

## EVIDENCE BRIEF

# Strategies to Facilitate Catch-up on Routine Childhood Immunizations

Published: October, 2022

## Key Messages

- The COVID-19 pandemic has disrupted routine immunizations for school-aged children (aged 4–18), and catch-up efforts are required to address gaps in immunization coverage across Ontario.
- Multi-faceted strategies and programs (i.e., incorporating several tools and interventions) are most frequently used and are generally more effective compared to single intervention catch-up strategies. The use of multiple interventions and strategies can reduce inequities and improve access to catch-up immunizations, especially for marginalized populations.
- Additional interventions demonstrating effectiveness included catch-up immunization clinics in multiple settings (i.e., schools; community-based locations such as community clinics, malls, churches, community centres; and primary care settings), reminder/recall systems to alert parents/guardians of routine and missed immunizations, and co-administration of multiple immunizations when possible.
- It is challenging to isolate the impact of any individual catch-up strategy or intervention due to the presence of multiple components in nearly any program or clinic described in the included records. In addition, there are complex and difficult-to-measure factors that should be considered, including social context, beliefs and attitudes related to immunizations, and equity issues that may create barriers for marginalized populations.

## Issue and Research Question

The purpose of this Evidence Brief is to provide an overview of the literature on strategies and interventions that may facilitate childhood immunization catch-up. The aim is to bring forward any evidence that demonstrates impact of strategies or interventions that may assist health care and public health providers in developing childhood catch-up immunization programs and selecting interventions. The term ‘catch-up immunization’ in this Evidence Brief refers to immunizing anyone under 18 years of age who, for any reason, has not received all doses of routine childhood immunizations for which they are eligible per the routine schedule.<sup>1</sup>

In Ontario, school-aged children (ages 4–18) access routine immunizations through primary care settings (measles, mumps, rubella [MMR] and tetanus, diphtheria, pertussis, polio [Tdap-IPV] at age 4) and school-based programs (hepatitis B [HBV], human papillomavirus virus [HPV], quadrivalent meningococcal [MCV4] in grade 7).<sup>2-4</sup> During the COVID-19 pandemic many health care providers (HCP), primary care providers (PCP), and public health units (PHUs) across Ontario needed to pivot resources towards efforts to reduce the spread and impact of COVID-19, resulting in significant disruptions in

routine immunizations.<sup>5</sup> PCPs in Ontario reported negative impacts of the pandemic on their practices, ranging from temporary closures of their practice to postponement of immunizations in certain age groups.<sup>6</sup> School-based immunization programs were impacted by the diversion of human resources as well as prolonged school closures.<sup>7</sup> These disruptions are reflected in childhood immunization coverage estimates for the years of the pandemic being substantially lower than during the years preceding the pandemic.<sup>7,8</sup>

Gaps in routine immunization coverage may increase the proportion of individuals who are susceptible to infection and illness from vaccine preventable diseases.<sup>9,10</sup> This increases the risk for community outbreaks, avoidable medical visits and hospitalizations, causing additional pressure on the health care system.<sup>9</sup> Although the impact of missed and delayed immunizations for children and youth during the pandemic currently remains unclear in Ontario, experts and stakeholders have recommended catch-up strategies to minimize gaps in immunization coverage.<sup>5</sup>

## Methods

The methods for this Evidence Brief included searches of grey literature and indexed literature guided and conducted by Public Health Ontario (PHO) Library Services. Custom Google search engines for Canadian, United States (US) and international public health websites were searched on June 24 to July 4, 2022 with search strings developed by a PHO library information specialist. PHO Library Services conducted database searches in Medline, Embase, supplementary databases (Ovid Global Health, PsycINFO, EBSCOhost CINAHL, Child Development & Adolescent Studies, and SocINDEX) and National Institutes of Health (NIH) COVID-19 Portfolio on June 30 to July 14, 2022. Resources provided by subject matter experts were also considered for inclusion.

English language resources published in the last 10 years that described strategies for health care and public health providers to facilitate catch-up of routine immunizations for school-aged children (i.e., 4–18 years of age) were included in this product. Only records relevant to high income countries were included. Critical appraisal of included studies and records was out-of-scope for this Evidence Brief.

## Main Findings

### Search Results

A total of 2,242 records were obtained from indexed literature database searches. After screening for eligibility, 23 indexed literature studies were included in this Evidence Brief. Custom Google search engines for Canadian, US and international public health websites returned 45 eligible grey literature records. A total of 33 included records were published prior to 2020 (i.e., pre-COVID-19 pandemic), and 45 records were published in 2020 onwards. Grey literature sources were identified from the following jurisdictions: Australia, Canada, United Kingdom (UK), US, and several sources from the World Health Organization (WHO).

