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TECHNICAL BRIEF

Interim IPAC Recommendations and Use of PPE for Care of Individuals with Suspect or Confirmed Measles

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Key Messages

- All health care workers (HCWs) should have documented immunity to measles.[1-19] This consists of two doses of measles-containing vaccine or history of laboratory-confirmed infection or serological evidence of immunity, regardless of year of birth.[20] Only HCWs with presumptive immunity to measles should provide care to patients with suspect/confirmed measles due to increased risk of transmission of measles to susceptible individuals.[21-24]
- Recent scientific literature describes measles transmission and associated outbreaks in hospitals in both susceptible HCWs and in HCWs with presumptive immunity.[4,5,14-17,25-27]
- **All HCWs should wear a fit-tested, seal-checked N95 respirator when entering the room and/or caring for a patient with suspect/confirmed measles,** given reports of transmission of measles to HCWs with presumptive immunity.[6,23,24,28] Patients should also be placed in an airborne infection isolation room (AIIR) whenever possible.[6,23,24,28-30]
- Additional personal protective equipment (PPE) such as gloves, gown and eye protection may be added as required based on a point of care risk assessment (PCRA). For example, Additional Precautions for acute respiratory infection (ARI) (previously known as Droplet and Contact Precautions) are to be used for patients presenting with respiratory symptoms and/or undifferentiated viral symptoms.[29,30]

Background

Measles cases and outbreaks have increased significantly globally over the past several years, becoming endemic again in countries where it had previously been eliminated (e.g., United Kingdom, Albania, Czech Republic and Greece). From 2022 to 2023, the World Health Organization (WHO) reported a 79% increase in global cases and outbreaks in 40 of 53 countries in the European region and ten EU/EEA countries.[31-33] Several factors have been implicated, including decline of measles vaccinations provided during the SARS-CoV-2 pandemic, as well as continued increase in vaccine hesitancy. In Canada, most measles cases are imported and outbreaks have been sporadic with limited secondary transmission.[20]

Recent scientific literature describes measles transmission and associated outbreaks in hospitals in both susceptible HCWs and in HCWs with presumed immunity.[4-6,14-17,25-27]

HCWs are at increased risk for occupationally acquired measles infection, in part due to increased exposure to patients who are ill with measles seeking health care.[6,13,21] Their risk is higher than the general population. Patients who are ill enough to be hospitalized are also generally at the peak of their communicability with high viremia and viral shedding.[18,26]

Between 2001 and 2014, six per cent of measles cases in the United States that were not imported cases, resulted from transmission in healthcare facilities.[34]

Given the transmissibility and potential for HCW exposure, there is consensus that only HCWs with presumptive evidence of immunity against measles should provide direct patient care to patients with suspect or confirmed measles. All HCWs should have documented immunity to measles.[1-6,8,9,11-19,34-36] Presumptive evidence of immunity for HCWs includes at least two doses of measles-containing vaccine received on or after their first birthday or laboratory evidence of immunity, regardless of year of birth.

In addition to the use of Routine Practices (RP), Additional Precautions are recommended for the care of patients with suspect/confirmed measles. Clinical presentations may vary and may evolve over time, thus a PCRA should always be performed before each patient encounter.

- Additional PPE such as gloves, gowns and eye protection may be added as required based on a PCRA. Precautions for respiratory particle protection (e.g. eye protection, facial protection, gown and gloves) are recommended for patients presenting with respiratory symptoms and/or undifferentiated viral symptoms.[29,30]
- Patient movement should be curtailed unless absolutely necessary. Where possible patient investigations/procedures should be conducted in the patient room with the patient wearing a medical mask, if tolerated. Should patient transport be required, use transport routes that minimize contacts and clear all hallways and elevators along the route. The patient should wear a medical mask, if tolerated, and HCWs assisting with transport should be wearing a fit-tested, seal-checked N95 respirator.[29]
- Although there is consensus for most recommended infection prevention and control (IPAC) practices for the management of suspect/confirmed measles, there is conflicting guidance amongst jurisdictions on the use of PPE as a control measure to reduce acquisition of nosocomial measles for HCWs with presumptive evidence of immunity:
    - Public Health Agency of Canada: “Immune HCWs do not require additional precautions (i.e., respirators) to enter the AIIR of an individual with suspected or confirmed measles.”[22]
    - Centers for Disease Control and Prevention (CDC): “HCP should use respiratory protection (i.e., a respirator) that is at least as protective as a fit-tested, NIOSH-certified disposable N95 filtering facepiece respirator, regardless of presumptive evidence of immunity, upon entry to the room or care area of a patient with known or suspected measles.”[23]
    - National Health Service (NHS) England: “Staff should wear ‘respiratory protective equipment (RPE)’ defined as ‘a filtering face piece (FFP)’… when a patient is admitted with a known/suspected infectious agent/disease spread wholly or partly by the airborne route.”[24]

In order to ensure that IPAC recommendations regarding PPE are evidence-based where possible, and to address recent reports of measles acquired by HCWs with presumptive immunity, a literature search was conducted to inform any change in current IPAC recommendations.

