Canadian Immunization Conference 2023

Conférence canadienne sur l'immunisation

25-27 April 2023
SHAW CENTRE

Du 25 au 27 avril 2023
OTTAWA

POSTER ABSTRACT PROGRAM

PROGRAMME DES RÉSUMÉS D'AFFICHES

1. Understanding mistrust of pediatric COVID-19 mRNA vaccines: Implications for vaccine promotion

Chittle A, Rivard M, Waite N, Grindrod K, Tetui M, MacDonald S, Jeimy S

Introduction/background: The COVID-19 pandemic highlighted health communication challenges posed by infodemics. In response, a multidisciplinary group developed evidence-informed pediatric COVID-19 vaccine infographics and collected feedback through an online survey prior to their release. A qualitative analysis of a subset of survey responses was conducted to better understand mistrust of pediatric COVID-19 vaccines.

Methods: The survey was posted on October 30, 2021 to Instagram,Twitter, and Facebook, and shared by team members. Survey participants responded to 12 questions about two 1-page infographics. For the subset who indicated they would not trust the tools, we summarized demographic data using descriptive statistics, and analyzed open-ended responses thematically.

Results and analysis: 1708 respondents completed the online survey and 913 (53.5%) answered the question: "Does it seem like information you can trust?" Of these, 603 (66.0%) indicated it was information they would mistrust. The average age of the subgroup was 41 years (range: 9 to 71 years). 253 (41.9%) had attained a college diploma or university degree and 231 (38.4%) had a graduate or professional degree. In our qualitative analysis of their survey responses, three key drivers of mistrust of the tools emerged: (1) misunderstandings of mRNA vaccines: that they are experimental, harmful, ineffective, and unnecessary; (2) strong negative sentiments, including anger, disgust, and fear; and (3) anti-authority and individualistic normative values.

Conclusions and implications for policy, practice or additional research: The rate of mistrust of COVID-19 pediatric vaccine infographics among respondents was higher than contemporaneous vaccine intention studies suggested. Survey responses can support our understanding of persistently low pediatric COVID vaccine uptake. We found that specific cognitive, emotional and social drivers were associated with mistrust of vaccine information, and of vaccines themselves. Combating misinformation and addressing the negative emotions and counter-normative values fueling mistrust will require multi-pronged strategies. Communication strategies could include using moral appeals that align with audience values and employing trusted communicators.

---

2. Ethnocultural equity characteristics associated with pediatric vaccination: a comparative scoping review of Canadian, Australian, and New Zealand literature

Wolf J, Kim K, Humble R, MacDonald S

Introduction/background: Canada's growing diversity necessitates the quality of equitable immunization research to be thoroughly examined. It is uncertain whether equity determinants are comprehensively portrayed in Canadian immunization studies. Therefore, we aimed to identify the strengths and shortfalls of current immunization studies, highlighting any need for change.

Methods: Our scoping review analyzes the measurement of equity characteristics in Canadian immunization research compared to Australia and New Zealand. Included studies were peer-reviewed; published after or in 2012; written in English; conducted in Canada, Australia, or New Zealand; and focused on determinants of pediatric vaccination. The assessed characteristics included ethnicity, Indigeneity, language, immigration/refugee status, and religion. We calculated the percentage of studies from each country that included our characteristics of interest.

Results and analysis: We included 69 articles in this study: 28 Canadian, 21 Australian, and 20 from New Zealand. Ethnicity was assessed in 64.3% of Canadian studies, and 85.7% of Australian and 100% of New Zealand studies. Indigeneity was included in 17.9% of Canadian studies, and 81.0% of Australian and 90.0% of New Zealand studies. Over half (53.6%) of Canadian studies included language, compared to 23.8% of Australian and 10% of New Zealand studies. Sixty percent (60.7%) of Canadian studies included immigration/refugee status compared to 47.6% of Australian and 25.0% of New Zealand studies. Religion was assessed in 35.7% of Canadian studies, 23.8% of Australian and 25.0% of New Zealand studies. A ten-year progress comparison reflects an increase in equity characteristic inclusion for Canada and Australia.

Conclusions and implications for policy, practice or additional research: Indigenous communities have sovereignty over their data, which may have contributed to the low inclusion of Indigenous data in Canadian studies. Ethical inclusion of diverse populations will increase research transferability and create equitable solutions for improving pediatric immunization uptake.

---

3. Patterns in COVID-19 vaccine uptake among children aged 5-11 in Alberta

Reifferscheid L, Paudel Y, Robinson J, MacDonald S

Introduction/background: Efforts to increase COVID-19 vaccination among children have focused mainly on understanding parental intention to vaccinate. However, understanding patterns in childhood vaccine uptake and timeliness are crucial for identifying opportunities to reduce the vaccination intention-to-action gap.

Methods: We conducted a population-based, retrospective cohort study using administrative health data to determine COVID-19 vaccine uptake among children 5-11 years of age in Alberta, during the first seven months of vaccine availability (November 26, 2021 through June 26, 2022). We determined cumulative vaccine coverage by year of age, and used a modified Poisson regression to determine factors associated with uptake.

Results and analysis: Of 377,753 eligible children, coverage levels for one- and two-doses reached 43.8% (n=165,429) and 32.6% (n=123,147), respectively, by the end of the study period. Of those who received only one dose, 95.8% (40,663/42,456) were eligible for their second dose but did not receive it. A total of 89.2% (n=147,701) of initial doses were received during the first two months of vaccine availability, with the highest gains in vaccine uptake occurring during weekend days. Most vaccine doses were delivered through public health centres (94.4%, n=272, 252). Localized efforts to increase availability through pharmacies and primary care physician offices were offered in the fourth month but uptake was low. Factors associated with increased vaccine coverage included urban location, higher income neighborhood, and living in the Calgary health zone, similar to those reported for adult coverage. Older child age was strongly associated with higher vaccine coverage.

Conclusions and implications for policy, practice or additional research: In Alberta, COVID-19 vaccine uptake among children aged 5-11 years remains below previously reported parental intentions. Efforts to promote childhood vaccination should focus on messaging tailored to individual age, increased appointment availability on weekends, and facilitating series completion.

---

4. Improving vaccine coverage among high-risk children: Are hospital-based interventions effective?

Reifferscheid L, Kiely M, Lin M, Libon J, Kennedy M, MacDonald S

Introduction/background: The hospital setting may represent an important opportunity to promote and/or provide vaccination for large numbers of high-risk children, who have lower vaccination rates compared to the general population. The aim of this systematic review was to identify, categorize, and evaluate the effectiveness of hospital-based strategies to improve vaccine uptake in children.

Methods: We searched literature in five databases, identifying studies reporting the impact of interventions to improve childhood vaccine coverage, conducted in inpatient and/or emergency departments. We included studies conducted in high-income countries, available in full-text in English or French, of any study design or date. We also searched reference lists and grey literature. Screening, extraction and quality assessment were conducted independently by two authors, followed by a narrative synthesis

Results and analysis: From 7845 unique citations, 40 articles met study inclusion criteria. Thirty-one were classified as low or moderate risk of bias and included in our narrative synthesis. We found that most studies were conducted without an equivalent control group, and/or failed to address potential confounders or co-interventions. None were theory-informed. Interventions focused on providing vaccination during hospital visits (termed 'opportunistic vaccination') and/or encouraging vaccination post-discharge (through patient education,

reminders, or connection with community services). Opportunistic vaccination programs were generally more effective at increasing vaccine uptake than programs focused on encouraging vaccination after discharge, though results ranged from no impact to vaccinating 88% of eligible children (routine vaccines), and vaccinating 9-68% of eligible children (influenza). Organization and provider-focused interventions that improved the vaccine screening and administration process improved the impact of opportunistic vaccination programs.

Conclusions and implications for policy, practice or additional research: Hospital-based interventions can improve childhood vaccine coverage, though program impact may be influenced by baseline coverage levels and program implementation processes. Future research should consider program outcomes within the broader context of community vaccination programs, and implement controlled designs in order to provide rigorous evaluation of intervention impact.

---

5. HPV Vaccine Education in British Columbia's School-Based Immunization Program for Grade 6 Students, a Qualitative Study

Blank G, Brohman I, Mitchell H, Bettinger J

Introduction/background: Despite its well-known benefits, HPV vaccine uptake in school-based immunization programs (SBIP) remains suboptimal. Vaccine education has been shown to be effective in improving vaccine uptake, confidence, self-efficacy, and decreasing vaccine-related anxiety among students. However, there is currently limited data on teachers', principals', students' and other stakeholders' opinions of and suggestions for a school-based vaccine curriculum.

Methods: This qualitative study included 80 participants affiliated with 8 BC Elementary Schools across 3 health regions. Interviews were conducted between November 2019, and May 2020, and included nurses (2), principals (7), parents (16), grade 6 teachers (6), and students aged 11-12 years (49), who are eligble for HPV vaccination via the SBIP. We used interpretive description to guide our research question and analyzed the data using an inductive approach with constant comparative analysis.

Results and analysis: Students reported limited knowledge of HPV, though expressed interest in learning more. The most common sources that students received vaccine information from were family, friends, and educational institutions. Stress and anxiety around vaccination was also a key concern voiced by students. Generally parents supported more vaccine education in schools. Granted, 94% of parents interviewed stated their child received the HPV vaccine. Regarding teachers and principals, both groups expressed a strong interest in expanding school-based vaccine education, though most teachers felt unprepared to deliver this information. Principals and teachers also expressed notable interest in more student-directed public health education by nurses.

Conclusions and implications for policy, practice or additional research: There is broad interest in expanding the current vaccine curriculum, through both supporting teacher education and re-enforcing nursing-led teaching. Additionally, the curriculum could include advice around managing students' vaccine-related stress and anxiety, which may in turn further promote vaccine acceptance among students. Finally, limitations in our study include risks inherent with subjective reporting (particularly desirability bias), selection bias, and a potentially skewed parental sample favoring HPV vaccination.

---

6. Changes to School-based Immunization Programs (SBIP) throughout the COVID-19 Pandemic: An Environmental Scan of SBIP in Prince Edward Island, Nova Scotia, and New Brunswick

Gallant A, Curran J, Steenbeek A, Parsons Leigh J, Halperin S

Introduction/background: Schools can be an ideal setting for public health initiatives, including SBIP, to support equitable health outcomes in students. SBIP had to adapt as schools switched between in-person and virtual attendance throughout the COVID-19 pandemic. We aimed to identify how SBIP in the Canadian Maritimes were

affected by the pandemic, and what catch-up programming were used to reach students who may have missed routine vaccinations.