All included evidence that demonstrated effectiveness or evaluation results are presented in this document's Results section. Many of the resources captured in our screening provided information on strategies or approaches for catch-up immunizations in children, but did not describe evaluation or effectiveness of these strategies. Due to their lack of evaluation, these resources are listed in the Additional Resources section at the end of the document. However, select guidance documents from WHO, CDC and the Ontario-based expert and stakeholder's roundtable were included in the main results as these documents provided comprehensive community-based guidance developed by experts.

## Interventions to Facilitate Catch-up Immunizations

### MULTI-FACETED INTERVENTIONS

There is strong evidence for the use of multiple interventions in combination for the purpose of increasing childhood immunization rates in general (i.e., outside of catch-up).<sup>11-13</sup> According to a behavioural and social drivers framework by WHO, strategies to increase vaccination should aim to reduce behavioural immunization barriers related to thinking and feeling (perceived disease risk), social processes, motivation, and practical issues.<sup>11</sup> The general approach of implementing multi-faceted approaches has been recommended by WHO to conduct catch-up immunizations.<sup>1,14-16</sup> Engaging various stakeholders and using multiple settings to deliver catch-up immunizations is further highlighted by Ontario experts and stakeholders in a recent report on maintaining immunizations for school-aged children during the COVID-19 pandemic.<sup>5</sup>

Most records identified for this Evidence Brief described childhood catch-up immunization strategies that, in practice, involved multiple components to increase vaccination rates (e.g., reminders with education; chart review, communication campaign and provider evaluations). Some key examples are described here, and the remaining publications which featured results of more specific catch-up interventions are described in the applicable sections below. There are several examples of multi-faceted approaches being used by various jurisdictions in the context of the COVID-19 pandemic but impact was not described, these can be found in the Additional Resources section.

In 2019, the Province of British Columbia (BC) used school mail reminders in conjunction with holding public and community immunization clinics, school-based immunization clinics, and reviews of immunization records to increase childhood catch-up immunizations for measles in children ages 5–19.<sup>17</sup> At the end of the three-month program, 10,154 more children added their vaccine history to the BC immunization registry and 37,525 more children in the registry were fully immunized against measles.

In 2018, a quality improvement initiative at a Cincinnati Children’s Hospital Medical Center primary care centre provided both educational seminars for clinicians and increased the frequency of reminders to parents regarding 3-dose completion of HPV.<sup>18</sup> Following these changes, there was an observed increase in HPV completion rates from 50.9% to 61.7% ( $P < 0.05$ ).

The effectiveness of multiple interventions for catch-up immunizations was illustrated in a study by Choi et al. (2018).<sup>19</sup> The City of Chicago implemented five interventions to improve HPV vaccination completion rates among eligible adolescents from 2013–2015.<sup>19</sup> The interventions included: (1) developing a jurisdiction-wide collaborative initiative with stakeholders; (2) implementing education and skill-building strategies targeting immunization providers; (3) using immunization information system-based reminder/recall; (4) conducting a comprehensive communication campaign targeting the public; and (5) using a federal quality improvement program to evaluate and improve immunization providers' performance in HPV vaccine series administration. Following this program, there was an observed increase in HPV immunization coverage: rates significantly increased to 78.1% for  $\geq 1$  dose and 52.6% for  $\geq 3$  doses (compared to 57.6% and 36.5% in 2013, respectively,  $P < 0.05$  for both).

From 2012–2015, the American Academy of Family Physicians developed and implemented a multi-intervention and multi-stage project to educate staff in 20 primary care practices about evidence-based interventions to increase immunization rates in adolescents and reduce missed immunization opportunities for eligible adolescents.<sup>20</sup> Strategies used through the project included: educational interventions for providers (practice manuals, online learning community, quarterly conferences); reminder/promotional materials (laminated vaccine schedules, posters); improvements to providing strong recommendations, using immunization registries and electronic health records (e.g., creating alerts); addressing vaccine hesitancy; and educational interventions targeting parents/guardians

(conversations with parents toolkits, patient education from the Centers for Disease Control and Prevention [CDC]). The following results show the increase in vaccination after implementation of the sustainability phase (MCV: 30% increase; Tdap-IPV: 10% increase; HVP Females 3 doses: 62% increase; HPV Males 3 doses: 208% increase).

