination with different combined vaccines against measles, mumps, rubella. *Vaccine*. 2000 Jan 31;18(14):1382-92.**

The humoral immune response after primary and re-vaccination confirmed the high immunogenicity of the combined vaccines used: "MMR-Vax(R)", "Pluserix(R)" and "Triviraten(R)". The investigation of paired serum samples of prevaccinal seronegative infants (n=90-100% for all three components with the exception of the mumps component of "Triviraten(R)" (38%). However, by additional methods (plaque neutralisation test, immunofluorescence test) mumps antibodies could be detected in 93.4% of infants having received vaccine "Triviraten(R)". The mean values of antibody activities against the three components did not differ significantly after vaccination with "MMR-Vax(R)" and "Pluserix(R)". However, after vaccination with "Triviraten(R)" the mean antibody values were significantly lower ( $P < 0.01$ ) against the measles strain "Edmonston-Zagreb" and especially lower (2-20 times) against the mumps virus strain "Rubini". Revaccination of prevaccinal seropositive schoolchildren and adolescents (n=676) with "MMR-Vax(R)" and "Pluserix(R)" produced no different results. The rate of vaccinees responding with a booster reaction reached 68.4% for measles and mumps, but only 8.6% for rubella. A booster reaction could be observed in 100% of those vaccinees who had antibodies at a low level, also in the case of naturally acquired immunity. The low-level range for antibodies against measles was defined as  $0.15 < 0.40$  IU/ml, mumps  $1:230 \leq 1:500$  and rubella 7-16 IU/ml. The rate of vaccinees with low-level antibodies against measles can become as high as 10%, for mumps 20% and for rubella 3%. The correlation between the level of antibodies and protection against the disease is discussed. The rate of individuals in a population with doubtful protection (unvaccinated, non-responder and low responder after primary vaccination) prevents to reach the herd immunity of 95% necessary for elimination. The results of our serological studies strongly recommend re-vaccination against measles, mumps and rubella.

**Chamot E, Toscani L, Egger P, Germann D, Bourquin C. [Estimation of the efficacy of three strains of mumps vaccines during an epidemic of mumps in the Geneva canton (Switzerland)] [Article in French]. *Rev Epidemiol Sante Publique*. 1998 Mar; 46(2):100-7. French. 1: *Rev Epidemiol Sante Publique*. 1998 Mar;46(2):100-7.**

**BACKGROUND:** The number of mumps cases reported in Switzerland markedly increased from 1993 to 1995 although vaccination coverage against mumps had risen steadily since the national MMR immunization program was launched in 1987. In 1991, an estimated 80% of children 27 to 36 month-old were immunized against mumps. The purpose of the present study was to assess the hypothesis that the epidemic was the consequence of a low vaccine efficacy of the Rubini strain--a mumps vaccine strain that has been widely used in Switzerland. **METHODS:** Vaccine efficacy was assessed by measuring secondary attack rates among immunized and nonimmunized children 16 year-old or younger who were family contacts of cases. **RESULTS:** From February 1993 to April 1996, Geneva pediatricians reported 283 primary cases of mumps and 63 secondary cases. Estimate of vaccine efficacy was equal to 6.3% (95% CI: -45.9; 39.8) for the Rubini strain, as compared to 73.1% (95% CI: 41.8; 87.6) for the Urabe Am 9 strain, and 61.6% (95% CI: 0.0; 85.4) for the Jeryl Lynn strain, two vaccine strains of mumps that had also been used in Geneva. **CONCLUSION:** Our study supports the hypothesis that the Rubini vaccine strain of mumps does not confer sufficient long-lasting protection against mumps.