Methods: Data related to SBIP programs and procedures, as well as school closures were collected through grey literature searches and provincial public health stakeholders. Data from the 2018/2019 school year was used to provide baseline details of SBIP programs and vaccine coverage. Data from 2019/2020- 2021/2022 were used to identify changes to SBIP and catch-up programming offered during school closures and changes to vaccine coverage. Data from 2022/2023 was used to identify any recovering efforts to catch-up remaining students on routine vaccinations.

Results and analysis: Baseline data revealed differences in SBIP procedures in each province, with variations in vaccines administered and the grades offered in. Provinces were meeting meningococcal coverage targets, but fell short for HPV, TDaP and/or Hepatitis B coverage goals. Preliminary findings identified provincial SBIP catch-up programs relied on summer and autumn clinics throughout 2020. Vaccine coverage dropped 2- 10% during this time. Additional resources have been required to support SBIP and follow COVID-19 public health measures since 2020.

Conclusions and implications for policy, practice or additional research: SBIP experienced barriers to reaching vaccination targets prior to 2020, which the COVID-19 pandemic exacerbated with school closures and increases in vaccine hesitancy. While Maritime provinces relied on catch-up programs during the summer and autumn of 2020, the timing and travel to some of these programs may have been inaccessible to students. SBIP could benefit from updates to program delivery to address pre-existing barriers and new challenges the pandemic has created.

---

7. SARS-CoV-2 (COVID-19) vaccine willingness and series initiation in a prospective cohort of post-secondary students in Ontario, Canada

Ledesma L, Atukorale V, Gould A, Grewal R, Coleman B, Todorova A, Gagnon F, Fadel S

Introduction/background: Previous studies measuring intention to vaccinate among university students conducted prior to vaccine licensure have shown varying acceptance of COVID-19 vaccines. We prospectively followed a cohort of university students in the first year after the COVID-19 vaccine became available in Canada to assess willingness to vaccinate and subsequent uptake of the vaccine.

Methods: Students who were registered for in-person classes or living in campus residences in the Fall 2020 school term were invited to participate in the UoT Student Cohort 2020-21: A Pandemic Study. Those who enrolled were followed prospectively from December 2020 to November 2021. Participants reported when they received each COVID-19 vaccine dose in four questionnaires released in January, April, August and September 2021. If they were not vaccinated, they were asked to rate their willingness to be vaccinated and perceived COVID-19 risk.

Results and analysis: Of 15,586 eligible students, 2013 consented and 1176 completed at least one vaccination history questionnaire. Of the 1176 participants, 777 (66%) reported receiving at least one dose, 19 (3%) reported receiving zero doses, and 380 (32%) were lost to follow up. Prior to April 30th, when participants were ineligible due to age-based prioritizations alone, 835 (71%) participants reported receiving zero doses. Of these, 92% reported that they were very likely to get vaccinated, 62% were worried about SARS-CoV-2 infection, 27% were worried about being hospitalized after SARS-CoV-2 infection, and 64% were worried about infecting close contacts. 65 participants reported that they would probably receive a COVID-19 vaccine but needed more information. Of these, most concerns expressed (n=40) were related to vaccine safety and potential long- and short-term side effects.

Conclusions and implications for policy, practice or additional research: University students showed high willingness to be vaccinated. Self-selection and attrition limited the generalizability of results. However, results build on previous evidence that addressing vaccine confidence and complacency are key concepts when communicating with this population.

8. Health TrueInfo: A social media approach in tackling COVID-19 vaccine misinformation and hesitancy in Bolivia, India, and Canada

Prompiengchai S, Maki N, Jain M, Yañez L, Dev J, Sriskandarajah T

Introduction/program need and objectives: COVID-19 vaccine misinformation has been fueling vaccine hesitancy, which has been one of the main factors in slowing down the vaccination rate. An increase in vaccine hesitancy, especially among the vulnerable communities, will exacerbate the already overwhelming economic and health burden of COVID-19. The purpose of Health TrueInfo is to use knowledge translation strategies to implement evidence-based health communications via social media in order to tackle COVID-19 vaccine misinformation and hesitancy among vulnerable populations in Bolivia, India, and Canada.

Program methods, activities and evaluation: We collaborated with local influencers, health experts, and community members from Bolivia, India, and Canada to understand local contexts of misinformation and created audiovisuals that convey powerful and culturally relevant messages to their communities. The knowledge translation strategies were to ensure that our content reached specific demographic groups, appeal to potential vaccine-hesitant groups, overcome linguistic and cultural barriers, and correct common misinformation. Popular social media platforms were used to disseminate our content. Relevant social media metrics were used to iteratively evaluate the impact of our content and improve our reach and content quality.

Program results or outcomes: There was greater reach and engagement among the targeted audience when the content collaborator was a social media influencer with more followers or connections within their community. Some of the influencers' content have reached over 1000 impressions and 200 views within targeted demographics on platforms like Facebook and Twitter, while the content by non social-media influencer did not have a good reach.

Recommendations and implications for practice or additional research: Health TrueInfo was particularly successful in combining the content creating skills from non-expert influencers with the health expertise on vaccines by Health TrueInfo team and health expert collaborators. This aligns with the very limited studies demonstrating how social media and non-medical community influencers can be an effective tool for health organizations to convey their messages.

---

9. Improving Vaccine Confidence and Uptake among South Asian Communities: A Qualitative Approach

Dhutt G, Pringle W, Sachal S, Kestler M, Kandola J, Dubé È, Bettinger J

Introduction/background: Minority ethnic communities, such as South Asian communities, face disproportional challenges and barriers when accessing healthcare. This exacerbates vaccine hesitancy among these communities. Vaccine hesitancy among minority ethnic communities, which make up approximately 20% of the Canadian population, threatens to limit the success of vaccination campaigns. Using feedback collected from B.C. based service providers, community leaders, and public health communication specialists, we examined how public health can improve vaccine confidence and uptake among South Asian communities.

Methods: Semi-structured interviews with fifteen participants working with the South Asian community in a healthcare or community service context were recorded, transcribed, inductively coded, and analyzed using qualitative thematic analysis.

Results and analysis: Participants identified three strategies to improve vaccine confidence and uptake: 1) provide vaccines in culturally appropriate places (e.g., places of worship such as Gurdwaras) which community members frequent often, are familiar with, and feel safe in. Such settings are a great way to reach those who may be invisible or vulnerable (e.g., undocumented workers, refugees, or those who don't speak English), 2) employ the use of spokespeople who speak the community's language and understand cultural norms to address specific community needs and concerns (e.g., impact of vaccine on fertility) using appropriate communication mediums (e.g., ethnic radio or social media applications such as WhatsApp), and 3) build trust with the community by collaborating with community/religious leaders who are willing to participate in vaccine

promotion strategies and can serve as gatekeepers to establish a two-way dialogue with community members, groups, and organizations.

Conclusions and implications for policy, practice or additional research: Providing vaccines in culturally appropriate places, employing the use of culturally appropriate spokespeople, and collaborating with community/religious leaders can improve vaccine confidence and uptake in South Asian communities by directly addressing language and structural barriers, community specific needs and concerns associated with vaccination, and increasing vaccine accessibility.

---

10. Successes and challenges of using Facebook to recruit parent participants for research on vaccine decision making

Ashfield S, Donelle L, Dubé È, Smith M, Tryphonopoulos P

Introduction/Background: Parents are looking online for vaccine information and using social media to connect with their peers. Over 90% of Canadian parents are searching online for information daily. Facebook is emerging as a successful recruitment method for health research studies.

Methods: A Facebook research account was developed to recruit parents to participate in an online survey about vaccine decision making. Two main methods of Facebook recruitment were utilized, Facebook groups and Facebook advertising. Emailing of recruitment posters to organizations where parents frequent was utilized as a third method of recruitment.

Results and analysis: Facebook recruitment included distribution of a recruitment poster throughout Facebook groups and in paid advertisement campaigns. The achieved sample of 231 participants surpassed the proposed sample size; 27.8% considered themselves somewhat hesitant or very hesitant about vaccination.

Successes: Achieved the sample size in time efficient manner -Facebook advertisements ran for a total of 39 days; paid advertisement costs were minimal at $157.09, while the Facebook groups cost $0. There was a range of participant age from 26-41+ years of age and a diversity of parents across the continuum of vaccine acceptance. The Facebook recruitment approach aligned with accepted research ethical policies.

Challenges: Facebook strategies are intended for commercial advertising of goods and services, not for research participant recruitment creating discordance between the ethical research processes and Facebook marketing policy. The ethnic diversity of participants was limited; 87.9% were Caucasian, 8.2% claimed a variety of other ethnic backgrounds, 3.9% were undisclosed.

Conclusion and implications for future research: Facebook is a cost-effective method for recruiting parents of young children in Ontario for vaccine research. Consider establishing and sustaining a Facebook marketing account for a program of research**.** This studies homogeneous sample may indicate that other methods may be necessary to access a more diverse sample of the population.

---

11. A qualitative investigation of COVID-19 vaccine information preferences among parents of diverse intersecting identities in Canada

Marfo E, Manca T, Aylsworth L, Cha E, Bettinger J, Driedger M, Meyer S, Pelletier C, Roch G, Tunis M, Dubé E, MacDonald S

Introduction/background: Disparities in vaccine uptake are shaped by intersecting social inequities due to a myriad of factors, including the influence of popular discourses (e.g., approaches to knowing and communicating), including online (mis)information. This study aimed to explore how diverse parents with intersecting identities use (mis)information when making decisions about COVID-19 vaccination.

Methods: We conducted semi-structured interviews on COVID-19 vaccination information use with diverse parents of children ages 12 to 17 years from April to August 2022. We purposefully invited parents from

respondents to a national online survey to ensure diverse representation across ethnicity, gender, language, and intersecting social identities. Five researchers coded transcripts in NVivo using a discourse analysis approach informed by intersectionality theory. Our analysis focused on relationships between participants' use of vaccine (mis)information and intersecting privileges and oppressions, including identifying with equity-denied group(s) or experiencing blame.