## REMINDER/RECALL INTERVENTIONS

Reminder/recall systems are recommended by WHO in their guidance for planning and implementing catch-up immunizations,<sup>15</sup> and there is strong evidence to support this practice to facilitate immunizations in general (outside of catch-up).<sup>21</sup> We identified ten records that primarily examined the impact of reminder/recall interventions from health systems/providers directed at parents/guardians to prompt participation in catch-up immunizations for children.<sup>17,22-30</sup> Overall, reminder/recall systems have been associated with improvements in catch-up immunization rates. Several examples of studies examining reminder/recall interventions are described below.

In a descriptive study by Mancarella et al. (2022), reminder letters were a key component of a four day vaccination campaign for children aged 6–8 years in Milan, Italy.<sup>24</sup> This campaign aimed to catch-up on routine immunizations that were missed due to the COVID-19 pandemic. A total of 3,943 letters were sent to families of children who were missing routine immunizations. Of those, 1,315 children (33%) were vaccinated during the catch-up campaign.

In a randomized controlled trial conducted in New York City by Wynn et al. (2021), reminder strategies directed at parents/guardians of adolescents who were eligible but had not completed the HPV vaccine series were compared.<sup>30</sup> The study compared the use of conventional reminder texts to precision reminder texts that contained stage-targeted educational information, next dose due date, and site-specific walk-in hours. Historical controls were used as baseline comparators. The authors found similarly high HPV completion rates in the conventional (75.7%) and precision (72.4%) text reminder groups, and both reminder groups had significantly higher completion rates compared to historical control groups (45.17% and 47.1%, respectively,  $P < 0.001$ ). Completion rates in the two reminder groups did not differ significantly from each other.

Matheson et al. (2014) conducted a quality improvement study that used text reminder interventions to increase HPV vaccination rates at an urban pediatric clinic in North Carolina, US.<sup>25</sup> Authors found significant differences between the text message group (14%) and the interested group (i.e., those who expressed initial interest but did not complete the opt-in process; 0%), and the standard care group (3%) for the outcome of HPV vaccine series completion ( $P < 0.05$ ).

Stockwell et al. (2012) examined the use of mailed reminders and text messages in an urban, low income population in New York City.<sup>17</sup> In the first study comparing text message reminders to no reminders, significantly more adolescents who were overdue for MCV4 and Tdap doses were immunized in the reminder compared to the non-reminder group at all follow up periods: 4 weeks (reminder: 15.4%; control: 4.2%;  $P < 0.001$ ), 12 weeks (26.7%; 13.9%;  $P < 0.005$ ), and 24 weeks (36.4%; 18.1%;  $P < 0.001$ ). In the second study comparing texts and mail, versus mail reminders only, the authors found significantly more parents attended a recall session for overdue pediatric and adolescent vaccines when they received a mailed reminder and up to three text messages (21.8%) compared to those who received only a mailed reminder (9.2%;  $P < 0.05$ ).

A 2012 randomized controlled trial examined reminders for parents of adolescents aged 11–19 years who were missing at least one routine immunization and were part of four private pediatric practices in Denver, Colorado.<sup>28</sup> The intervention of two letters and two telephone calls was examined against the control group (no reminders). Authors found adolescents in the letter and phone call reminder group,

compared to the control group, had significantly higher rates of receiving at least one targeted vaccine (47.1% versus 34.6%,  $P < 0.0001$ ), and all targeted vaccines (36.2% versus 25.2%,  $P < 0.0001$ ).

While reminder/recall systems in the studies above demonstrated impact on immunization rates, other studies have suggested that their isolated use may only have a slight effect, again highlighting the value of multi-faceted approaches.<sup>23,29</sup> For example, a 2022 study compared Colorado State and New York State HPV vaccination rates.<sup>29</sup> The strategy used an auto-dial centralized reminder and recall from state immunization information systems to remind patients from randomly selected practices to complete their adolescents' HPV vaccination series. The study identified little change in rates in New York: initiation rates ranged from 37%–37.4% and completion rates between 29.1%–30.1% with no difference between the reminder and control groups. In Colorado, HPV vaccine initiation rates ranged from 31.2%–33.5% and were slightly higher for one reminder compared to none, but vaccine completion rates were not significantly different between reminder and control groups.<sup>29</sup>

## SCHOOL-BASED INTERVENTIONS

School-based interventions are suggested in Canada to combat many of the challenges that come with vaccine uptake, including accessibility, equity, feasibility, reach, and convenience.<sup>11</sup> Currently used by some regions in Ontario,<sup>31</sup> schools may facilitate routine immunizations by acting as a liaison between parents/guardians and public health programs by providing a location for immunizations.<sup>32</sup> Several studies have shown the success of school-based approaches to enhance catch-up immunizations.<sup>33-39</sup>

A 2020 study assessed whether MMR catch-up coverage differed if provided in school-based settings or in general practice, utilizing Child Health Information Service Records in the UK.<sup>33</sup> The findings show an increase in coverage for one dose of MMR by 1.6% in the catch-up group that received doses in school-based settings compared to the general practice setting (0.2%). In an analysis by ethnicity, authors also found evidence to suggest catch-up immunizations provided by nurses in schools is more effective for Black, Asian and minority ethnic students when compared to general practice. A similar finding was reported for the analysis by deprivation, further supporting the practice of in-school catch-up immunizations to reach children from lower income areas.