## Long-term impact of immunization and vaccination policy

**Watson-Creed G, Saunders A, Scott J, Lowe L, Pettipas J, Hatchette TF. Two successive outbreaks of mumps in Nova Scotia among vaccinated adolescents and young adults. CMAJ. 2006 Aug 29;175(5):483-8**

**BACKGROUND:** Before the widespread use of vaccine, mumps was the most common cause of viral meningitis (up to 10% of mumps infections). Vaccination programs have resulted in a drop of more than 99% in the number of reported mumps cases in the United States and Canada. Although rare in Canada, outbreaks have recently occurred throughout the world, including a large outbreak in the United Kingdom, where more than 56,000 cases were reported in 2004-2005. **METHODS:** Two recent outbreaks in Nova Scotia were investigated by public health officials. Cases were defined by laboratory confirmation of infection (i.e., isolation of mumps virus by culture) or clinical diagnosis in people epidemiologically linked to a laboratory-confirmed case. The people infected were interviewed to determine possible links and to identify contacts. Mumps virus was cultured from urine and throat specimens, identified via reverse-transcriptase polymerase chain reaction (RT-PCR) and subjected to phylogenetic analysis to identify the origin of the strain. **RESULTS:** The first outbreak involved 13 high-school students (median age 14 yr): 9 who had previously received 2 doses of measles-mumps-rubella vaccine (MMR) and 4 who received a single dose. The second outbreak comprised 19 cases of mumps among students and some staff at a local university (median age 23 yr), of whom 18 had received only 1 dose of MMR (the other received a second dose). The viruses identified in the outbreaks were phylogenetically similar and belonged to a genotype commonly reported in the UK. The virus from the second outbreak is identical to the strain currently circulating in the UK and United States. **INTERPRETATION:** The predominance in these outbreaks of infected people of university age not only highlights an environment with potential for increased transmission but also raises questions about the efficacy of the MMR vaccine. The people affected may represent a "lost cohort" who do not have immunity from natural mumps infection and were not offered a 2-dose schedule. Given the current level of mumps activity around the world, clinicians should remain vigilant for symptoms of mumps.

**Centers for Disease Control and Prevention (CDC). Update: multistate outbreak of mumps--United States, January 1-May 2, 2006. MMWR Morb Mortal Wkly Rep. 2006 May 26;55(20):559-63.**

CDC and state and local health departments continue to investigate an outbreak of mumps that began in Iowa in December 2005 and involved at least 10 additional states as of May 2, 2006. This report summarizes preliminary data reported to CDC from these 11 states and provides recommendations to prevent and control mumps during an outbreak.

**Vandermeulen C, Roelants M, Vermoere M, Roseeuw K, Goubau P, Hoppenbrouwers K. Outbreak of mumps in a vaccinated child population: a question of vaccine failure? Vaccine. 2004 Jul 29;22(21-22):2713-6.**

In Belgium, children are immunized against measles-mumps-rubella (MMR) in a two-dose schedule at the age of 15 months and 11 years. Despite these recommendations, epidemics of

mumps still occur. During an outbreak of mumps in Bruges (Belgium), 105 cases were registered in seven schools (age group 3-12 years). Lower than optimal vaccination coverage, inadequate vaccination schedule and a combination of primary and/or secondary vaccine failure are considered as possible reasons for the outbreak as described in the article. The role of secondary vaccine failure is highlighted.

**Peltola H, Davidkin I, Paunio M, Valle M, Leinikki P, Heinonen OP. Mumps and rubella eliminated from Finland. JAMA. 2000 Nov 22-29;284(20):2643-7**

Many countries use trivalent measles-mumps-rubella (MMR) vaccine for their mumps and rubella immunization programs. In Finland, a national 2-dose MMR vaccination program for children, free of charge and on a voluntary basis, was launched in 1982. Serological confirmation of all suspected cases of mumps and rubella has been required since 1987. Despite intensive surveillance, no persistent sequelae or deaths attributable to vaccination have been detected. Indigenous mumps and rubella were eliminated in 1996, but 4 imported cases of mumps and 2 of rubella occurred from 1997 to 1999. Lack of secondary cases indicates sufficient immunity in the community. Compared with an epidemic year, up to thousands of cases of mumps meningoencephalitis and orchitis and around 50 cases of congenital rubella syndrome are now avoided annually. A 2-dose vaccine regimen in children during the last 17 years (1983-1999) has interrupted circulation of the target viruses entirely. Finland is the first country documented to be free of indigenous mumps and rubella (measles was eliminated in 1996). Despite the ongoing possibility of imported disease, major outbreaks probably can be avoided by maintaining high vaccination coverage and the 2-dose policy. JAMA. 2000;284:2643-2647.