Results and analysis: Interview participants (N=48) identified as ethnically diverse non-Indigenous (n=40) and Indigenous (n=8) Peoples from seven provinces. Preliminary themes from analyses showed inequities in access to information, experiences of stigmatization, and variation in trusted information. For example, many participants identified information gaps for specific populations (e.g., populations with specific health problems, children, and girls). Some participants described barriers to accessing vaccines and information due to intersecting systemic inequities (e.g., racism, colonialism, and health conditions). Finally, the information sources participants trusted to inform decisions about childhood vaccination varied, with some participants identifying barriers to trust from systemic inequities.

Conclusions and implications for policy, practice or additional research: Inequities and privileges along axes of race/ethnicity, Indigeneity, health status, and intersecting social locations shaped preferred information and decision-making about COVID-19 vaccination for children. Public health information and interventions should be developed and adapted in collaboration with diverse communities to meet the needs of diverse people. There is a need to dismantle inequities that create barriers to accessing and trusting healthcare institutions.

---

12. Pharmacists as immunizers in Nova Scotia, Canada: Identifying immunization prescribing trends and patient characteristics

Lawrence R, Isenor J, Langley J, Stewart S, Wranik D

Introduction/background: Pharmacists are one of the most accessible healthcare providers in Canada and now provide more services than ever, including immunization services. In Nova Scotia, literature published to date on pharmacists as immunizers has mainly focused on influenza vaccines and the characteristics of patients receiving pharmacist-prescribed vaccines have not been previously described. Therefore, the objectives of this project are 1.) To describe patterns in age, sex, geographic location, and relative deprivation of patients receiving immunizations prescribed in community pharmacies in Nova Scotia, compare characteristics of these patients pre-COVID-19 versus during COVID-19, and compare the characteristics of these patients to the general provincial population, and 2.) To describe immunization prescribing activity (influenza and non-influenza vaccines, excluding COVID-19 vaccines) of community pharmacists in Nova Scotia and compare this activity pre-COVID-19 versus during COVID-19.

Methods: A retrospective time-series analysis using administrative health data from existing databases will be conducted to identify changes in pharmacist prescribing of vaccines, both before and during the COVID-19 pandemic. Included data sources are the Nova Scotia Drug Information System, the MASTER Patient Registry, the DOCTORS Licensed Provider Registry, the Postal Code Conversion File, and the Canadian Index of Multiple Deprivation.

Results and analysis: Descriptive statistics will be calculated for patient age, sex, geography, and deprivation. Comparisons will be made over time and against the general provincial population using simple t and chi-square tests. Multivariable negative binomial regression models including time-varying covariates will be built to characterize immunization prescribing activity over time.

Conclusions and implications for policy, practice or additional research: The results of this project will identify successes in pharmacist immunization prescribing as well as potential gaps in access and opportunities to improve immunization through community pharmacists. This may include increased advertising of immunization prescribing services, increased support allocated to pharmacies in areas of low prescribing, or supports for those with low access to immunization services due to social or financial barriers.

13. "We all have a social responsibility": Drawing parallels between COVID-19 and influenza vaccine uptake among Canadian healthcare providers and trainees

Thaivalappil A, Young I, MacKay M, Pearl D, Papadopoulos A

Introduction/background: Vaccines are effective pharmaceutical interventions which reduce health and economic burdens while protecting healthcare providers from vaccine-preventable diseases in the public and occupational contexts. The aim of this study was to identify barriers and facilitators to COVID-19 and influenza vaccines among healthcare providers and trainees using the Theoretic Domains Framework (TDF) as a lens.

Methods: Semi-structured interviews (n = 18) were carried out with healthcare providers and trainees in Canada. A combination of inductive and deductive thematic analysis was used to code interview transcripts and match findings to TDF domains and broader categories.

Results and analysis: Three overarching themes were generated from 6 TDF domains and 3 inductively generated categories: (1) making informed health decisions with an added responsibility to protect oneself and patients, (2) a pro-vaccine social network, widespread accessibility, and pursuing a sense of normalcy, and (3) seeking a more nuanced, respectful, and calculated approach to vaccine communication and policy implementation.

Conclusions and implications for policy, practice or additional research: These findings help to identify factors associated with influenza and COVID-19 vaccine uptake among individuals in the healthcare field. Addressing these factors may improve healthcare provider sentiments surrounding vaccines, existing health messaging, lead to better patient education, and increased uptake of vaccinations with the potential for seasonal booster doses.

---

14. Impact of recruitment strategies on individual participation practices in the Canadian National Vaccine Safety Network: Active Safety Surveillance for COVID-19 vaccines (CANVAS-COVID); a Canadian Immunization Research Network (CIRN) study

Soe P, Bettinger J, Sadarangani M, Marty K, Kek K, Top K, Isenor J, MacIntyre P, Kellner J, Vanderkooi O, Gray J, Muller M, McGeer A, Khan S, Valiquette L, Grenier C, De Serres G, Hegg S

Introduction/background: The Canadian National Vaccine Safety Network (CANVAS), established in 2009, has implemented active safety surveillance for COVID-19 vaccines since December 2020. This analysis aims to 1) estimate the overall CANVAS-COVID catchment by provinces and territories 2) assess the impact of different recruitment strategies on overall completion and retention for follow-up surveys.

Methods: We recruited participants from seven provinces and territories: Alberta, British Columbia, Nova Scotia, Ontario, Quebec, Yukon, and Prince Edward Island (PEI). Two primary recruitment methods were used: 1) traditional recruitment via electronic or media communication strategies where participants self-initiated for enrollment, and 2) automated recruitment through provincial/territorial vaccination databases, vaccination booking appointments and/or voluntary vaccine registries where participants received an email invitation link. Registered participants were followed up for the occurrence of health events seven days after doses 1 and 2, and six months after dose 2.

Results and analysis: This analysis was restricted to adults (20 years and above) who participated in CANVAS-COVID between December 2020 and August 2022. Approximately 1.3 million adults (traditional recruitment: ~0.3 million; automated recruitment: ~1 million) were captured in CANVAS-COVID, representing 4.3% of the adult Canadian population and ranging from 0.3% in PEI to 9.7% in Quebec. The overall completion rates for dose 1, dose 2 and the 6-month surveys were 680597 (52.6%), 369744 (28.6%), and 448894 (34.7%) respectively. Survey completion rates were consistently higher among self-registered (dose 1: 265412 [85.0%];

dose 2: 182127 [58.3%]; 6-month: 213174 [68.3%]) than auto-recruited participants (dose 1: 415185 [42.3%]; dose 2: 187617 [19.1%]; 6-month: 235720 [24.0%]).

Conclusions and implications for policy, practice or additional research: Although traditional recruitment was associated with higher survey completion, findings suggest that automated recruitment strategy reached more individuals. Additional communication strategies may be necessary to enhance participants' retention, particularly in vaccine safety study samples recruited with automated recruitment methods.

---

15. Are we incorporating intersectionality in Canadian vaccine research? Findings from a scoping review

King K, Cha E, Vyas V, Reiffershied L, MacDonald S

Introduction/background: Intersectionality refers to the coexistence of social identities that create an amalgamate disadvantage for individuals or groups. As part of vaccine coverage research, intersectionality allows healthcare professionals and policymakers to become aware of the constellation of characteristics contributing to low vaccine uptake. The objective of this scoping review was to examine the inclusion, or lack thereof, of intersectionality-informed approaches in Canadian vaccine coverage research, emphasizing sex and gender-based analysis.

Methods: We searched six health literature databases from inception to July 2021. We searched provincial and federal websites and the Proquest Dissertations and Theses Global database to include grey literature. We included studies reporting on immunization coverage among Canadians of all ages. Literature written only in English or French was included. Studies were descriptively analyzed.

Results and analysis: In total, 78 studies from 2,254 citations were included in the review. Seventy-three studies included one or more intersectional characteristics influencing vaccine uptake. However, most studies (n=58) examined characteristics in isolation and did not account for the combined effect of these factors on an individual's level of vaccine uptake. Of the 78 studies, only 20 included elements of intersectionality, describing the interactive effects of multiple intersectional factors in the results or discussion. No studies used an explicitly stated intersectionality theoretical framework to guide their research on factors that affect vaccine uptake. Of the 19 studies that mention "gender," 18 had misused this term, conflating it with sex.

Conclusions and implications for policy, practice or additional research: There is a lack of intersectionality theory utilization in vaccine coverage research and misinterpretation of the terms "gender" and "sex" in Canadian vaccine coverage research. Rather than only focusing on discrete characteristics, vaccine researchers should explore the interaction between numerous characteristics to better understand the barriers to immunization uptake in Canada.

---

16. Analysis of vaccine preventable disease outcomes in Canada from 2005-2018: a study from the Canadian Immunization Monitoring Program Active (IMPACT)

Verly M, **Mason E**, Shulha H, Bettinger J, Le Saux N, Halperin S, Tan B, Sadarangani M

Introduction/background: Vaccines have long been recognized as one of the most successful public health measures; they have significantly contributed to decline in morbidity and mortality associated with various infectious diseases. Acquiring longitudinal data on vaccine preventable diseases (VPDs) provides the opportunity to understand the epidemiology and burden associated with infectious diseases since the introduction of vaccines. In this study we summarize trends in outcomes associated with six VPDs in Canadian children: Haemophilus influenzae type b, Streptococcus pneumoniae, Neisseria meningitidis, Bordetella pertussis, varicella zoster virus and rotavirus.

Methods: During 2005-2018, IMPACT monitored VPDs at 12 pediatric tertiary care hospitals across Canada. Data were collected using standardized case report forms, including age, sex, health condition, vaccine status, and organism typing. Outcomes included total annual cases, rates of intensive care unit (ICU) admission and length

of stay. To identify determinants of these outcomes, linear and logistical regressions of patient demographic data (age, sex, health, vaccine status, and disease strain preventability) was performed using R.

Results and analysis: 9,533 cases of VPDs were identified during 2005-2018. Overall, total hospital admissions decreased from 1096 to 360 over the study period ($p<0.001$), however hospital length of stay increased from a median of 4 to 6 days ($p=0.010$). ICU admission rate increased from 11% to 20% ($p<0.001$), while the median length of ICU stay doubled from 2 to 4 days ($p=0.019$). Multivariate analysis indicated male sex may be predictive of lower hospital length of stay ($p=0.03$).

Conclusions and implications for policy, practice or additional research: Reduction in case hospitalization associated with the surveyed VPDs is encouraging and supports the effectiveness of immunization in Canada. However, longer durations of hospitalizations coupled with significant increases in the rate of ICU admission is concerning for either increased complexity of disease, delayed diagnosis, or other factors which may require more case level analysis to delineate.