A 2019 study examined school-based interventions versus primary care interventions in Italy for HPV completion, meningococcal B, and meningococcal C.<sup>36</sup> This study found school-based interventions to be associated with greater immunization rates in students at 8 months follow up. HPV completion rates were 30.5% for those in the school-based intervention group and 13.8% for the primary care intervention group ( $P = 0.003$ ); meningococcal C immunization rates were 6.0% and 2.0%, respectively ( $P = 0.005$ ); and meningococcal B immunization rates were 14.7% and 0.3%, respectively ( $P < 0.001$ ).

A 2013 study examined Scotland's HPV vaccine catch-up campaign that ran from 2008 to 2010.<sup>37</sup> The study compared girls who were in school and had access to the school catch-up campaign, to those who were no longer in school but of the same age. Uptake of all 3 vaccine doses for girls in the catch-up cohort accessing vaccination through school was 87%, compared to 32% among girls who had left school and could access vaccination via primary care or community clinics.

A 2016 study of a Swedish school-based HPV vaccination catch-up program compared all Swedish counties and their interventions.<sup>38</sup> The counties used varying and multiple interventions. All counties offered vaccination to the catch-up group through primary health care settings, 34% additionally offered the vaccine in some of their schools, 19% in all of their schools, and 10% in other health care centres. This analysis found differences to be significant, with counties not offering catch-up in any schools as the reference, the incidence rate ratio (IRR) of vaccine uptake in counties offering catch-up immunizations in all schools was 1.3 (95% CI: 1.1, 1.5) and in counties offering catch-up immunizations in some schools was 1.2 (95% CI: 1.1, 1.3).

A 2012 study examined the catch-up of the teenage booster of tetanus/diphtheria/polio vaccine, utilized a cross-sectional survey to compare the strategies used to deliver the vaccine across the seven Health Boards in Wales.<sup>39</sup> Authors noted a greater consistency of vaccine uptake rates when delivered in schools (76-81%) over the uptake rate of vaccine catch-up in general practice (5-74%).

The above studies show how school-based interventions can facilitate catch-up immunizations, but a 2016 study notes that there are barriers related to school-based immunization programs that should be addressed.<sup>35</sup> Authors identify lead time, consent processes, interagency collaboration, and access to the targeted cohort, as barriers to school-based programs but suggest that proper resources and lead time can reduce these barriers. Additionally, a Canadian 2019 study suggested that vaccination uptake rates in schools could be impacted by other external influences, such as “interrelated factors at the individual and interpersonal level (e.g. knowledge and attitudes of the different players involved in the vaccination system), at the community level (e.g. social group values and norms, media coverage around the HPV vaccine), at the organizational level (e.g. allocated resources, information provision, consent process, immunization setting and environment) and at the policy level (e.g. changes in provincial HPV vaccine program)”.<sup>40</sup>

## COMMUNITY-BASED INTERVENTIONS

Community-based interventions that engage local, trusted, leaders in order to reduce barriers for catch-up immunization have been recommended by WHO<sup>14</sup> and in a recent Ontario-based expert and stakeholder roundtable report regarding immunizations for school-aged children during the COVID-19 pandemic.<sup>5</sup> The use of community-based interventions includes partnerships with community organizations, local government, and vaccination providers to increase community demand for immunizations (through education, reminders, immunization records) and increase community access to services.<sup>12,41</sup> Across Ontario, nine PHUs were identified as offering catch-up immunizations in community settings.<sup>31,42-47</sup> A similar approach was used in BC to ensure children are vaccinated before the beginning of the 2022 school year.<sup>48</sup> Three studies below included evaluated outcomes.

A 2016 study conducted by Health Improvement for Milwaukee Children (CHIMC) used community-based participatory research to improve immunization rates by engaging community members to develop community-specific strategies.<sup>49</sup> Community members developed education and social marketing interventions that were targeted to their own community. The authors noted “Ultimately, children between the ages of 19 and 35 months whose parents/caregivers completed education sessions and benefitted from a community-wide social marketing message increased their immunization status from 45% baseline to 82% over 4 years.”