**Broliden K, Abreu ER, Arneborn M, Bottiger M. Immunity to mumps before and after MMR vaccination at 12 years of age in the first generation offered the two-dose immunization programme. Vaccine. 1998 Jan-Feb;16(2-3):323-7.**

Sweden was the first country in the world to introduce a two-dose programme of vaccination against measles, mumps and rubella with a combined vaccine (MMR). It was commenced in 1982 and the vaccination was carried out at the ages of 18 months and 12 years. In 1992-93 the first age-group vaccinated at 18 months reached the age of 12 and accordingly received a second dose of MMR. A total of 382 children participated in the present study. Seroimmunity against mumps was studied by testing neutralizing antibodies using serial dilutions inoculated into cell cultures before and after the 12-year vaccination. Of the 229 children earlier vaccinated (group A), 27% lacked demonstrable antibodies before the booster. Of those without documented vaccination records (group B), 56% were seronegative before vaccination. After vaccination, 93% of group A and 86% of group B were seropositive (titre > or = 2). In the seronegative children, whether vaccinated earlier or not, the seroconversion was ca 75%. Previously unvaccinated children positive before vaccination and thus likely to be naturally immune had a higher mean-titre both before and after vaccination than the seropositive children earlier vaccinated. So far, the two-dose programme has proceeded as expected.

**Gay N, Miller E, Hesketh L, Morgan-Capner P, Ramsay M, Cohen B, Brown D. Mumps surveillance in England and Wales supports introduction of two dose vaccination schedule. *Commun Dis Rep CDR Rev.* 1997 Feb 7;7(2):R21-6.**

Sentinel surveillance in general practice and laboratory reports to the PHLS Communicable Disease Surveillance Centre show that the incidence of mumps has fallen to very low levels since vaccination against measles, mumps, and rubella was introduced in 1988. Hospital admissions for mumps show a 92% decline compared with the prevaccination era, to a rate of 0.2 per 100,000 population per year. Serological surveillance has shown an increase in the proportion of school age children who have no detectable antibody to mumps, which is consistent with the reduction in mumps virus transmission. The proportion of children aged 11 to 15 years with no detectable antibody is expected to peak at 19% in 1997. Mathematical models suggest that this increase in susceptibility is unlikely to allow a large resurgence of mumps in the short term but that school outbreaks may become more common. Outbreaks in universities and military establishments are possible in the medium term. Analysis of efficacy data for mumps vaccine indicates that mumps is unlikely to be eliminated with a single dose of vaccine at current coverage rates. A second dose of vaccine, which is now being offered to preschool children, will reduce morbidity and should eventually eliminate mumps if coverage is high enough.

**Cheek JE, Baron R, Atlas H, Wilson DL, Crider RD Jr. Mumps outbreak in a highly vaccinated school population. Evidence for large-scale vaccination failure. *Arch Pediatr Adolesc Med.* 1995 Jul;149(7):774-8.**

**OBJECTIVES:** To describe an outbreak and to identify risk factors for mumps occurring in a highly vaccinated high school population. (Note: Highly vaccinated means a population in which more than 95% have been vaccinated.) **DESIGN AND PARTICIPANTS:** Survey and cohort study of 307 (97%) of 318 students. **OUTCOME MEASURES:** Mumps was defined as an illness with 2 or more days of parotid swelling. Serologic confirmation of infection was obtained in eight cases, seven of which were evaluated for presence of IgM antibody using immunofluorescent antibodies. Vaccination records were verified for 297 (97%) students. **RESULTS:** Between October 3 and November 23, 1990, clinical mumps developed in 54 students (attack rate, 18%), 53 of whom had been vaccinated. Most cases (40 [77%] of 52) occurred 12 to 20 days after a school-wide pep rally. Immunofluorescent antibody testing of all seven specimens demonstrated IgM antibody to mumps. Risk factors for clinical mumps identified in multivariate analyses included female gender (odds ratio, 3.0; 95% confidence interval, 1.6 to 5.7) and source of vaccination other than the local public health clinic (students vaccinated by private providers [odds ratio, 3.0; 95% confidence interval, 1.3 to 5.2] or in other districts [odds ratio, 2.4; 95% confidence interval, 1.1 to 5.3]). **CONCLUSIONS:** The overall attack rate is the highest reported to date (and to our knowledge) for a population demonstrating virtually complete mumps vaccine coverage. Even verified documentation of vaccination may not be an accurate indicator of an individual's protection against mumps. Vaccination failure may play an important role in contemporary mumps outbreaks. We found no evidence to indicate that waning immunity (secondary vaccine failure) contributed significantly to this outbreak. A second dose of mumps vaccine, as recommended using measles-mumps-rubella vaccine, could potentially prevent similar outbreaks in secondary school populations in the future.

