Antivirals & Antiretrovirals

Takahashi and Kanda, J Antivir Antiretrovir 2013, 5:6
http://dx.doi.org/10.4172/jaa.1000080

Research Article Open Access

Japan's Vaccine Service and an Introduction to the History of Cumulative Vaccine Coverage

Kenzo Takahashi[1,2]* and Hideyuki Kanda[1]

[1]Department of Epidemiology and Public Health, School of Medicine, Yokohama City University, Yokohama, Japan
[2]Advanced Research Center, Yokohama City University, Yokohama, Japan

Abstract

During the measles epidemic periods in 1999-2003, a research group elaborated a method of estimating vaccination coverage. The objective of cumulative vaccination coverage (CVC) was to estimate the age of vaccine completion for vaccine targets in an age cohort. From randomly selected children of an age cohort, vaccine records including the date of birth and date of vaccine administration were retrieved, allowing for the calculation of the age of vaccine targets. By acquiring this information, it is possible to derive vaccination trends by age. According to the literature, CVC is now more widely applied and is used for monitoring delays of vaccination due to changes of the vaccine administration schedule and schedule interaction when newly-introduced vaccines are implemented. Although CVC is rather costly because it requires random sampling, we conclude that it is a useful method for estimating herd immunity.

Keywords: Cumulative vaccine; Vaccination coverage

Introduction

Assessing vaccination coverage is an essential part of evaluating a vaccination program. The vaccine coverage calculation is, in a word, simple. The denominator is the target population, which is usually defined as the number of children in one targeted area. The numerator is the number of children vaccinated within a certain time period, usually the fiscal year. The measurement of vaccine coverage is simply the numerator over the denominator. However, routine methods sometimes vary and are not always accurate [1,2]. Thus, the method for determining vaccine coverage should be carefully considered.

Japan experienced a series of measles epidemics from 1999-2003. During the epidemic period, a vaccination monitoring method named "Cumulative Vaccination Coverage" (CVC) was devised.

In this article, we first review Japan's vaccination services and the past measles epidemics of 1999-2003 and then introduce the structure of the CVC calculation method and its wider application to the monitoring of vaccination services. We conclude that it is a useful method for estimating herd immunity.

Vaccine Service in Japan

That Japan's vaccine service falls short in comparison to vaccination trend in other developed countries is well-known. This lag can be attributed to several elements, including vaccine gap [3]. Here, we briefly summarize the recent Japanese vaccination situation as it stands at the time of writing (September, 2013).

Prior to 2006, the measles-containing vaccine (MCV) was administered only once to children aged 12-90 months. This changed in 2006 with the revision of Japan's Preventive Vaccination Act. The present two-dose MCV vaccination service was first implemented in Japan after the revision. At the same time, the measles-rubella (MR) vaccine was made available to children [4]. The Bacille de Calmette et Guérin (BCG) vaccination protocol in regular service was changed from a single dose with a tuberculin test before the age of four years to a single dose before the age of six months without a tuberculin test. The change was made due to a review of vaccine services in 2004 [5,6]. The Haemophilus influenzae B (HiB) and pneumococcus vaccines were introduced in 2007 [7,8]. Oral polio vaccine (OPV) was replaced by inactivated polio vaccine (IPV) in September, 2012 and DPT-IPV vaccine was introduced in November 2012 [9]. At present, two-dose MR vaccination and DPT-IPV vaccination have become mainstream, even though monovalent MCV remains available.

With regard to other vaccines, the Japanese encephalitis vaccine is in regular service and is given at the age of three, while hepatitis B vaccine is not a regular service but is given to selected babies born to mothers who are seropositive for HBs-Ag [10,11].

Japan's 1999-2003 Measles Epidemics

During the measles epidemics of 1999-2003, the number of reported cases in Japan ranged from 5,957 (1999) - 34,734 (2001); the estimated total number of cases for this period was 100,000 - 200,000 [12,13]. These epidemics were attributed to insufficient disease suppression due to low vaccination coverage, which ranged from 75 - 81% nationwide [4]. The epidemics were controlled after a nationwide public awareness campaign in 2001, which promoted vaccination with the first dose of MCV soon after the age of 12 months; at the same time, the measles vaccine was offered free of charge, and the two-dose MR vaccine was introduced [14]. According to the latest news, Japan has come to the stage of measles elimination because indigenous measles D5 has not been detected in Japan since May, 2010 [15].