A 2015 qualitative Australian study examined a Pacific island community that used churches for locations of catch-up clinics, aiming to improve vaccine access for parents and reduce the barrier of parental time needed to get their children vaccinated.<sup>50</sup> The researchers interviewed 12 community participants and seven health professionals to determine barriers for immunization and the effectiveness of churches as a location.

A 2015 study conducted in New York City examined the effectiveness of using a non-clinical, trusted community setting for Mexican parents of HPV vaccine-eligible children to improve observed low immunization rates in this demographic.<sup>51</sup> The interventions included HPV education at a trusted community setting, and a series of text message vaccine reminders. The results showed similar high rates of children receiving first HPV vaccine doses when comparing the education plus text reminder group (98%) to the education only group (87%; P = 0.11), but greater completion of three doses in the education plus text group (88%) versus the education only group (40%; P = 0.004).

## PRIMARY CARE INTERVENTIONS

PCPs can lead and support catch-up immunization programs through various interventions. These include chart reviews of patients' vaccination status, patient follow-up for booking vaccination appointments and creating sustainable practices for ensuring routine vaccinations are provided.<sup>20,52-54</sup> In the US, the CDC (2022), the Washington State Department of Health (2021), and the American Academy of Family Physicians (2015) have incorporated PCPs into their vaccination catch-up strategies.<sup>20,52,53</sup> To support physicians to facilitate catch-up, the CDC (2022) developed a childhood vaccination toolkit for clinicians in response to the disruption to routine childhood vaccines caused by the COVID-19 pandemic.<sup>55</sup>

One study reported on outcomes of interventions implemented in a primary care setting. This 2019 study used quality improvement principles to educate providers in a pilot project with five pediatric practices.<sup>56</sup> Authors note that after six months of the pilot project "mean HPV vaccine completion rates increased (45% to 65%) and missed opportunities for HPV vaccination decreased (45% to 19%) in the pilot program. When the program was replicated in phase 2, an increase was seen in both HPV vaccine initiation (46% to 61%) and completion (62% to 94%) rates."

## CO-ADMINISTRATION STRATEGIES

The WHO suggests co-administration of multiple vaccines to facilitate catch-up.<sup>14</sup> Considerations related to this practice include assessing for contraindications, following recommendations for intervals between immunizations based on manufacturers' instructions, assessing for appropriate interchangeability of vaccines (e.g., combination versus monovalent immunizations), as well as national or regional requirements or recommendations (e.g., Canadian Immunization Guide).<sup>14,57</sup> In addition, our search identified five resources that discussed co-administration, or the administration of multiple vaccines at once.<sup>57-61</sup> The Public Health Agency of Canada (PHAC) updated the Canadian Immunization Guide in June of 2022 with guidance from the National Advisory Committee on Immunization (NACI) which states that children over age five can be given the COVID-19 vaccine at the same appointment as routine childhood vaccines,<sup>57</sup> in alignment with the Government of Australia and the CDC in the US.<sup>59,60</sup>

Paranthaman et al. (2012) examined an opportunistic immunization strategy in the UK.<sup>61</sup> Providers offered the MMR vaccine to incompletely immunized adolescents at the same time as their routine Tdap-IPV booster administration in secondary schools. The study found that providing this opportunistic immunization helped increase overall uptake of two doses of the MMR vaccine from 86.3% to 90.6% (significance not reported).<sup>61</sup>

Our search identified jurisdictions in BC that used COVID-19 clinics as an opportunity to administer other routine vaccinations. Fraser Health in BC used some of their COVID-19 clinics to offer childhood immunizations in addition to COVID-19 vaccines to help children and youth get up-to-date on routine immunizations.<sup>58</sup> We did not identify any records that reported on the impact or evaluation of using COVID-19 clinics for routine immunizations.

## PROVIDER EDUCATION AND COMMUNICATION INTERVENTIONS

We did not identify any records demonstrating impact of provider education or communication interventions. We identified several resources from government, public health, and other jurisdictional sources that provided suggestions or examples of education or communication tools related to catch-up immunizations, these can be found in the Additional Resources below.