**Briss PA, Fehrs LJ, Parker RA, Wright PF, Sannella EC, Hutcheson RH, Schaffner W. Sustained transmission of mumps in a highly vaccinated population: assessment of primary vaccine failure and waning vaccine-induced immunity. J Infect Dis. 1994 Jan;169(1):77-82.**

From January to July 1991, an outbreak of mumps occurred in Maury County, Tennessee. At the primarily affected high school, where 98% of students and all but 1 student with mumps had been vaccinated before the outbreak, 68 mumps cases occurred among 1116 students (attack rate, 6.1%). Students vaccinated before 1988 (the first year mumps vaccination was required for school attendance in Tennessee) may have been at greater risk of mumps than those vaccinated later (65[6.1%] of 1001 vs. 2[2.2%] of 89; risk ratio, 2.9; 95% confidence interval, 0.7-11.6). Of 13 persons with confirmed mumps who underwent serologic testing, 3 lacked IgM antibody in well-timed acute- and convalescent-phase serum specimens. Vaccine failure accounted for a sustained mumps outbreak in a highly vaccinated population. Most mumps cases were attributable to primary vaccine failure. It is possible that waning vaccine-induced immunity also played a role.

**Fine PE, Zell ER. Outbreaks in highly vaccinated populations: implications for studies of vaccine performance. Am J Epidemiol. 1994 Jan 1;139(1):77-90.**

Most of the factors associated with the failure of a vaccination to provide protective immunity are not distributed uniformly or randomly within populations. This paper explores the extent to which a nonrandom distribution of vaccination failures and the selection of exceptional situations for investigation may influence estimates of vaccine performance. The authors show that outbreak investigations will tend to underestimate vaccination efficacy, and that the extent of underestimation will be related directly to the size of the epidemic triggering an investigation, the vaccination coverage in the community, and the extent of clustering of vaccination failures in the population; it will be related inversely to the size of and contact intensity within the investigated community. These potential sources of bias are not the only problems that arise in estimating vaccine efficacy, but they should be taken into consideration when analyzing and interpreting outbreak situations. The fact that outbreak investigations carried out within the United States during the past decade have provided estimates of measles vaccination efficacy on the order of 95% is consistent with a somewhat higher overall "true" efficacy of current vaccines and procedures in the total population. It is important to understand better the frequency, distribution, and risk factors for vaccination failures in populations.

## Adverse effects of mumps vaccines

**Atrasheuskaya AV, Neverov AA, Rubin S, Ignatyev GM. Horizontal transmission of the Leningrad-3 live attenuated mumps vaccine virus. Vaccine. 2006 Mar 6;24(10):1530-6. 1: Vaccine. 2006 Mar 6;24(10):1530-6**

Here we describe symptomatic transmission of the Leningrad-3 mumps vaccine virus from healthy vaccinees to previously vaccinated contacts. Throat swab and serum samples were

taken from six symptomatic mumps cases and from 13 family contacts. Assessment of serum IgG and IgM anti-mumps virus antibodies and IgG avidity testing was performed using commercial test kits. Sera neutralizing antibodies were measured by plaque reduction neutralization assay using the L-3 vaccine mumps virus as the target. All six of the symptomatic mumps cases and three contact subjects tested positive for mumps by RT-PCR. The genomic sequences tested (F, SH and HN genes) of all nine of these samples were identical to the L-3 mumps vaccine strain. All 13 contacts were asymptomatic; however clear serological evidence of mumps infection was found in some of them. The likely epidemiological source of the transmitted L-3 mumps virus was children who were recently vaccinated at the schools attended by the six symptomatic mumps patients described here. The L-3 mumps vaccine virus can be shed and transmitted horizontally, even to subjects previously vaccinated with the same virus.