---

17. Neurological adverse events following immunization against COVID-19 among adults and adolescent Canadians referred to the Special Immunization Clinic Network

Summerby-Murray D, Fitzpatrick T, Sadarangani M, Constantinescu C, McConnell A, Cowan J, Wright A, Belga S, Top K

Introduction/background: Rare neurologic adverse events following immunization (AEFI) were reported following COVID-19 vaccination. This project describes the characteristics and presentations of participants presenting with neurologic AEFIs post-COVID-19 vaccination who were referred to the Special Immunization Clinic (SIC) Network.

Methods: Participants aged 12+ years referred to one of 15 SICs in eight provinces by April 30, 2022 for neurological events (e.g., Guillain Barre Syndrome (GBS), facial palsy, seizures, paresthesia/anaesthesia) following COVID-19 vaccination were eligible. Participants underwent standardized assessment by SIC physicians, including revaccination recommendations. Following consent, demographic and clinical data were collected, including characteristics of the AEFI; e.g. impact was categorized as "Low", "Medium", "High", or "Serious". Participants were followed up post-revaccination to capture AEFI recurrence. Analysis of de-identified data was performed using descriptive statistics and case studies.

Results and analysis: There were 54 eligible participants with a confirmed neurologic AEFI included in this analysis. Participants were predominantly male (70.4%), with median age of 47 years (interquartile range (IQR): 33-56). Median symptom onset time was 24 hours post-vaccination (IQR: 4-168 hours). Most participants were referred following BNT162b2 vaccination (66.7%), followed by ChAdOx1 (20.4%) and mRNA-1273 (13.0%). Bell's palsy was the most common final diagnosis (n=27, 50.0%), followed by paresthesia/anaesthesia (11.1%) and GBS (7.4%); seizures were rare (1.9%). Among participants with Bell's Palsy and paresthesia/anaesthesia, 20/27 (74.1%) and 5/6 (83.3%), respectively, received BNT162b2; in contrast, 3/4 (75.0%) of GBS patients had received ChAdOx1. Most AEFIs were either high (37.0%) or serious impact (25.9%), e.g., requiring physician care or hospitalization, respectively. While revaccination was recommended for most (63.6%) participants, analysis of revaccination outcomes is currently ongoing.

Conclusions and implications for policy, practice, or additional research: A range of neurological AEFIs were observed after COVID-19 vaccination in the SIC Network. Despite most AEFIs being classified as high-serious impact, revaccination was recommended in most cases, suggesting the benefit of expert assessment of patients with medically challenging AEFIs.

---

18. A Longitudinal Seroepidemiology Study to Evaluate Antibody Response to SARS-CoV-2 Virus and Vaccination in Children in Calgary, Canada from July 2020 to September 2022

Doucette E, Gray J, Fonseca K, Charlton C, Kanji J, Tipples G, Kuhn S, Dunn J, Sayers P, Symonds N, Wu G, Freedman S, Kellner J

Introduction/background: Measurement of SARS-CoV-2 antibody seropositivity is important to accurately understand exposure to infection and/or vaccination in populations.

Methods: A cohort of children with or without prior SARS-CoV-2 infections was enrolled in Calgary, Canada in 2020. Venous blood was sampled 4 times from July 2020 to April 2022 for SARS-CoV-2 nucleocapsid and spike antibodies, with an additional 5th visit in the fall of 2022. Demographic and clinical information was obtained including SARS-CoV-2 test results and vaccination records.

Results and analysis: 1035 children were enrolled and 88.9% completed 4 visits; median age 9 years (IQR: 5,13); 519 (50.1%) female; and 815 (78.7%) Caucasian. 477 (46.1%) participants attended Visit 5. Before enrollment, 118 (11.4%) had confirmed or probable SARS-CoV-2 infection. By September 2022, the total cumulative percentage of previously uninfected participants diagnosed with COVID-19 was 53.9% by Visit 5. (0/917 (0%), 15/873 (1.7%), 31/837 (3.7%), 280/820 (34.1%), and 63/439 (14.4%) at Visits 1-5, respectively). Nucleocapsid antibody seropositivity declined to 18.0% after more than 200 days after diagnosis. In contrast, spike antibodies remained elevated in 97.6% of unvaccinated children after more than 400 days after diagnosis. By September 2022, 97.1% (232/239) of children 12 years and older, 85.9% (171/199) of children 5-11, and 15.4% (6/39) of children under 5 received at least 1 dose of vaccine. At that time, all 409 vaccinated children had spike antibodies, compared with 38/64 (59.4%) of unvaccinated children ($P<0.001$ for comparison of proportions). Further analysis is pending.

Conclusions and implications for policy, practice or additional research: By September 2022, most children in the study had a serologic response against the SARS-CoV-2 virus from infection and/or vaccination, with unvaccinated children much less likely to have a serologic response. Ongoing studies of serologic status are needed to estimate population levels of virus exposure and durability of antibody response after infection and/or vaccination.

---

19. The Vaccine Immunogenicity and Safety in ImmunoDeficient patients (VISID) study: Immunological responses of patients with primary and secondary immunodeficiencies to SARS-CoV-2 BNT162b2 and mRNA-1273 vaccines, and breakthrough infections in Canada.

Unninayar D, Vinh D, Falcone E, Chapdelaine H, Top K, Derfalvi B, Palma A, Issekutz T, Barrett L, Oldford S, Lacuesta G, Decaluwe H, Langlois M, Pham-Huy A, Upton J, Betschel S, Rubin T, Kalicinsky C, Suresh S, Murguia-Favela L, Wright N, Sadarangani M, Cowan J

Introduction/background: Adults and children with primary or secondary immunodeficiency (ID) are at increased risk of severe COVID-19. Data on ID vaccine immunogenicity and breakthrough infection is limited.

Methods: We began a nationwide multicenter prospective study since July 2021 to assess vaccine response and breakthrough infection in ID. Blood for humoral (anti-S IgG measured by ELISA, and neutralizing antibody calculated as 50% inhibitory dilution (ID50)), and T cell response (measured by IFN-γ-ELISpot) was collected pre-vaccine and 4-weeks post-vaccine doses. Post-vaccination COVID-19 infections were captured.

Results and analysis: 199 adults (153 primary ID, 20 secondary ID, 26 controls) and 95 children (70 primary ID, 4 secondary ID, 21 controls) were recruited. Seroconversion rates in ID were 12/16(75%), 46/53(87%), 54/58(93%) post-dose 1,2,3, respectively compared to 12/12(100%), 6/6(100%) post-dose 1, 2 respectively in controls. Median(IQR) of anti-S IgG was 410(160-4719)BAU/mL post-dose 3 in adult ID, 464(250-7867)BAU/mL post dose 2 in adult controls. Pediatric ID had higher anti-S titres (1233(98-3038) and 9148(6472-11823)BAU/mL) compared to adult ID (127(28-333) and 410(160-4719) BAU/mL) before dose 3(p=0.01) and post-dose 3(p=0.04),

respectively. Median(IQR) ID50 were 22(1-44) post-dose 2 and 85(4-245) post-dose 3 in adult ID, but 212(106-598) post-dose 2 in controls. Median(IQR) T-cell response was 25(0-127) IFN-γ spots/106 PBMCs post-dose 2 and 11(0-65) post-dose 3 in adult ID, and 63(48-95) post-dose 2 in controls. Delta and omicron T-cell responses were comparable. Analysis of pediatric ID neutralization data and T cell response is ongoing.

Rates of post-vaccination SARS-CoV-2 infection were 65/173(37.8%) in adult ID and 43/74(58.1%) in pediatric ID while infection rate in controls was 14/47(29.8%). Most infections occurred post-dose 3(45.5%) and 4(19.6%), and in 2022(90.3%). Two adult ID participants were hospitalized.

Conclusions and implications for policy, practice or additional research: This data supports a 3-dose primary series for ID and the need for additional strategies to prevent infection in this population.

---

20. Impact of vaccination on COVID-19 outcome trends: a Joinpoint regression analysis

Bang F, Merali S, Dam D, Ho Mi Fane B, Schertzer A, David S

Introduction/background: Monitoring trends in COVID-19 cases and outcomes following vaccination provides evidence to inform immunization program planning, particularly with the emergence of vaccine escape variants and waning vaccine-induced immunity. This analysis explores whether national trends in COVID-19 incidence, hospitalizations, ICU admissions, and deaths by vaccination status aligned (in timing and relative magnitude) over the Delta- and Omicron-predominant time periods.

Methods: Joinpoint regression analyses were conducted for two time periods. Time period 1 (July 11, 2021-November 27, 2021) coincided with the Delta (B.1.617.2) variant predominant period in Canada. Time period 2 (January 9, 2022-April 24, 2022) aligned with the Omicron (B.1.1.529, BA.1, BA.2) variant predominant period. Pairwise tests for joinpoint regression function coincidence and parallelism were conducted to compare trends in the following rates among those unvaccinated, with a completed primary series, and with a completed primary series and one or more additional dose(s): incidence vs. hospitalization, hospitalization vs. ICU admission, hospitalization vs. mortality. Rate numerators were from the National COVID-19 Case Dataset. Denominators were from the Canadian COVID-19 Vaccination Coverage Surveillance System and Statistics Canada.

Results and analysis: Rates of all outcomes were higher among the unvaccinated than the vaccinated in both analysis periods. During period 1, pairwise comparisons of all outcomes were found to be statistically parallel among those unvaccinated, and statistically different among those with a completed primary series ($p<0.05$). During period 2, pairwise comparisons of outcomes varied: pairwise comparisons among those with a completed primary series and 1 or more additional doses were found to be statistically parallel between hospitalization and ICU admission ($p<0.05$), but statistically different between hospitalization and mortality ($p<0.05$).

Conclusions and implications for policy, practice or additional research: Evidence from national surveillance supports the protective effect of vaccination against infection and severe outcomes. Joinpoint regression analyses present an innovative method to assess COVID-19 vaccine performance over time.

---

21. Direct Quantitative Comparison of Benefits and Risks of COVID-19 Vaccines Used by National Immunization Technical Advisory Groups in their Pandemic Guidance

Doyon-Plourde P, Farley R, Krishnan R, Tunis M, Ismail S, Zafack J

Introduction/background: Benefit-risk assessments (BRA) are used by National Immunization Technical Advisory Groups (NITAGs) to inform guidance. The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach has been widely used by NITAGs to develop recommendations. However, during the COVID-19 pandemic, several NITAGs used direct quantitative comparisons (DQCs) between benefits and risks of vaccination with or without the GRADE framework to support timely decision-making. This study aimed

to evaluate the role of DQCs in NITAGs' work by identifying situations where DQCs have been clearly outlined in NITAGs' guidance, as well as identifying their strengths and weaknesses.