Methods

To identify relevant evidence on this topic, PHO Library Services designed and executed searches of scientific and grey literature. The search was limited to articles published in English from 2013 to present. The scientific databases were searched on March 5, 2024. The grey literature searches were run on March 7, 2024.

The following databases were searched to identify evidence published in scientific journals: MEDLINE (Ovid), and CINAHL (EBSCO).

To identify grey literature on this topic, several approaches were used. Targeted searches were run of websites of relevant public organizations, both national and international, such as the Public Health Agency of Canada (PHAC), Centers for Disease Control and Prevention (CDC), and the UK Health Services Authority (UKHSA). Searches were also run using the general search engines Google and Google Scholar.

The database search strategy was designed to retrieve records containing:

- At least one search term (in major topic heading, title keyword, or natural language descriptor fields) related to the concept of Measles; and
- At least one search term (in major topic heading, title keyword, or natural language descriptor fields) related to the concept of N95 Respirators;

The MEDLINE search strategy was adapted to create web search queries to find grey literature. These queries accommodated the limitations on the search engine functionality (e.g., 32 word limit per query), but the conceptual logic of the database search strategy was preserved. Since it is not practical or useful to review all the results retrieved by a search engine query, a limit of 50 results per query (ranked by relevancy) was manually enforced.

The MEDLINE search strategy (exactly as run) is available in Appendix A. The MEDLINE search strategy was peer-reviewed by members of the PHO Library Services team. Full search strategies are available upon request.

Transmission of Measles to Health Care Workers

Reports of transmission of measles to HCWs are summarized below encompassing various measles outbreaks in hospitals throughout Europe, South Korea and the United States that have resulted in measles cases in not only susceptible HCWs but in those with a history of documented immunity.

Choi S, et al. in September 2023 described a measles outbreak in a hospital in South Korea in 2018 where two HCWs with presumptive evidence of measles immunity were infected by a patient with typical measles.[17] One worker had a history of two measles-containing vaccines and the other was presumed immune by age (born 1967).

Pampaka D, et al. in 2023 described a multi-regional outbreak in Spain involving 148 laboratory-confirmed cases of which six were epidemiologically linked.[16] The main route of transmission was nosocomial with at least six healthcare facilities and 41 HCWs affected.

Song K, et al. described in 2022 a measles outbreak in 2019 among previously vaccinated HCWs and patients.[15] Patients had laboratory-confirmed measles with throat swabs tested by quantitative polymerase chain reactions (PCR). Immunization records were obtained and among 26 measles case-

patients (22 HCWs, four inpatients) aged 18-28 years, 25 had previously received measles-mumps-rubella (MMR) vaccine and (12/26) 46% had received two doses.

Berry et al. described in 2019 a case in a hospital in England in 2017 where a late diagnosis in a case resulted in seven further confirmed cases, five of whom had received two doses of MMR vaccine.[15] This report highlighted the importance of not relying on vaccination status to rule out the diagnosis of measles.

Gohil S, et al. described an outbreak in Orange County California occurring in 2014.[6] Among 22 confirmed measles cases, five secondary cases occurred in HCWs, four having had direct contact with measles patients and none wore N95 respirators. Four HCWs had prior evidence of immunity and continued working after developing symptoms, resulting in 1014 exposures, but no transmissions. Overall, 13 of 15 secondary cases had face-to-face contact with measles patients, eight with prior evidence of immunity. Conclusions were that HCWs with unmasked, direct contact with measles patients are at risk for developing disease despite evidence of prior immunity, resulting in potentially large numbers of exposures and necessitating time-intensive investigations. The authors concluded that vaccination may lower infectivity. Regardless of immunity status, HCWs should wear N-95 respirators (or equivalent) when evaluating suspected measles patients.

Hahné S, et al. described a measles outbreak among HCWs in the Netherlands in 2014 published in 2016.[5] Eight HCWs became infected with measles and six of the eight had received two doses of measles vaccine.

López-Perea N, et al. described in the post-elimination phase of measles in Spain, an increasing proportion of measles appearing in individuals with two doses of vaccine.[26] The severity of illness and clinical presentation were milder among the vaccinated. One third of measles in fully vaccinated people was contracted in healthcare settings, mainly in doctors and nurses.