**Kulkarni PS, Phadke MA, Jadhav SS, Kapre SV. No definitive evidence for L-Zagreb mumps strain associated aseptic meningitis: a review with special reference to the da Cunha study. Vaccine. 2005 Nov 16;23(46-47):5286-8.**

The study by da Cunha et al. published in 2002 reported that MMR vaccine containing L-Zagreb mumps strain manufactured by Serum Institute of India Ltd. caused a high incidence of aseptic meningitis (AM) from routine surveillance during two mass immunization campaigns (MIC) conducted in 1998 in two states in Brazil. Since the results were contrary to those in India, Egypt and Bahamas, a critical analysis of the study was done. Several inconsistencies were found in the study, which undermined the conclusions drawn. Two similar studies from Brazil reported similar results. Review of these studies and those done on the vaccine from Zagreb, Croatia showed that in no study the L-Zagreb mumps virus has been isolated from cerebrospinal fluid (CSF) of an AM case. Isolation of the vaccine virus is necessary for definite causal association of AM with the vaccine. There is no such evidence to causally link MMR vaccine containing L-Zagreb mumps strain with AM.

**da Silveira CM, Kmetzsch CI, Mohrdieck R, Sperb AF, Prevots DR. The risk of aseptic meningitis associated with the Leningrad-Zagreb mumps vaccine strain following mass vaccination with measles-mumps-rubella vaccine, Rio Grande do Sul, Brazil, 1997. Int J Epidemiol. 2002 Oct;31(5):978-82**

**BACKGROUND:** Few data are available on the risk of aseptic meningitis following vaccination with the Leningrad-Zagreb (L-Z) strain of mumps vaccine. In 1997 the mumps vaccine was introduced into the state of Rio Grande do Sul in Brazil through mass vaccination with mumps-measles-rubella (MMR), targeting children aged 1-11 years. Five municipalities used exclusively MMR vaccine containing the L-Z strain of mumps. An outbreak of aseptic meningitis was observed shortly after the mass campaign. **METHODS:** To estimate the risk of aseptic meningitis associated with this strain, we analysed vaccination and meningitis case surveillance data from the selected municipalities. A case of vaccine-associated aseptic meningitis was defined as one with a pleocytosis of 10-1,500 leukocytes/ml and occurring within 15-35 days after vaccine receipt. **RESULTS:** We estimated a risk of 2.9 cases per 10,000 doses of L-Z administered, equivalent to 1 case per 3,390 doses administered. The overall risk of aseptic meningitis following the campaign was increased 12.2-fold (95% CI: 6.0-24.7) compared with the same period in 1995-1996. Following the mass campaign, the

incidence of mumps declined 93% during 1998-2000. CONCLUSIONS: Vaccination with the L-Z strain of mumps vaccine as part of a mass campaign was associated with a significantly increased risk of aseptic meningitis. Decisions about type of mumps vaccine and mumps vaccination strategies must consider vaccine safety issues in addition to other criteria.

**Patja A, Davidkin I, Kurki T, Kallio MJ, Valle M, Peltola H. Serious adverse events after measles-mumps-rubella vaccination during a fourteen-year prospective follow-up. *Pediatr Infect Dis J.* 2000 Dec;19(12):1127-34.**