Methods: The MEDLINE database and websites of 8 NITAGs were searched for NITAG publications on COVID-19 vaccines. Publications were included if the DQC between benefits (e.g., hospitalizations prevented by vaccination) and risks (e.g., adverse events following immunization) of any COVID-19 vaccine was explicitly used for NITAG decision-making. Two reviewers assessed publication eligibility and extracted data independently.

Results and analysis: A total of 23 publications with 16 unique DQCs used by 7 NITAGs were included. Situations prompting the use of DQCs included new safety signals, additional available information and changing contexts (e.g., vaccine supply, new authorization/indication, and epidemiology). DQCs were relatively simple to calculate and could be easily updated. Their simplicity made them accessible, timely, and allowed for transparency in communication. DQCs heavily relied on assumptions making them sensitive to changes in model parameters; thus, DQCs were not easily applicable to other contexts and quickly became obsolete in the evolving context of the COVID-19 pandemic.

Conclusions and implications for policy, practice or additional research: The use of DQCs by NITAGs during the COVID-19 pandemic allowed for rapid decision-making in an evolving environment while maintaining public trust. Although DQCs may inform NITAGs' guidance, implementation/standardization of their use in the future will need to address their limitations.

---

22. Factors associated with re-infection in adults with SARS-CoV-2 infection early during the pandemic in Toronto, Canada

Farooqi L, Zhong Z, Shigayeva A, Barati S, Colwill K, Crowl G, Dayam R, Delgado-Brand M, Haq N, Jannat K, Kim P, Kyaw M, Lefebvre M, Xinliu Li A, Mailhot G, Major M, Malik N, Martin C, McLaughlin J, Mozafarihashjin M, Pejkovska M, Qi F, Quadri A, Rallabandi S, Rizvi S, Sultana A, Tursun T, Vikulova T, Vojicic J, Yang J, Zhang P, Coleman B, Kandel C, Katz K, Kozak R, Mubareka S, Gingras A, McGeer A

Introduction/background: As the COVID-19 pandemic evolves, understanding risk of SARS-CoV-2 re-infection is increasingly important. We identified factors associated with re-infection in adults with COVID-19 in the first months of the pandemic.

Methods: We enrolled SARS-CoV-2 infected adults admitted to 7 hospitals between February and September 2020 and those managed as outpatients between February and July, 2020. Consenting participants provided demographic, clinical, and COVID-19 vaccination information and were followed until May 2022. Serum or dried blood spot samples at enrolment, 2-4 weeks after any vaccine dose received, and 3-5 weeks after infection were obtained to assess antibody responses to nucleoprotein (NP), spike trimer (S), and receptor binding domain (RBD), which were quantified using enzyme immunoassay. Mutivariable logistic regression was performed to determine risk factors for re-infection.

Results and analysis: The cohort included 249 inpatients and 300 outpatients. Median age at first infection was 54 years (IQR 41-64); 288 (53%) were female. Seven re-infections occurred between Nov 2020 and Dec 15, 2021 (before Omicron predominated); 82 re-infections occurred between Dec 13, 2021 and June 1, 2022 (Omicron wave). In multivariable analysis, older age and receipt of ≥2 vaccine doses were significantly associated with reduced risk of re-infection. Among individuals with convalescent serum drawn 21-180 days after their first infection, a higher anti-NP antibody level was associated with reduced risk of re-infection (ratio normalized concentration 075 [IQR 0.39, 0.96] versus 0.91 [IQR 0.75, 0.99] in those re-infected versus not; P=.003). Re-infection with Omicron was significantly less common in persons with detectable anti-NP antibody in Oct-Dec 2021 (9/92 versus 23/94; P=0.01).

Conclusions: In persons with SARS-CoV-2 infection before October 2020, re-infection in the subsequent 18-24 months was more common in younger persons, those with <2 doses of vaccine, and those with lower concentrations of convalescent anti-NP antibody.

23. Clinical features and disease severity of hospitalized children by SARS-CoV-2 lineage: An IMPACT surveillance network analysis

Farrar D, Bettinger J, Audet A, Campigotto A, Deeks S, Embree J, Haddad E, Halperin S, Jadavji T, Kazmi K, Laffin Thibodeau M, Moore Hepburn C, Papenburg J, Purewal R, Sadarangani M, Wilson S, Yeung R, Top K, Kakkar F, Morris S

Introduction/Background: Changes in relative virulence of SARS-CoV-2 lineages amongst children remain poorly understood, yet are important considerations for vaccination. We aimed to compare presenting features and disease severity among hospitalized children with COVID-19 in Canada by SARS-CoV-2 lineage.

Methods: We combined data collected during two national surveillance studies, conducted via the Canadian Paediatric Surveillance Program (April 2020–May 2021) and Canadian Immunization Monitoring Program, ACTive (June 2021–May 2022). Cases were eligible for inclusion if they were <17 years old and hospitalized for COVID-19 (excluding incidental SARS-CoV-2) at one of thirteen sentinel hospitals. SARS-CoV-2 lineages were classified as "Ancestral", "pre-Delta" (i.e. Alpha, Beta, or Gamma), "Delta", or "Omicron" based on individual-level genetic sequencing, if available, or the predominant lineage across Canada at the time of hospitalization. Severe disease was defined as intensive care, ventilatory, or hemodynamic support requirements, select organ system complications, or death. Case reporting is ongoing.

Results and analysis: We identified 1357 children hospitalized with COVID-19, including 254 (18.7%) during ancestral waves, 105 (7.7%) during pre-Delta waves, 175 (12.9%) during Delta waves, and 823 (60.6%) during Omicron waves. Median age at hospitalization was highest for Delta (3.0 years, interquartile range 0.2–11.1) and lowest for Omicron (1.3 years, interquartile range 0.3–5.4; p<0.001). The proportion of patients with chronic comorbid conditions did not significantly differ by lineage, ranging between 44.9% (ancestral) to 54.3% (Delta, p=0.149). COVID-19 vaccination (≥1 doses) was received by <5 pre-Delta cases (<4.8%), six Delta cases (3.4%), and 98 Omicron cases (11.9%). Among unvaccinated patients (n=1251), severe COVID-19 was most common among Delta lineages (34.3%) versus other lineages (24.0% ancestral, 22.3 pre-Delta, 24.8% Omicron; p=0.049).

Conclusions and implications for policy, practice, or additional research: Our results show more children were hospitalized during Omicron waves than all other waves combined. These preliminary findings underscore the significant burden of Omicron in children.

---

24. What can we learn from COVID-19 "vaccine passports" to inform future use of digital proof-of-immunization technologies?

Greyson D, Pringle W, Wilson K, Bettinger J

Introduction/background: As part of COVID-19 pandemic control efforts, digital proof-of-vaccination credentials (PVCs) were launched in 2021-22 following widespread vaccine availability. Given the controversies over PVCs—often colloquially referred to as vaccine or immunization "passports"—it is imperative to document their successes, shortcomings, and recommendations for any future uses.

Methods: This expert consultation applied reflexive thematic analysis to transcripts of online video interviews with 12 multisectoral experts to identify what we can learn from this experience with PVCs, and what decision-makers must keep in mind for possible future use of such technologies.

Results and analysis: There remains a lack consensus regarding appropriate language and scope for digital PVCs, respective roles of private companies versus government in design and implementation, and parameters for future use. However, experts agree on many recommendations, including importance of clear communication including evidence-based rationale for use, multidisciplinary consultation, and the importance of standards for accessibility and interoperability. Risks of use that were identified, and should be minimized in the future, include coercion and backlash; threats to access, equity and privacy; and the cost of the technology and workload burden of enforcement and fraud detection.

Conclusions and implications for policy, practice or additional research: Future PVC use should be informed by robust, multisectoral consultation that includes the public, academic, and legislative experts. Terminology should be consistent and clearly defined, and the rationale for use be clearly communicated and evidence-based. Pan-Canadian technical standards must be maintained, including usability for and inclusion of marginalized populations and those who travel or migrate. Data privacy and security must not be compromised in partnerships with private technology companies, and roles of all partners in PVC development and operations should be clearly communicated to the public.

---

25. Capturing the Value of Vaccination within health technology assessment and health economics

Tennant B, Postma M, Biundo E, Chicoye A, Doherty M, Dronova M, Garcia S, Garcia Ruiz A, Garrison L, Nolan T, Salisbury D, Sheikh S, Smith R, Toumi M, Wasem J, Beck E

Introduction/background: Vaccination provides significant health gains to individuals and society. Policy decisions are, however, rarely informed by comprehensive economic evaluations (EE). The objectives of this analysis were to focus on health technology assessment systems to identify relevant value concepts and provide guidance on how to implement these to improve EE of non-pandemic vaccines.

Methods: Following a literature review, a novel Value of Vaccination (VoV) framework was developed with experts in vaccine EE. Inclusion of the framework's concepts in current EE guidelines were assessed, experts ranked these based on criteria relevant for decision-making and feasibility considerations. The relative ranking and gaps in guidelines were used to identify three priority concepts. For the selected concepts, case studies were developed to illustrate possible applications for EE.

Results and analysis: Eighteen unique value concepts relevant to EE were identified, defined, and grouped into three dimensions: I) conventional payer perspective concepts; II) conventional societal perspective concepts; and III) novel societal concepts. The EE guidelines review highlighted differences across countries and between guidelines and practice. The top-three concepts selected for near-term consideration were: macroeconomic gains (e.g., impact on Gross Domestic Product); equity (e.g., distribution of health outcomes); and health systems strengthening, resilience, and security (HSS) (e.g., efficiency gains, increased capacity). Case studies illustrating the concepts in EE for meningococcal (equity) and rotavirus (HSS) vaccination demonstrated feasibility of including these into decision-making framework and provided further insights into evidence generation needs.

Conclusions and implications for policy, practice or additional research: The COVID-19 pandemic has highlighted the far-reaching benefits that vaccination programmes can offer. This VoV framework is relevant to policy decisions considering EE and to a broader concept of the value of non-pandemic vaccination. Gaps, inconsistencies, and limited assessment of VoV in EE can lead to differences in policy and vaccination access. The three priority concepts provide a feasible approach for reflecting VoV more broadly in EE.