***Corresponding author:** Kenzo Takahashi, M.D, MHS, Ph.D, Department of Epidemiology and Public Health, Graduate School of Medicine, Yokohama City University, 3-9 Fukuura, Kanazawa-ku, Yokohama 236-0004, Japan, Tel: +81-45-787-2610; Fax: +81-45-787-2609; E-mail: kenzo_gh@yokohama-cu.ac.jp or kt_intl_@ja2.so-net.ne.jp

Received October 05, 2013; **Accepted** November 07, 2013; **Published** November 11, 2013

Citation: Takahashi K, Kanda H (2013) Japan's Vaccine Service and an Introduction to the History of Cumulative Vaccine Coverage. J Antivir Antiretrovir 5: 151-153. doi:10.4172/jaa.1000080

Research Group Recommends CVC

In 1999, a research group tasked with controlling the national measles epidemics was organized with funding from the Ministry of Health, Labour and Welfare. This group was organized with the expectation that it would make recommendations for controlling measles epidemics. It actually made several recommendations, one of which was introducing CVC to monitor national vaccination coverage.

Dr. Hiroshi Sakiyama, one of the members of the research group devised the CVC protocol. Its purpose was to retrieve the age (in months) of the children when they were vaccinated. The principle is as follows:

1) The objective is to grasp the vaccination trends of the children in an age cohort (originally, all children nationwide who had reached their 3rd birthday).

2) Even if exploring nationwide coverage, the minimum required number is about 2,500, which can be randomly selected from government registries in Japan from a total of approximately 1,000,000 total births.

3) Vaccine records for the vaccinated children, which include date of birth and vaccine administration, are retrieved. The age (in months) of vaccine targets can then be calculated.

4) By accumulating the age (in months) of vaccine targets, vaccination trends by age can be derived from the children who are randomly selected from an age cohort.

As Figure 1 shows, vaccination coverage at a certain point of age can be identified in the age cohort. The steeper the curve rises, the greater the number of children who are immunized by an earlier age [16].

Wider Application of CVC to Monitoring

We searched the *Ichushi* database of medical abstracts, which covers almost all medical Japanese medical publications, for the keyword "*Ruiseki Sesshuritsu*" (Japanese: cumulative vaccination coverage) (final search: September 18, 2013), with conference abstracts excluded from the search terms. The search yielded 46 published articles published from 1999 - 2013, all of which were written in Japanese. Five articles discussed the methodology of CVC and 41 were original articles describing studies that made use of the CVC.

The 41 original articles examined the following target vaccines (10 articles covered more than one vaccine): MR (12 articles), BCG (11 articles), MCV (10 articles), OPV (10 articles), Japanese Encephalitis (5 articles), Diphtheria-Pertussis-Tetanus vaccine (5 articles), Rubella vaccine (4 articles). The monitoring of the effects of delays of BCG and MR vaccination due to the change of the vaccine administration schedule was examined by one author [17], while another examined vaccine administration schedule interaction, and delay of vaccination due to the newly introduced Hib and pneumococcus vaccines with respect to DPT and OPV [18].

Strengths and Weaknesses of CVC

When we consider the strengths of CVC, we can conclude that it is useful for estimating the herd immunity of an age cohort. Currently, the World Health Organization (WHO) recommends the "lot quality technique", which can be applied even in developing countries [19,20]. However, as Sakiyama noted, the core objective of lot quality technique is to understand the percentage of people who received a vaccine, not the age at which the vaccine was administered [21]. CVC can monitor the trends in age of vaccine recipients. If we extend the targets to more than one age cohort in the planning stage of the survey, the herd