**BACKGROUND:** Several disorders have been attributed to measles-mumps-rubella (MMR) vaccination during the past decade. The aim of this prospective follow-up study was to identify serious adverse events causally related to MMR vaccination. **METHODS:** When the MMR vaccination program was launched in Finland in 1982, a countrywide surveillance system was set up to detect serious adverse events associated with MMR. To obtain detailed case histories vaccinees' clinical charts were reviewed. Serum samples were analyzed to trace concurrent infections. **SETTING:** All hospitals and health centers in Finland from 1982 through 1996. **RESULTS:** Immunization of 1.8 million individuals and consumption of almost 3 million vaccine doses by the end of 1996 gave rise to 173 potentially serious reactions claimed to have been caused by MMR vaccination. In all, 77 neurologic, 73 allergic and 22 miscellaneous reactions and 1 death were reported, febrile seizure being the most common event. However, 45% of these events proved to be probably caused or contributed by some other factor, giving an incidence of serious adverse events with possible or indeterminate causal relation with MMR vaccination of 5.3 per 100,000 vaccinees or 3.2 per 100,000 vaccine doses. **CONCLUSIONS:** Causality between immunization and a subsequent untoward event cannot be estimated solely on the basis of a temporal relation. Comprehensive analysis of the reported adverse reactions established that serious events causally related to MMR vaccine are rare and greatly outweighed by the risks of natural MMR diseases.

**Dourado I, Cunha S, Teixeira MG, Farrington CP, Melo A, Lucena R, Barreto ML. Outbreak of aseptic meningitis associated with mass vaccination with a urabe-containing measles-mumps-rubella vaccine: implications for immunization programs. *Am J Epidemiol.* 2000 Mar 1;151(5):524-30.**

A mass immunization campaign with a Urabe-containing measles-mumps-rubella vaccine was carried out in 1997 in the city of Salvador, northeastern Brazil, with a target population of children aged 1-11 years. There was an outbreak of aseptic meningitis following the mass campaign. Cases of aseptic meningitis were ascertained through data collected from the records of children admitted to the local referral hospital for infectious diseases between March and October of 1997, using previously defined eligibility criteria. Vaccination histories were obtained through home visits or telephone calls. Eighty-seven cases fulfilled the study criteria. Of those, 58 cases were diagnosed after the vaccination campaign. An elevated risk of aseptic meningitis was observed 3 weeks after Brazil's national vaccination day compared with the risk in the prevaccination period (relative risk = 14.3; 95% confidence interval: 7.9, 25.7). This result was confirmed by a case series analysis (relative risk = 30.4; 95% confidence interval: 11.5, 80.8). The estimated risk of aseptic meningitis was 1 in 14,000 doses. This study confirms a link between measles-mumps-rubella vaccination and aseptic

meningitis. The authors discuss the implications of this for the organization and planning of mass immunization campaigns.

**Nokes DJ, Anderson RM. Vaccine safety versus vaccine efficacy in mass immunisation programmes. Lancet. 1991 Nov 23;338(8778):1309-12.**

In community-wide immunisation programmes against childhood infections there is a conflict between the interests of the individual (vaccine safety and efficacy) and the interests of the community (vaccine uptake and level of herd immunity). Studies suggesting that the complication rate is greater with the high efficacy Urabe Am 9 mumps vaccine than with the lower efficacy Jeryl Lynn vaccine, have led to concern about whether the higher efficacy mumps vaccine should be introduced or retained in nationwide mass immunisation programmes. We describe the use of a mathematical model to assess benefits and risks to both individual and community, and illustrate this method by reference to immunisation programmes based on these vaccines. On the basis of current epidemiological data on viral transmission and vaccine coverage in England and Wales, data on vaccine-associated and infection-associated complication rates, and vaccine efficacies estimated from clinical trials, our analyses suggest there is little to choose between the two vaccines, but that overall performance depends on the level of vaccine coverage in a defined population. In community-based programmes, the greater apparent safety of the Jeryl Lynn vaccine (fewer vaccine-induced complications) is offset by the greater apparent efficacy of the Urabe Am 9 vaccine (fewer complications due to natural infection). The findings suggest that it may not always be in the interests of the community to use the vaccine with the lowest complication rate.

## Laboratory methods

**Farrington CP. Estimation of vaccine effectiveness using the screening method. Int J Epidemiol. 1993 Aug;22(4):742-6.**

The screening method provides a simple and rapid way of estimating vaccine effectiveness. The paper discusses the validity of the screening method with particular reference to bias and precision. Methods for correcting confounding, adjusting for covariates and over-dispersion, and deriving confidence limits are discussed in a modelling framework. The methods are illustrated using data on measles and pertussis vaccines.