## Discussion

Routine childhood immunizations are an important part of ensuring population health, and immunization programs have been negatively impacted by the COVID-19 pandemic.<sup>5-8</sup> Catch-up strategies are recommended to reduce the gap in routine childhood immunization rates as a result of the COVID-19 pandemic.<sup>5</sup> NACI highlights the importance of catch-up strategies, as there is evidence that those who miss routine immunizations may not catch-up later, and those seeking catch-up immunizations could have long wait-times and availability challenges.<sup>10</sup>

Multi-faceted strategies were often reported in the available evidence and are associated with positive results for their effectiveness of increasing immunization rates. Studies evaluating reminders and recalls demonstrated positive effects to facilitate catch-up immunizations, and there is some evidence to suggest informing parents/guardians using different formats (i.e., texts, phone calls, and letters) and multiple reminders may enhance this strategy. School-based, community-based and primary care interventions can all contribute to catch-up immunization efforts. Each setting may be uniquely positioned to best reach different segments of the population eligible for catch-up, and each may involve different operational considerations (e.g., primary care offices may have electronic medical records and existing infrastructure to schedule alerts/reminders). However, the availability of catch-up immunizations in multiple settings is ideal to reach the greatest number of children in need of catch-up immunizations. Co-administration of catch-up immunizations with other immunizations (e.g., COVID-19) can also positively affect immunization catch-up as it reduces accessibility and time barriers for parents/guardians and their children.

Ensuring equitable access to immunizations in catch-up programs should be incorporated when planning catch-up immunization programs. A Canadian commentary by MacDonald et al., (2020) described three components essential to effective immunization catch-up in the COVID-19 context: 1) integrating equitable approaches to identify who has been missed; 2) developing tailored, multipronged strategies to address these gaps; and 3) communicating, documenting, evaluating, and readjusting immunization programs to the evolving reality of the COVID-19 pandemic.<sup>62</sup> An Italian study on catch-up immunizations required due to COVID-19 delays noted the importance of developing effective catch-up strategies that increase accessibility to vaccines and bring the vaccines directly to those who need them.<sup>24</sup> The catch-up program described in this study aimed to increase accessibility by planning immunization sites at schools, mobile clinics and organizing mass immunization events. In a systematic review exploring interventions to improve overall access and coverage of adolescent vaccines, Das et al. (2016) state that understanding the target population and their views on immunization is critical, and must be taken into consideration when developing catch-up strategies.<sup>63</sup>

Muhoza et al. (2020) described the need for not only catch-up immunization strategies, but to support broader changes that can be made to establish a stronger catch-up framework within routine immunization programs to improve vaccination rates long-term.<sup>64</sup> While catch-up strategies might focus on immediate activities (e.g., targeted communication to those who have missed doses or facilitating mass vaccination activities), developing a robust catch-up framework could also strengthen program resilience to withstand any other large-scale disruptions in the future. This is echoed by Skolnik et al. (2021) and Larson et al. (2022) who emphasize the need for both short-term and long-term strategies (e.g., enhancing immunization information systems, mitigating financial barriers to vaccination, investing in building vaccine confidence, and ensuring sustainable funding for immunization infrastructure) to address immunization coverage gaps that emerged as a consequence of the COVID-19 pandemic.<sup>65,66</sup>

In addition, the pandemic impacted routine childhood immunizations due to severe interruptions to in-person learning, in-person primary care appointments and a shift in priorities for public health

resources.<sup>5-7</sup> While lack of access during the pandemic is a key reason for missed immunizations, other factors either present before or emerged during the pandemic, such as lack of trust and vaccine hesitancy, may act as additional barriers to catch-up immunizations. Additional evidence focused on immunization uptake or vaccine hesitancy could be consulted for more guidance but this was out of scope for this Evidence Brief.

There were several publications and resources that did not specifically examine catch-up immunization and were therefore not included in the main results of this Evidence Brief. However, principles and strategies related to immunization uptake in general may be reasonably applied to the catch-up context.<sup>11,67,68</sup> For example, the Ontario COVID-19 Science Table (2021) developed a Science Brief on behavioural science-informed strategies to increase COVID-19 vaccines uptake in children and youth.<sup>11</sup> This science brief did not directly examine routine childhood immunizations; however, most results could be considered applicable to catch-up immunization, and several align with the findings of this Evidence Brief. Strategies reported by the Science Table included: school-based immunization programs as a high-impact effective approach that can address many practical issues (e.g., access, convenience, accessibility and equity); HCP recommendations; reminder/recall systems; school and community health communication campaigns that are delivered by authoritative sources and include parents; efforts to address misinformation, reduce risk perception, promote positive attitudes towards vaccines, and stimulate action. Finally, four principles are presented to support COVID-19 vaccination in children: build and leverage trust; avoid one-size-fits-all approaches; ensure special considerations for reaching at-risk populations; and ensure special considerations for reaching black, indigenous and all racialized communities.