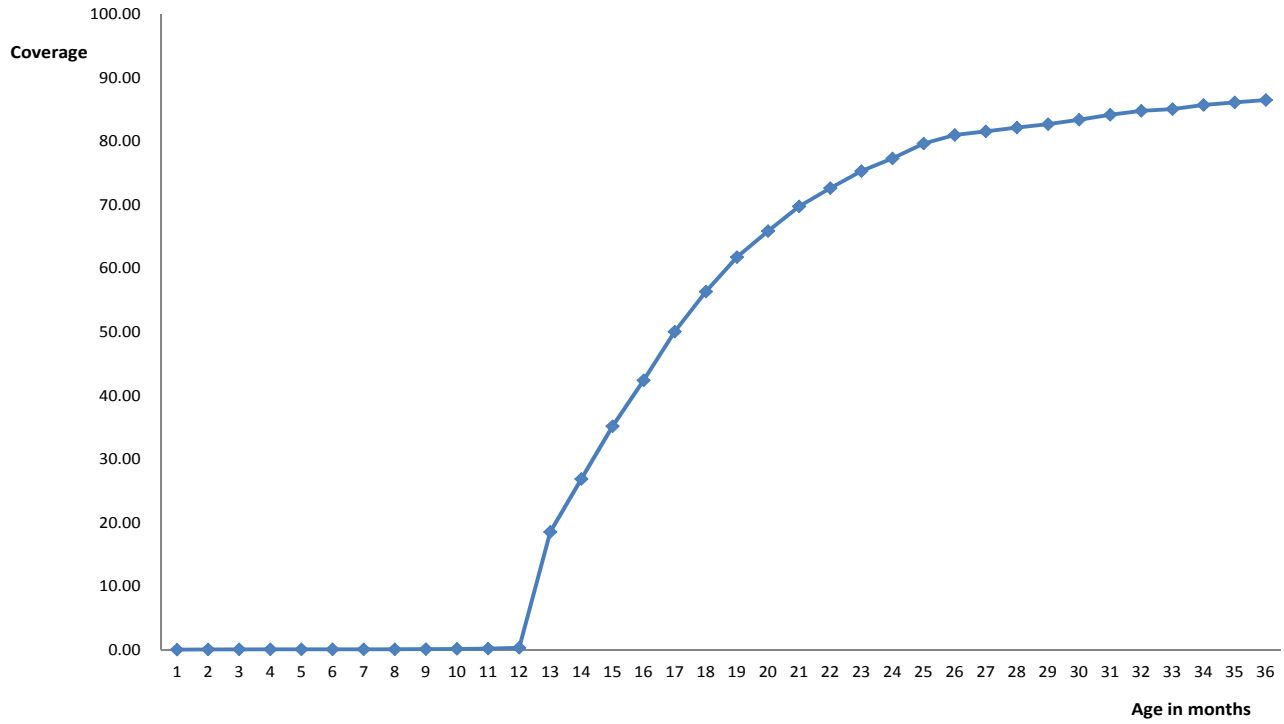

Figure 1: National cumulative vaccination coverage by age (in months).

immunity of a community can also be estimated. Japan used to adopt an original method for calculating vaccine coverage. The numerator of vaccine coverage was the number of children vaccinated. When children are vaccinated, their parent/guardian is given a questionnaire, with questions on the physical health of the vaccine. The number of children vaccinated was taken from the number of questionnaires collected. The denominator was "the number of target age children" plus "the number of children left unvaccinated from previous vaccination sessions". The number, in principle, increases year by year if the targeted children are left unvaccinated [21]. However, it is sometimes hard to follow the number of unvaccinated children, resulting in unreliable vaccine coverage. Since CVC is calculated from random sampling, the above mentioned uncertainties can be avoided. On the other hand, CVC has a weakness in that it can sometimes be costly to retrieve randomly sampled data. A cost analysis of CVC may be the subject of future research.

Conclusion

We have reviewed the contents of CVC from its theoretical background to its application to the monitoring of several vaccine services. Despite the random sampling requirement, the strength of the CVC is that it can monitor the herd immunity among age cohorts.

Authors' contributions

KT wrote the first draft of the manuscript. KT and HK discussed and modified the final draft of the manuscript.