Bianchi FP, et al. conducted a systematic review and meta-analysis in 2022 to estimate the prevalence of susceptible HCWs in EU/EEA countries and in the UK and to explore the characteristics (sex and age differences).[14] Of nineteen studies included, the prevalence of measles-susceptible HCWs was 13.3% (95 %CI: 10.0-17.0%). In a comparison of age (born after vs. before 1980) the RR was 2.78 (95 %CI = 2.20-3.50) indicating those born later were at higher risk. The most recent studies proposed mandatory vaccination of HCWs.

In addition to discussion of measles transmission to HCWs with documented immunity, some authors addressed the lack of respiratory protection, and the role that may have played in transmission of measles to presumed immune HCWs and recommended routine use of a N95 fit-tested, seal-checked respirator.

Hierarchy of Hazard Controls

Hierarchy of Hazard Controls IPAC practices can reduce the risk of infection transmission to patients, HCWs, as well as other staff and visitors, in all settings where health care is delivered. A Hierarchy of Controls (HOC) is used in health care settings (and other workplaces) to reduce the risk of transmission of infectious diseases.[29,37,38]

The hierarchy of hazard controls describes five levels of control, in decreasing order of effectiveness. The greatest reduction in hazard exposures often combines multiple levels. The highest level of control is Elimination, followed by Substitution, Engineering Controls, Administrative Controls and Personal

Protective Equipment. Used in combination, these strengthen the layers of protection of the worker against the hazard.

In applying the hierarchy of controls to protection of HCWs against acquisition of measles, elimination of the disease would be the most effective. Although there have been great strides toward elimination of measles within many countries, including Canada in 1998 achieving the status of having eliminated measles by the World Health Organization, there has been a resurgence of measles particularly in Europe and Africa.

The most common engineering control used in measles control is the placement of patients in an Airborne Infection Isolation Rooms (AIIR) where the air is under negative pressure and door is closed.

Key administrative controls include vaccination against measles. Other administrative controls include employee health policies and procedures regarding immunization and surveillance and IPAC programs with education of employees in the use of a PCRA and transmission-based precautions and training in the correct selection, use and disposal of PPE.

Finally, personal protective equipment is the last barrier between the hazard and the worker. As measles is transmitted through the airborne route, via small respiratory particles, a fit-tested, seal-checked N95 respirator is the recommended PPE for care of suspect/confirmed cases under Airborne Precautions.[6,23,29,30]

Recommendations

- Consistent with the role of administrative controls in the hierarchy of controls, all acute care facilities should, beginning with their highest risk settings (including Emergency Departments), make immediate efforts to ensure that documented immunity to measles is in place for all HCWs and initiate investigation or vaccination for those with incomplete records.
- All HCWs regardless of presumptive immunity to measles should follow all IPAC recommendations for care of patients in Airborne Precautions, including wearing a fit-tested, seal-checked N95 respirator as an additional layer of protection and patient placement in an airborne infection isolation room (AIIR) whenever possible.
- Additional Precautions may also include PPE such as gloves, gown and eye protection based on a PCRA. For example, Additional Precautions for ARIs for respiratory particle protection (e.g. eye protection, facial protection, gown and gloves) are to be used for patients presenting with respiratory symptoms and/or undifferentiated viral symptoms.

Summary

Despite significant global efforts to eliminate measles, there continues to be a resurgence of cases and outbreaks, including sporadic cases and outbreaks with limited secondary transmission in Canada. Health care facilities, including hospitals and primary care offices, where patients often present for diagnosis and/or treatment, increase the potential risk of HCW exposure to the disease. Although vaccination with two doses of measles-containing vaccine or positive serology suggests immunity, this presumptive immunity may not prevent HCWs from acquiring measles in the occupational setting. Following the hierarchy of controls and adding respiratory protection (fit-tested, seal-checked N95 respirator) to all workers regardless of immune status, while providing care to cases of suspect/confirmed measles offers an additional layer of protection.

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Appendix A

Table 1: Ovid MEDLINE(R) ALL <1946 to March 06, 2024>

#	Searches
1	Measles/ or Measles Virus/ or (measles or (edmonston adj3 virus*) or rubeola).mp.
2	N95 Respirators/ or (N95 or "N-95" or N95s or "N-95s" or KN95 or "KN-95" or KN95s or "KN-95s").mp.
3	1 and 2
4	Measles/ or Measles Virus/ or (measles or (edmonston adj3 virus*) or rubeola).kf,kw,ti.
5	Masks/ or Respiratory Protective Devices/ or Personal Protective Equipment/ or ((facemask* or mask* or ((face or faces or facial or eyes or mouth or mouths or nose or noses) adj3 (protect* or PPE or cover* or mask* or respirator*)) or "respiratory protect*" or respirator* or "personal protective equipment" or ((protective or protection) adj3 (device* or equipment)) or PPE).kf,kw,ti. not medline.st.)
6	4 and 5
7	3 or 6
8	limit 7 to yr="2013 -Current"
9	limit 8 to English

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