## Review papers

**Plotkin SA, Wharton M. Mumps vaccine. In: Plotkin SA, Orenstein WA, eds. Vaccines. 4th ed. Philadelphia: Saunders; 2003: 441-69.**

**Galazka AM, Robertson SE, Kraigher A. Mumps and mumps vaccine: a global review. Bull World Health Organ. 1999;77(1):3-14**

Mumps is an acute infectious disease caused by a paramyxovirus. Although the disease is usually mild, up to 10% of patients can develop aseptic meningitis; a less common but more serious complication is encephalitis, which can result in death or disability. Permanent deafness, orchitis, and pancreatitis are other untoward effects of mumps. Based on data reported to WHO up to April 1998, mumps vaccine is routinely used by national immunization programmes in 82 countries/areas: 23 (92%) of 25 developed countries, 19 (86%) of 22 countries with economies in transition (mainly the Newly Independent States of the former Soviet Union), and 40 (24%) of 168 developing countries. Countries that have achieved high coverage have shown a rapid decline in mumps morbidity. Furthermore, in many of these countries, mumps-associated encephalitis and deafness have nearly vanished. This review considers the disease burden due to mumps; summarizes studies on the immunogenicity, efficacy, and safety of different strains of mumps vaccine; and highlights lessons learned about implementing mumps immunization in different countries. Countries already using mumps vaccine should monitor immunization coverage and establish routine mumps surveillance with investigation of outbreaks. Where mumps is targeted for elimination, countries need to add a second dose of mumps vaccine for children, keeping in mind that the disease may still occur in susceptible adults.

PIP: Mumps is an acute infectious disease caused by a paramyxovirus. While the disease is usually mild, up to 10% of patients can develop aseptic meningitis. A less common but more serious complication is encephalitis, which can result in death or disability. Permanent deafness, orchitis, and pancreatitis are other adverse effects of mumps. Based upon data reported to the World Health Organization (WHO) up to April 1998, mumps vaccine is routinely used by national immunization programs in 82 countries/areas: 23 of 25 developed countries, 19 of 22 countries with economies in transition, and 40 of 168 developing countries. Countries which have achieved high vaccine coverage have realized a rapid decline in mumps morbidity. Also in many such countries, mumps-associated encephalitis and deafness have almost vanished. The authors consider the disease burden due to mumps; summarize studies on the immunogenicity, efficacy, and safety of different strains of mumps vaccine; and note lessons learned about implementing mumps immunization in different countries. Countries already using mumps vaccine should monitor immunization coverage and establish routine mumps surveillance with investigation of outbreaks. Where mumps is targeted to be eliminated, countries need to add a second dose of mumps vaccine for children.

**CDC. Measles, mumps and rubella – vaccine use and strategies for elimination of measles, rubella, and congenital rubella syndrome and control of mumps. Recommendations of the Advisory Committee of Immunization Practices (ACIP). MMWR 1998;47 (No.RR-8):1-57.**

## Relevant WHO documents

**Report of the April 2006 meeting of the WHO immunization Strategic Advisory Group of Experts (SAGE) is provided in the WHO Weekly Epidemiological Record No. 21, 2006, pp 209-220 (section on mumps vaccination, pp 214-215).**

**Report of the Nov 2006 meeting of WHO's Global Advisory Committee on Vaccine Safety (GACVS) is provided in the WHO Weekly Epidemiological Record No. 3, 2007, pp. 18-24.**

**WHO-recommended standards for surveillance of selected vaccine-preventable diseases. Geneva, World Health Organization, 2003 (WHO/V&B/03.01; available at <http://who.int/vaccines-documents/DocsPDF06/843.pdf>).**

**Requirements for Mumps vaccine (Live). Geneva, World Health Organization, 1987 (WHO Technical Report Series, No 760, Annex 7). (Available from <http://www.who.int/biologicals/publications/trs/areas/vaccines/mumps/en/index.html>).**