---

26. Working together: Comparing vaccine safety surveillance via the Canadian National Vaccine Safety Network (CANVAS) with Ontario provincial surveillance of adverse events following immunization (AEFI); a Canadian Immunization Research Network (CIRN) study

Johnson C, Wilson S, Khan S, McGeer A, Meyer W, Harris T, Navarro C, Bettinger J, Muller M

Introduction/background: In Ontario, COVID-19 vaccine safety surveillance has included both active and passive components through a collaboration between Public Health Ontario (PHO) and CANVAS. This provided an opportunity to compare events identified through the two systems.

Methods: In Ontario, passive vaccine safety surveillance relies on the reporting of AEFIs to the local health unit (PHU) for investigation and documentation within a provincial system (CCM). Enrollment in active surveillance (CANVAS) was facilitated by an email invitation from the COVID-19 vaccine registry. Following enrollment, health

surveys were emailed 8 days after each dose of the primary series and 6 months later. Individuals with medically attended events were interviewed; referrals of possible AEFIs to PHUs was facilitated by PHO.

Information in CCM was reviewed by PHO to determine how many events were referred from CANVAS, what proportion were confirmed as AEFIs, and whether events meeting CANVAS's probable case definitions for VITT and myocarditis/pericarditis were already in CCM at the time of the referral.

Results and analysis: As of June 2022, 180,767 Ontarians completed at least one post-vaccination health survey and 1,281 possible AEFIs were referred for PHU investigation. Of these, 94% did not have a record in CCM at the time of referral.

CANVAS identified one probable VITT and 23 probable myocarditis/pericarditis events. The probable VITT event was classified as confirmed VITT within CCM at the time of CANVAS referral. 17 of the 23 probable myocarditis/pericarditis events referred for investigation were entered in CCM as confirmed AEFIs, as myocarditis/pericarditis (n=12, 3 of which were in CCM at the time of the referral) and other severe/unusual events (n=5). One event was not classified as a confirmed AEFI and five events remain under investigation.

Conclusions and implications for policy, practice or additional research: The collaboration between CANVAS and passive surveillance demonstrates how these systems can work together to strengthen post-market vaccine safety surveillance, including for rare vaccine safety events.

---

27. Sex Differences in the Immunogenicity and Efficacy of Seasonal Influenza Vaccines: A Meta-analysis of Randomized-controlled Trials

Tadount F, Kiely M, Assi A, Rafferty E, Sandarangani M, MacDonald S, Quach C

Introduction/background: Seasonal influenza is an important cause of morbidity and mortality, despite being vaccine preventable. Sex is known to impact individuals' response to vaccination. However, most vaccine studies do not report sex differences in vaccine response. We used data from clinical trials to assess sex-difference in the immunogenicity and efficacy of influenza vaccines.

Methods: We obtained data for phase III randomized-controlled trials, conducted from 2010 to 2018, and performed a meta-analysis. Mean difference and 95% confidence intervals (CI) were calculated by sex, age group, and influenza strain for post-vaccination geometric mean titers (GMT) and geometric mean ratios (GMR). Risk ratios (RR) and 95% CI comparing seroconversion proportions (SCP) in females vs. males were pooled, for each influenza strain. Vaccine efficacy (VE) was also assessed. Data were analyzed separately for younger (18-64 years) and older (≥65 years) participants, and a random-effects model was used.

Results and analysis: 33,092 adults were included for immunogenicity analysis, and 6740 for efficacy. In older adults, higher SCPs were observed in females compared to males for all influenza strains (RRH1N1 1.15 [1.08, 1.23]; RRH3N2 1.1 [1.05, 1.15]; RRB-Victoria 1.25 [1.11, 1.41]; RRB-Yamagata 1.24 [1.14, 1.34]. In younger adults, a difference was noticed only for B-Yamagata strain, with slightly higher SCPs in females: RRB-Yamagata 1.06 [1.02, 1.09]. GMRs were also higher in females in the older age group for all strains, whereas GMTs were higher in older females for the H1N1 and H3N2 strains, and higher in younger males for both B strains. VE in preventing lab-confirmed influenza was higher in older females compared to older males with VEs of 27.32% (1.15, 46.56) and 6.06% (-37.68, 35.90), respectively.

Conclusions and implications for policy, practice or additional research: Our results suggest a higher immunogenicity and VE in females compared to males among older adults. These differences in immunogenicity and VE may support the stratification of vaccine efficacy and effectiveness by sex.

---

28. Forecasting seasonal influenza in Ontario using ACES daily emergency department ILI visit data: An interactive dashboard

Thommes E, Amiri L, Cojocaru M, Glazer M, Grunnill M, Lee J, McCarthy Z, Prashad C, Schanzer D, Shin T, Slipp N, Van Dijk A, Wu J

Introduction/background: Accurate forecasts of seasonal influenza activity are an important tool to inform healthcare resource capacity planning, vaccine distribution, and even vaccine uptake within the population. A promising avenue for improving forecasting to combine traditional surveillance data with other inputs.

However, no matter how accurate a forecast, in order to be meaningful and actionable, it must be disseminated in a user-friendly, accessible manner.

Methods: We present a proof-of-concept of a dashboard which uses emergency department influenza-like illness (ILI) data from Ontario's Acute Care Enhanced Surveillance (ACES) system, operated by Kingston, Frontenac, Lennox and Addington (KFL&A) Public Health. Additionally, we use the weekly number of viral identifications reported by the Respiratory Virus Detection Surveillance System (RVDSS), as published by FluWatch. The underlying forecast model incorporates early season onset detection and early peak timing/height prediction using a novel optimization-driven piecewise fitting approach.

Results and analysis: To validate the model, we conducted retrospective forecasts for the 2014/2015 to 2019/2020 influenza seasons in Ontario. Forecasts performance over time horizons of 1 to 6 weeks was assessed using the mean absolute error (MAE) and weighted interval score (WIS). Overall, performance increased with successive seasons as the model was able to "learn" from more past seasons. Visualization of retrospective forecasts was integrated into the dashboard, allowing the user to compare forecasts to reality for past influenza seasons.

Conclusions and implications for policy, practice or additional research: This proof of concept represents an important milestone in the development of the dashboard. In its ultimate form, the dashboard is intended as an information and decision-support tool for both Public Health and the general public.
This work is supported by an NSERC Industrial Research Chair (PI: JH) co-funded by Sanofi, and an NSERC Discovery grant (PI: MC). ACES data is provided by KFL&A Public Health.

---

29. Evaluation of tick surveillance to monitor the prevalence of Borrelia burgdorferi-infected Ixodes scapularis ticks, in Canada: a comprehensive literature review

Kelly P, Xu Q, Major M, Burn L, Halsby K, Angulo F, Vojicic J, Start J

Introduction/problem definition that demonstrates the need for a policy change: Lyme disease (LD) incidence is increasing in Canada in concert with the northward expansion of Ixodes scapularis ticks, a primary vector of Borrelia burgdorferi (Bb). Canada utilizes tick surveillance to monitor tick populations and assess LD risk, but an aggregated long-term analysis has not been performed. This review aimed to explore I. scapularis tick surveillance data and assess LD risk before and after 2009 when LD became notifiable in Canada.

Research methods: A comprehensive literature review was performed with searches between January 2002-May 2022. I. scapularis data collected from humans, animals, and tick dragging, were included. Descriptive analyses were performed to assess the prevalence of Bb-infected I. scapularis ticks accounting for surveillance type, province, year, and incidence of reported LD cases.

Results and analysis: 1178 publications were retrieved; 45 met inclusion criteria. The studies reported 169,042 I. scapularis ticks from 28 active and 22 passive surveillance datasets between 1990-2020. 7 passive and 8 active surveillance studies were initiated prior to 2009 (n=13,627 ticks). After 2009, 16 passive and 20 active surveillance studies were performed (n=155,415). A high degree of heterogeneity in methods or inconsistent data prevented meta-analysis. However, subsets of data were used for structured analyses. In Quebec and Ontario, pooled Bb-infection prevalence in citizen-science submissions significantly increased from 12.6% before

2009 (n=3614) to 16.3% after 2009 (n=58,282) (p<0.04). In ticks collected from dragging, Bb-infection prevalence significantly increased from 11.3% (n=521) to 26.5% (n=5373) (p<0.01). The analyses revealed the utility of a dual-use tick surveillance approach to measure the prevalence of Bb-infected ticks and assess LD risk in Canada.

Recommendations and implications for policy, practice or additional research: Standardized methods to collect and report long-term tick surveillance data, such as those performed by the Canadian Lyme Sentinel Network, are crucial to identify LD risk areas. Public health interventions, such as a safe and effective vaccine, are needed to mitigate increasing LD incidence in Canada.

---

30. Does a humoral correlate of protection exist for SARS-CoV-2? A systematic review

Perry J, Osman S, Wright J, Richard-Greenblatt M, Buchan S, Sadarangani M, Bolotin S

Introduction/background: A correlate of protection (CoP) is an immunological marker associated with protection from an infectious agent following infection or vaccination. CoPs are used to provide vaccine trial endpoints, and to determine individual and community-level immunity. A CoP is still undefined for SARS-CoV-2, leaving an evidence gap in public health knowledge and policy.

Methods: We searched OVID MEDLINE, EMBASE, Global Health, Biosis Previews and Scopus and the NIH COVID-19 pre-print server for studies describing SARS-CoV-2 re-infection or breakthrough infection with associated antibody measures up to Jan. 4 2022. Two reviewers independently extracted study data and performed quality assessment.

Results and analysis: We included 25 studies in our systematic review. Two studies examined the correlation of antibody levels to vaccine efficacy, and reported values ranging from 48.5% to 94.2%. Several studies found an inverse relationship between antibody levels and infection incidence, risk, or viral load. However, individual level data suggest infection can still occur in the presence of high antibody levels. Two studies estimated a quantitative CoP: for Ancestral SARS-CoV-2, these included 154 (95% confidence interval (CI) 42, 559 anti-S binding antibody units/mL (BAU/mL)), and 28.6% (95% CI 19.2, 29.2%) of the mean convalescent antibody level following infection. One study reported a CoP for the Alpha (B.1.1.7) variant of concern of 171 (95% CI 57, 519) BAU/mL. No studies reported an Omicron-specific CoP.