A comprehensive resource on immunization interventions is the evidence-based Community Guide developed by the by the Community Preventative Services Task Force in the US.<sup>68</sup> This guide provides recommendations and states the strength of evidence supporting each recommendation based on systematic reviews. A number of recommendations related to immunization in the Community Guide are reflected in the findings of this Evidence Brief, and there are many recommendations that expand further. To improve vaccination rates, based on strong evidence, the Community Guide recommends: using a combination of health care system-based interventions;<sup>69</sup> using a combination of community-based interventions;<sup>12</sup> client reminder and recall interventions;<sup>21</sup> provider assessment and feedback;<sup>70</sup> provider reminders;<sup>71</sup> standing orders;<sup>72</sup> immunization information systems;<sup>73</sup> school and organized child care center-located programs;<sup>74</sup> immunization requirements for school and child care attendance;<sup>75</sup> home visits to increase immunization rates in children and adults;<sup>76</sup> and reducing out of pocket costs for immunizations.<sup>77</sup> In contrast, there is insufficient evidence for: provider education alone;<sup>78</sup> community-wide education alone,<sup>79</sup> and clinic-based client education alone.<sup>80</sup>

A recent National Institute for Health and Care Excellence (NICE) guideline (2022) outlined interventions to increase the uptake of routine immunizations in the general population by improving access.<sup>67</sup> Interventions included: reducing distance/time to access vaccinations; having clinics in community settings; having dedicated clinics for specific/all vaccinations (e.g., mass clinics, walk-in or open access clinics); extending clinic hours (e.g., weekends, early mornings and late evenings); enhancing outreach interventions or mobile services; offering vaccination in parallel with other regular appointments; and providing opportunistic vaccinations (e.g., having vaccinations provided in hospitals or emergency departments).

## Additional Resources

Provided below are the additional resources identified in our search of the grey literature related to catch-up on routine childhood immunizations relevant to each of the intervention approaches described above. These include government or public health agency resources, and records that do not provide evaluated outcomes, but may be of interest as suggestions or examples of strategies that have been operationalized in various jurisdictions.

### Multi-Faceted Interventions

- City of Toronto (2022). [School immunization program & catch-up clinics](#).<sup>31</sup> Example of a region that has implemented over 50 mobile clinics that have been deployed in various settings such as schools, malls and community centres.
- National Association of County and City Health Officials (2020). [Innovative ways to maintain immunization coverage during a pandemic](#).<sup>81</sup> A US-based resource, suggestions include: using online systems to organize appointments and verify immunization history; using social media to promote immunization; using reminder calls; holding mass vaccination clinics at schools and libraries; introducing innovative strategies such as drive-through vaccines clinics; and advocating for public support from elected officials regarding the importance of continuing routine immunizations.

### School-based interventions

- Renfrew County and District Health Unit (2022). [Immunization](#).<sup>82</sup> Example of Ontario region implementing school-based immunizations.
- Texas Health and Human Services (2022). [Texas School Nurse Webinar](#).<sup>83</sup> This resource provided guidance and strategies for planning and hosting school-located vaccination sites, including: reminders and follow-up communication with families, direct support for families to set up appointments, reassurance regarding the safety of delivering vaccines in the context of the COVID-19 pandemic and the infection prevention and control measures in place; and general communication about the importance of well child visits and getting caught up on all routine vaccines that may have been missed due to the pandemic.
- Windsor-Essex County Health Unit (2022). [March 2022 Board of Health meeting - student immunization catch-up plan information report](#).<sup>84</sup> Example of Ontario region implementing school-based immunizations.
- Washington State Department of Health (2022). [School Nurse Toolkit for Catch-Up and COVID-19](#).<sup>85</sup> The toolkit provides links for immunization information, resources for parents, and sample letters to parents from school nurses, COVID-19 vaccine information, and social media messaging suggestions.
- Centre for Disease Control (2021). [Customizable content for school and childcare-located vaccination clinics](#) includes materials that can be used to inform parents, school principals, teachers, staff, early care and education program staff, and health care providers about vaccination clinics.<sup>86</sup>

- Winnipeg Regional Health Authority (2021). [Guidance for the Planning of Public Health School based Cohort & Catch-up Immunizations for Children in Grade 6-12 affected by school closures during COVID-19 as well as School COVID-19 vaccination clinics](#).<sup>87</sup> Guidance to assist public health nurses in the planning of school-based catch-up immunizations for children in grades 6–12.
- CDC (2021). [Considerations for planning school-located vaccination clinics](#).<sup>88</sup> Guidance for the planning and implementation of school-located vaccination clinics (i.e., assessing need for clinic and resources available, establishing local partnerships and practical day of planning prompts). Modifiable communication materials are provided, such as customizable content to inform parents, school principals, teachers, staff, early care and education program staff, and health care providers about upcoming vaccination clinics. The templates include sample letters, newsletters and social media content.
- American Academy of Pediatrics, Georgetown University Center for Children and Families (2021).<sup>89</sup> [Urgent action needed to catch up on routine childhood vaccinations](#).