References

1. Guérin N (1998) Assessing immunization coverage: how and why? Vaccine 16 Suppl: S81-83.
2. Murray CJ, Shengelia B, Gupta N, Moussavi S, Tandon A, et al. (2003) Validity of reported vaccination coverage in 45 countries. Lancet 362: 1022-1027.
3. Igarashi T (2008) A vaccination system below the global standard.
4. Takahashi K, Ohkusa Y, Kim JY (2011) The economic disease burden of measles in Japan and a benefit cost analysis of vaccination, a retrospective study. BMC Health Serv Res 11: 254.
5. National Institute of Infectious Diseases (2007) Amendment of the Infectious Diseases Control Law, Japan, as of June 2007. IASR 28: 185-188.
6. Yamamoto S, Yamamoto T (2007) Historical review of BCG vaccine in Japan. Jpn J Infect Dis 60: 331-336.
7. Ihara H, Suga H, Asada K, Togashi T, Hosoya M, et al. (2012) Effect of introduction of Hib vaccines and 7-valent pneumococcal conjugate vaccines (PCV7) on invasive bacterial infections: report of a study group (2008-2011). IASR 33: 71-72.
8. National Institute of Infectious Diseases (2010) Invasive Haemophilus influenzae type b infection and Hib vaccine, Japan. IASR 31: 92-93.
9. Ministry of Health, Labour, and Welfare, Japan (2012) Basic information on polio and polio vaccines.
10. Shiraki K (2000) Perinatal transmission of hepatitis B virus and its prevention. J Gastroenterol Hepatol 15 Suppl: E11-15.
11. Takahashi K, Kobayashi J, Sugiura Y (2012) The relevance of Japan's hepatitis vaccine policy to national Hepatitis B prevention and control. J Public Health Policy 33: 136-138.
12. Japan Pediatric Society, Japanese Society of Child Health, Japan Pediatric Association (2001) A written request for implementation of effective control measures of measles epidemics. Submitted to the Ministry of Health, Labor and Welfare in July, 2001. IASR 22: 285-286.
13. Gomi H, Takahashi H (2004) Why is measles still endemic in Japan? Lancet 364: 328-329.
14. Centers for Disease Control and Prevention (CDC) (2008) Progress toward measles elimination--Japan, 1999-2008. MMWR Morb Mortal Wkly Rep 57: 1049-1052.
15. Yomiuri Shimbun (2013) Measles is eliminated, indigenous type virus has gone.
16. Sakiyama H, Umemoto S, Takayama N (2003) The national cumulative vaccination coverage of measles obtained by nationwide survey. Nihon Iji Shinpo 4150: 26-29.
17. Takayama N, Sakiyama H, Okabe N, Shimizu H, Miyamura T, et al. (2011) Cumulative vaccination coverage of BCG vaccine, diphtheria-pertussis-tetanus trivalent vaccine, oral polio vaccine and measles-rubella bivalent vaccine obtained by the nationwide survey in the year 2009. Shonika Rinsho 64: 963-971.
18. Takayama N, Sakiyama H, Okabe N, Shimizu H, Miyamura T, et al. (2011) Cumulative vaccination coverage of BCG, diphtheria-pertussis-tetanus, oral polio vaccine, and measles-rubella bivalent vaccine obtained by the nationwide survey in the year 2009. Shonika Rinsho 64: 2393-2400.
19. Robertson SE, Anker M, Roisin AJ, Macklai N, Engstrom K, et al. (1997) The lot quality technique: a global review of applications in the assessment of health services and disease surveillance. World Health Stat Q 50: 199-209.
20. Cakir B, Uner S, Temel F, Akin L (2008) Lot quality survey: an appealing method for rapid evaluation of vaccine coverage in developing countries - experience in Turkey. BMC Public Health 8: 240.
21. Sakiyama H (2004) Current trends of vaccination coverage. Shonika Shinryo 67: 2086-2091.

Citation: Takahashi K, Kanda H (2013) Japan's Vaccine Service and an Introduction to the History of Cumulative Vaccine Coverage. J Antivir Antiretrovir 5: 151-153. doi:10.4172/jaa.1000080