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Measles associated with international travel in the region of the Americas, Australia and Europe, 2001–2013: A systematic review

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Summary *Background:* Travel volumes are still increasing resulting in a more interconnected world and fostering the spread of infectious diseases. We aimed to evaluate the relevance of travel-related measles, a highly transmissible and vaccine-preventable disease.
Method: Between 2001 and 2013, surveillance and travel-related measles data were systematically reviewed according to the PRISMA guidelines with extraction of relevant articles from Medline, Embase, GoogleScholar and from public health authorities in the Region of the Americas, Europe and Australia.
Results: From a total of 960 records 44 articles were included and they comprised 2128 imported measles cases between 2001 and 2011. The proportion of imported cases in Europe was low at 1–2%, which reflects the situation in a measles-endemic region. In contrast, imported and import-related measles accounted for up to 100% of all cases in regions with interrupted endemic measles transmission. Eleven air-travel related reports described 132 measles index cases leading to 47 secondary cases. Secondary transmission was significantly more likely to occur if the index case was younger or when there were multiple infectious cases on board. Further spread to health care settings was found. Measles cases associated with cruise ship travel or mass gatherings were sporadically observed.

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Conclusions: Within both, endemic and non-endemic home countries, pretravel health advice should assess MMR immunity routinely to avoid measles spread by nonimmune travelers. To identify measles spread as well as to increase and sustain high vaccination coverages joint efforts of public health specialists, health care practitioners and travel medicine providers are needed.

1. Introduction

Measles is an acute viral infection of the respiratory system easily transmitted among humans, mainly through droplets by coughing or sneezing [1]. Symptoms include fever, cough, coryza, conjunctivitis and are followed by a generalized, specific maculopapillar erythematous skin rash with an incubation period of seven to 21 days following exposure. Hospitalization rates are high and especially among adults complications are relatively common. The virus is shed for several days before the typical rash appears, which increases the risk of silent transmission. Immunization is the best preventive measure [1] but the vaccination coverage varies between the different regions of the world.

Since 2002, the Region of the Americas (North, Central, South America and the Caribbean) has achieved and maintained measles elimination reaching sufficient vaccination coverages. Australia also has interrupted endemic measles transmission and recently, has achieved measles elimination [2,3]. However, in both regions, outbreaks still occur involving imported cases. In contrast, Europe, Africa and parts of Asia still suffer from endemic measles with outbreaks, e.g. between 2006 and 2009, 2011, and recently, in 2013. Therefore, spread of measles remains a relevant risk for non-immune international travelers and their contacts due to its easy spread and the varying regional vaccination coverage rates [4—6]. By the end of 2020, the World Health Organization targets to eliminate measles in at least five WHO regions [1].

Imported measles cases to regions with interrupted measles transmission can have substantial consequences. Therefore, our aim was to assess the relevance of both, travel-associated and imported measles cases to identify shared challenges as well as to evaluate data by mode of transportation and travel characteristics, including mass events.

2. Methods

2.1. Literature extraction

A systematic review was performed according to the structured procedure described by the PRISMA guidelines [7]. To retrieve information, electronic databases (Medline, EMBASE, GoogleScholar) were searched for relevant articles published between 2001 and 2013 without any language restriction, as is shown in Fig. 1. The date of the last search was November, 9th, 2013. Reports might cover a broader time range but only cases that had occurred between 2001 and 2013 were included. Search terms included measles, infection, infect*, surveillance, notification, import*, importation, export*, exportation, travel*, international, abroad, vacation, holidays, student, education, business, expatriate, visiting friends and relatives (vfr), mass gathering, sport, games, festival, meeting, transport, flight, air, airplane, bus, train, ship. The term 'measles' was used separately as well as cross-referencing each other term. An asterix was used for abridged terms. Within articles the reference lists were checked for completeness.

Furthermore, Public Health authorities were searched separately including the World Health Organization, the European Centre for Disease Prevention and Control, the U.S. Centers for Disease Control and Prevention, and the Department of Health, Australia. Where possible, summary reports of surveillance data were selected.

Measles cases were documented through clinical and laboratory definition (IgM antibodies, virus identification through isolation or PCR). Links to secondary cases were included if case ascertainment was performed on an epidemiological basis or combined with genotyping and phylogenetic analyses. The case definition of imported cases varied among notification authorities. Therefore, confirmed imported or import-associated cases were included based on the judgments of the respective authorities. Mass gatherings were defined as a high number of persons at a specific location for a specific purpose for a defined period of time [8]. Exposure to air travel included not only the in-flight environment but also exposure in the airport, e.g. in the check-in area, the departure lounge or at the baggage claim.

2.2. Selection and analysis of references

Articles were included if they reported data about the importation status of measles cases in the Region of the Americas, Europe, and Australia. Duplicates and reports of preventive measures, e.g. measles vaccination, or disease-specific data were excluded. Out of scope of this review were references of measles among Irish-, Gypsy- or Roma-ethnic-traveler communities, adoption-related articles and those targeting refugees. Furthermore, educational or health care settings were not specifically investigated. Mainly full articles and reviews were targeted, but editorials, comments, letters and 'grey' literature were included if a substantial contribution to the topic was found. The title and abstracts of the remaining references were screened by two members of the students' group. For all included articles full-text analysis was performed.