## Community-based interventions

- CDC (2020). [Guidance for planning vaccination clinics held at satellite, temporary, or off-site locations](#).<sup>90</sup> This document provides clinical guidance to assist with planning of off-site vaccination clinics for immunizations. This document includes links to checklists outlining best practices, supplies, and COVID-19 safety considerations which should be incorporated into the planning of vaccination clinics, alongside operational guidance.

## Primary Care Interventions

- Peterborough Public Health (2021). [Catch-up of school-base and routine vaccines](#).<sup>54</sup> An advisory for physicians on the importance of immunization catch-up and how they can support immunization catch-up efforts.
- Public Health England. (2019). [MMR catch up for 10 and 11 year olds](#).<sup>91</sup> Communication resources from Public Health England to support messaging of MMR catch-up immunizations.

## Education and Communication Resources Applicable to Multiple Settings

- Centre for Disease Control and Prevention (2022). [Resources to encourage routine childhood vaccinations](#).<sup>52</sup> This resource includes curated posts to promote catch-up efforts on various social media platforms.
- Centers for Disease Control and Prevention (CDC) (2022). [Catch-up Immunization Schedule for Children and Adolescents Who Start Late or Who Are More than 1 Month Behind](#).<sup>92</sup> This document describes the steps involved in using the catch-up schedule along with specific resources for each step.
- Government of Victoria, Australia. (2022). [Flow chart resource](#).<sup>93</sup> This resource outlines steps for providers to follow when administering catch-up vaccinations.
- Region of Waterloo Public Health (2022). [Immunization Quick Reference Table](#).<sup>94</sup> This table enables providers to quickly see publicly funded childhood vaccine information including the

type of vaccine, indication, dose, routine and catch-up schedule, efficacy, components, contraindications/precautions and side effects.

- The Australian Government Department of Health and Aged Care (2022). *Australian Immunization Handbook*, Chapter: [Catch-up vaccination](#).<sup>95</sup> This resource outlines major principles of catch-up vaccination and schedules, and worksheets to facilitate catch-up vaccine administration and documentation with example scenarios.
- Washington State Department of Health (2022). [Healthcare Provider Toolkit for Catch-Up and COVID-19](#).<sup>96</sup> This toolkit includes: direct links to childhood vaccination information resources; sample and customizable letters for parents/guardians to inform them of the need for catch-up vaccines (in multiple languages), COVID-19 vaccines and school clinic information; social media messaging suggestions related to catch-up on childhood vaccinations (in multiple languages); and resources to support providers' communication to parents about both routine and COVID-19 vaccines.
- WHO (2022). [Catch-up Vaccinations](#).<sup>1</sup> This page includes short videos that provide information on administering catch-up vaccinations; managing multiple injections; and how to record and report catch-up vaccinations.
- Center for Disease Control and Prevention (2021). [Vaccine Schedules App for Healthcare Providers](#).<sup>97</sup> The CDC developed a mobile application to quickly access information about routine and catch-up vaccines schedules for patients of all ages.
- Centre for Disease Control and Prevention (2021). [Talking to parents about vaccines](#).<sup>98</sup> This resource describes proven communication strategies and tips for effectively addressing questions from parents, including those who choose not to vaccinate. This page also includes a video featuring a CDC pediatrician answering tough vaccine questions.
- Centre for Disease Control and Prevention (2021). [#HowIRecommend Vaccination Video Series](#).<sup>99</sup> This resource shares strategies for providers to effectively address questions from parents about vaccine safety and effectiveness, provide strong recommendation for all childhood vaccines, and recommend same day vaccination.
- US Department of Health & Human Services (2021). [Catch-up to get ahead toolkit](#).<sup>100</sup> This toolkit includes prepared key messages and talking points for providers. These are topics to be considered when communicating with parents and to support discussion around the importance of all routine vaccinations being up to date in the context of the COVID-19 pandemic.
- Washington State Department of Health (2021). [The Routine Immunizations and School and Child Care Immunization Requirements Webinar](#).<sup>53</sup> This webinar provides approaches for effective vaccine messaging for providers to use.
- Region of Peel Public Health (2015). [Immunization Catch-Up Schedules](#).<sup>101</sup> This slide deck provides an overview of catch-up vaccination, including indications, general principles, schedules and case scenarios.

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## Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Strategies to facilitate catch-up on routine childhood immunizations. Toronto, ON: King's Printer for Ontario; 2022.

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