Conclusions and implications for policy, practice or additional research: Our review suggests that a SARS-CoV-2 CoP is likely relative, where higher antibody levels decrease the risk of infection, but do not eliminate it completely. Furthermore, although antibody level correlates with immunity, other immune components likely contribute to protection. More work is urgently needed in this area to establish a SARS-CoV-2 CoP and guide policy as the pandemic continues.

---

31. Forecasting the 2022-23 Epidemic Trends of Respiratory Syncytial Virus in Ontario

Amiri L, Shin T, Thommes E, Wu J

Introduction/background: Respiratory syncytial virus (RSV) is a highly seasonal and common respiratory virus that can infect people of all ages across Canada.

Methods: We constructed a seasonally forced age-structured Susceptible-Exposed-Infectious-Recovered (SEIR) disease transmission dynamics model with individuals stratified by their age intervals to study the seasonal epidemic trends of RSV peak time in Ontario. The model was calibrated by weekly RSV cases reported by the Public Health Agency of Canada for five different age groups from 2013–2019, and the seasonal curves of positive RSV detections were statistically fit by applying R software.

Results and analysis: We assumed each age group had different disease parameters across the various RSV seasons. Using simulations, the set of parameters minimizing mean square error was the optimal predictive

model. Our age-structured SEIR model accurately mimicked the observed epidemic curves. This model was used to project the 2022-2023 RSV peak time and peak values in different age groups in Ontario.

Conclusions and implications for policy, practice or additional research: Our age-structured SEIR model accurately mimicked RSV seasonal epidemic curves and may serve as a reliable model for predicting future RSV peak times. This may be valuable for public health stakeholders when planning and executing infection prevention and control programs.

---

32. Cost-effectiveness Analysis of an Infant 20-valent Pneumococcal Conjugate Vaccine Program for Prevention of Pneumococcal Disease in Canada

Lytle D, Grajales A, Vojicic J, Ait Yahia N, Yarnoff B, Patel S, Chapman R, Dillon-Murphy D, Perdrizet J

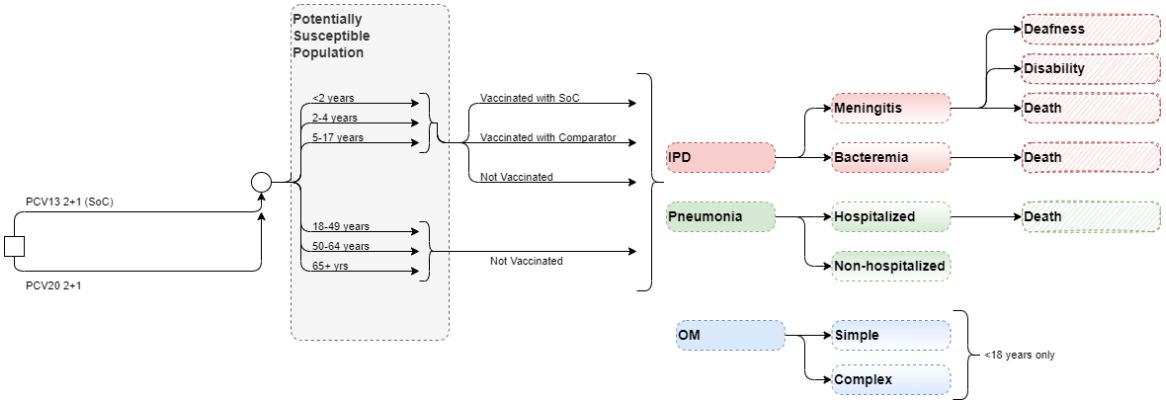
Introduction/background: The 13-valent pneumococcal conjugate vaccine (PCV13) is used in a 2+1 schedule in the pediatric publicly funded program in Canada. The 20-valent PCV (PCV20) was approved by Health Canada in May of 2022 for adults ≥18 years and is expected to be approved in the pediatric population in Canada in the near future. The cost-effectiveness of switching the publicly funded infant immunization program from PCV13 to PCV20 in the Canadian health care system has not been assessed.

Methods: A decision-analytic Markov model was developed to compare PCV13 versus PCV20 under a 2+1 schedule (Figure 1). Vaccine effect estimates were based on PCV13 clinical effectiveness and PCV7 efficacy studies. Epidemiologic, clinical, cost per event, and list price input data were taken or estimated from published Canadian sources. Clinical and economic outcomes related to invasive pneumococcal disease (IPD), hospitalized and non-hospitalized pneumonia and simple and complex otitis media (OM) were calculated for the entire population to capture all indirect benefits. The incremental cost-effectiveness ratio was evaluated from the perspective of the publicly funded Canadian health care system over 10 years.

Results and analysis: Over 10 years, PCV20 has the potential to avert over 11,000 IPD cases, 316,000 pneumonia cases, 378,000 OM cases, and 15,000 deaths compared with maintaining PCV13. For PCV20, acquisition costs were offset by monetary savings from pneumococcal disease prevention. Therefore, PCV20 is estimated to result in 3.2 Billion (CAD) in cost-savings and 47,000 more QALYs (i.e. a dominant strategy) compared with PCV13.

Conclusions and implications for policy, practice or additional research: Considering the current pneumococcal disease burden in Canada, a PCV20 infant immunization program is estimated to be cost-saving relative to PCV13 at list prices. Results demonstrate the substantial clinical and economic benefit of a universal infant PCV20 program for the Canadian health care system.

Figure 1. Model Structure



Abbreviations: IPD = invasive pneumococcal disease; OM = otitis media; SoC = standard of care

33. Molecular epidemiology of rotavirus isolates following the widespread use of rotavirus vaccines from the Canadian Immunization Monitoring Program, Active (IMPACT)

Vadlamudi N, Sadarangani M, LeSaux N, Halperin S, Booth T, Bettinger J

Introduction/background: Group A rotaviruses causes significant morbidity and mortality globally among children <5years. Rotavirus strains typing is based on two structural proteins in the outer capsid: VP7, a glycoprotein(G protein) and VP4, a protease-cleaved protein(P protein). Two rotavirus vaccines, Rotarix(RV1) and RotaTeq(RV5), are based on G and P protein specificity. Monovalent vaccine(RV1) contains a human strain,G1P[8], and pentavalent vaccine(RV5) contains human bovine reassortants G1, G2, G3, G4, and P1A[8] strains. The vaccines were introduced in publicly funded rotavirus vaccine programs at different times from 2011 to 2019 across Canadian provinces. This study describes circulating vaccine (homotypic) and non-vaccine (partially and fully heterotypic) rotavirus strains following the implementation of rotavirus vaccines in Canadian infant immunization programs.

Methods: Stool specimens were collected from children aged 0-16 years admitted with lab confirmed rotavirus to 12 pediatric tertiary care IMPACT hospitals across Canada from 2012 to 2020. The National Microbiology Laboratory (NML) completed genotyping of these samples by hemi-nested multiplex PCR. Using generalized linear regression models, changes in the distribution of rotavirus strains were evaluated by year. Significance was $p<0.05$.

Results and analysis: A total of 1,134 cases were reported. The most frequent vaccine strains were G1P[8] (398 specimens, 32.0%) and G3P[8] (n=94, 7.5%), and non-vaccine strains were G9P[8] (n=236, 18.3%), G2P[4] (n=173, 13.9%), and G12P[8] (n=160, 12.8%). Substantial overall reductions were observed for cases from strains: G1P[8] (98%, $p<0.01$), G2P[4] (92%, $p<0.03$), and G9P[8] (90%, $p<0.003$). In contrast, year-to-year variation in prevalence of strain G3P[8] ranged from 11.6% (2012) to 3.2% (2015) to 26.1%(2019) and G12P[8] strain ranged from 15.3% (2012) to 3.8% (2017) to 18.6%(2018).

Conclusions and implications for policy, practice or additional research: Frequently circulating rotavirus vaccine strain G1P[8] and non-vaccine strains G2P[4], and G9P[8] have declined from 2012-2020. Annual variation in circulation of rotavirus strains during the study period emphasizes the importance of monitoring circulating strains in Canada to ensure vaccine program effectiveness.

---

34. Interim Results From a Phase 2, Randomized, Observer-Blind, Placebo-Controlled, Dose-Finding Trial of an mRNA-Based Cytomegalovirus Vaccine in Healthy Adults

Brown K, Panther L, Fierro C, Brune D, Leggett R, Peterson J, Pickrell P, Lin J, Wu K, Lee H, Hasselbeck R, Natenshon A, Miller J

Introduction/background: Cytomegalovirus (CMV), the most common congenital viral infection, can cause severe long-term health consequences in children, including neurosensory hearing loss and neurodevelopmental delay. Prevention of CMV infection is a public health priority. mRNA-1647, an mRNA-based vaccine against CMV consisting of 6 mRNA sequences encoding CMV antigens in a lipid nanoparticle formulation, is in development.

Methods: This Phase 2, randomized, placebo-controlled, observer-blind, dose-finding trial is evaluating the safety and immunogenicity of mRNA-1647 in healthy adults aged 18-40 years (NCT04232280). In Part 1 of the trial, CMV-seronegative and CMV-seropositive participants were randomized 3:1 to receive either 50 µg, 100 µg, or 150 µg mRNA-1647 or placebo at months 0, 2, and 6. In Part 2, CMV-seronegative and CMV-seropositive women were randomized 3:1 to receive either 100 µg mRNA-1647 or placebo at months 0, 2, and 6. Safety endpoints were solicited local/systemic adverse reactions, unsolicited adverse events (AEs), medically attended AEs, and serious AEs. Humoral immunogenicity endpoints were antigen-specific binding antibody titers and neutralizing antibody titers against epithelial cell infection and against fibroblast infection.

Results and analysis: In Parts 1 and 2, 252 and 63 participants were randomized, respectively. An interim analysis of Part 1 through 1 month after Dose 3 indicated that mRNA-1647 was generally well-tolerated and

immunogenic in both CMV-seronegative and CMV-seropositive participants. A subsequent interim analysis of Part 1 through end-of-study and Part 2 through 1 month after Dose 3 indicated immune persistence and a consistent safety and immunogenicity profile at the 100-µg dose level.

Conclusions and implications for policy, practice or additional research: Interim Phase 2 analyses of safety and immunogenicity observed mRNA-1647 to be generally well-tolerated and immunogenic in CMV-seronegative and CMV-seropositive participants. mRNA-1647 is currently being evaluated at the 100-µg dose level in a Phase 3 trial.

---

35. Imvamune® vaccine safety in Toronto, 2022

Beckermann K, Padhi S, Minnings K, Kadri O

Introduction/background: Surveillance and timely reporting of Adverse Events Following Immunization (AEFI) is key for a functional vaccine safety monitoring system. This is especially true when rarely used vaccine is administered. Although Imvamue® was designed to be both safe and effective, AEFI do occur and need to be reported in order to identify issues and take appropriate corrective action. The aim of this study is to document trends and summarize the reports of AEFI for Imvamune® administered vaccines in Toronto to control the Monkeypox outbreak.

Methods: Confirmed AEFI reported following Imvamune® administered during 2022 were extracted from the Ontario integrated Public Health Information Database (iPHIS). Data were analyzed with Microsoft Excel 2013 and SAS version 9.4. Imvamune® AEFI rate was calculated per 100,000 doses distributed.

Results and analysis: In Toronto, 19 confirmed AEFI were reported from June 24, 2022 through October 31, 2022, with an overall reporting rate of 0.64 per 100,000 population. Imvamune AEFI rate was 67.9 per 100,000 doses distributed. Almost a quarter (26%, n=5) of the reported AEFI were considered medically important events. There were no serious AEFI or deaths reported. The most commonly reported important events were: Syncope with injury (40%), Event managed as anaphylaxis (20%) and Cellulitis (20%). Results will be updated before the conference.

Conclusions and implications for policy, practice or additional research: To date, examination of Imvamune® AEFI reports, we found a low AEFI reporting rate. The most commonly reported AEFI were mild. Overall this preliminary analysis demonstrates the safety of Imvamune®, making it an option to respond to a community Monkeypox outbreak.

---

36. Long-term Protection Against Herpes Zoster (HZ) by the Adjuvanted Recombinant Zoster Vaccine (RZV): Interim Efficacy, Immunogenicity and Safety Results at Approximately 10 Years after Initial Vaccination

Ghesquiere W, Strezova A, Diez-Domingo J, Al Shawafi K, Tinoco J, Shi M, Pirrotta P, Mwakingwe-Omari A

Introduction/background: The recombinant zoster vaccine (RZV) demonstrated high vaccine efficacy (VE) against herpes zoster (HZ) in adults ≥50 years of age (YOA) in two phase 3 clinical trials (ZOE-50, NCT01165177 and ZOE-70, NCT01165229), and VE persisted up to year (Y)2 in the interim analysis of the extension study (ZOSTER-049, NCT02723773). Here we describe the interim analysis for Y4 of the extension study. Understanding the persistence of VE and long-term protection against HZ can help to optimize the use of RZV in adults ≥50 YOA.

Methods: Participants received two-dose RZV in the ZOE-50/-70 parent studies. In ZOSTER-049, the primary objective included VE against HZ over the study period. Secondary objectives included VE against HZ from 1 month post-dose 2 in the ZOE-50/-70 studies until the end of ZOSTER-049 Y4 (Y10 post-vaccination), persistence of vaccine-induced humoral immunogenicity in terms of anti-glycoprotein E (gE) antibody and cell-mediated immune response in terms of frequency of gE-specific CD4[2+] T-cells and safety. VE analysis used historical control estimates from ZOE-50/-70 placebo groups.

Results and analysis: ZOSTER-049 enrolled 7,413 participants and 7,277 were included in VE analyses. During 4 years of follow-up, overall VE against HZ was 81.6% (95% confidence interval [CI]: 75.2–86.6). From 1 month post-dose 2 in ZOE-50/-70 until Y4 of ZOSTER-049, the overall VE was 89.0% (95% CI: 85.6–91.3). Anti-gE antibody concentrations persisted >5 times above pre-vaccination up to Y10 post-vaccination. The frequency of gE-specific CD4[2+] T-cells remained above pre-vaccination from Y6 to Y10 post-vaccination. No safety signals were identified until the end of ZOSTER-049 Y4.

Conclusions and implications for policy, practice or additional research: Efficacy against HZ and immune responses to RZV remained high until the end of the observation period, suggesting that the clinical benefit of RZV in adults ≥50 YOA is sustained for at least 10 years post-vaccination. RZV safety profile remained clinically acceptable.

---

37. Immunogenicity, reactogenicity and safety of a Respiratory Syncytial Virus prefusion F (RSVPreF3) candidate vaccine co-administered with the seasonal quadrivalent influenza vaccine in older adults

Loukov D, Chandler R, Montenegro N, Llorach C, Quinn D, Noriega-Aguirre L, Bensellam M, De Schrevel N, Kuriyakose S, Lambert A, Olivier A, Hulstrom V

Introduction/background: Respiratory syncytial virus (RSV) can cause severe respiratory disease in older adults (OAs). There is no approved vaccine against RSV disease in OAs. Co-administration of vaccines against RSV and influenza could be considered given their overlapping seasonality. Here, we assessed the immunogenicity, reactogenicity and safety of an RSV prefusion F protein Older Adult (RSVPreF3 OA) investigational vaccine when co-administered with the seasonal quadrivalent influenza vaccine (FLU-QIV) in OAs.

Methods: In this Phase 3, open-label, controlled, multi-country study (NCT04841577), OAs aged ≥60y recruited in New Zealand, Panama and South Africa were randomized 1:1 to receive either RSVPreF3 OA and FLU-QIV simultaneously on day 1 (Co-Ad group), or FLU-QIV on day 1 and RSVPreF3 OA on day 31 (Control). The co-primary objectives were to demonstrate the non-inferiority of i) RSVPreF3 OA in terms of RSV-A neutralizing antibody geometric mean titers (GMT) ratio and ii) FLU-QIV in terms of hemagglutinin inhibition antibody GMT ratio for each Flu strain when co-administered versus sequentially administered. Non-inferiority was demonstrated when upper limit (UL) of 95% CI of the GMT ratio (Control/Co-Ad) was ≤1.5. Secondary descriptive outcomes included reactogenicity and safety.

Results and analysis: 885 participants received at least 1 dose of the study interventions. Of these, 838 were included in the per protocol set at 1-month post-vaccination. The demographic characteristics of participants were similar across groups. The study co-primary objectives were met. For both vaccines, UL of 95% CI of the GMT ratio was ≤1.5. The observed safety events were balanced between Co-Ad and Control groups. The reactogenicity profile of the Co-ad group compared with the Control was driven by the RSVPreF3 OA investigational vaccine.

Conclusions and implications for policy, practice or additional research: Our results support simultaneous seasonal vaccination with RSVPreF3 OA and FLU-QIV in adults ≥60y, as co-administration elicits a statistically non-inferior immune response to the administration of each vaccine alone, with no safety concerns identified.

---

38. Bell's Palsy following vaccination against COVID-19: Analysis of passive surveillance reports and population-based emergency room consultations in Quebec

Mckay R, Drescher O, **Rouleau I**, Padet L, De Serres G

Introduction/background: An excess of Bell's palsy was observed in the vaccine arm of phase III COVID-19 trials and numerous cases have been reported to the vaccine adverse event following immunization surveillance system (ESPRI) in Quebec. This study describes the characteristics of reported cases and the active investigation of this safety signal.

Methods: All cases of Bell's palsy occurring within 42 days following immunization reported to ESPRI between December 14, 2020 and March 31, 2022 were included.

All incident visits for Bell's palsy during the same period were extracted from the database recording all emergency room visits in the province. These cases were linked to the Vaccine Registry to identify their COVID-19 immunizations, and to the provincial COVID-19 laboratory database to exclude visits among patients with a positive COVID-19 test in the 42 days prior. We compared the rates of visits occurring on days 0 to 41 (at-risk period) following vaccination to those occurring on days 42 to 83 (control period).

Results and analysis: The passive surveillance system received 173 reports of Bell's palsy following a dose of COVID-19 vaccine. The weekly % of cases was higher during the first week following immunization than in later weeks. The rate per 100,000 doses was higher in women compared to men and with 1234mRNA compared to BNT162b2, following a first but not subsequent doses.

For the active investigation, there were 1121 Bell's palsy emergency room consultations within 84 days of vaccination. The weekly frequency of event was similar during the 84 days. Rate ratios of consultations in the 0-41 vs 42-83 days following immunization were all non-significant regardless of type of vaccine, number of doses, age or sex.

Conclusions and implications for policy, practice or additional research: While cases occurred following immunization, this analysis showed no evidence of increased risk of Bell's palsy following COVID-19 vaccines.

---

39. DANFLU-1: Feasibility of a pragmatic randomized trial to assess the relative effectiveness of high-dose (QIV-HD) vs. standard-dose quadrivalent influenza vaccine (QIV-SD) on severe cardio-respiratory outcomes in elderly adults

Johansen N, Modin D, Nealon J, Samson S, Salamand C, Loiacono M, Larsen C, Reimer Jensen A, Landler N, Claggett B, Solomon S, Landray M, Gislason G, Køber L, Stæhr Jensen J, Sivapalan P, Vestergaard L, Valentiner-Branth P, Krause T, **Biering-Sørensen T**

Introduction/background: The relative vaccine effectiveness (rVE) of high-dose quadrivalent influenza vaccines (QIV-HD) versus standard-dose quadrivalent influenza vaccines (QIV-SD) against hospitalizations and mortality in the general older population has not been evaluated in an individually randomized trial. Due to the large sample size required, such a trial will need to incorporate innovative, pragmatic elements.

Methods: We conducted a pragmatic, open-label, active-controlled, randomized feasibility trial in Danish citizens aged 65-79 years during the 2021/2022 influenza season. Participants were randomized 1:1 to QIV-HD or QIV-SD. Randomization was integrated into routine vaccination practice and the trial relied solely on nationwide administrative health registries for data collection. Outcomes consisted of a feasibility assessment and descriptive rVE estimates.

Results and analysis: A total of 12,477 randomized participants were included in the final analyses. Mean age was 71.7 years (SD 3.9) and 5,877 (47.1%) were women. Registry-based data collection was feasible with complete follow-up data for 99.94% of participants. Baseline characteristics were comparable to the overall Danish population aged 65-79 years. Compared with QIV-SD recipients, the QIV-HD group had a lower incidence of hospitalization for influenza or pneumonia (10 (0.2%) vs. 28 (0.4%) events; rVE 64.4% (95% CI 24.4% to 84.6%)) and all-cause mortality (21 (0.3%) vs. 41 (0.7%) events; rVE 48.9% (95% CI 11.5% to 71.3%).

Conclusions and implications for policy, practice or additional research: Conducting a pragmatic randomized trial of QIV-HD vs. QIV-SD utilizing existing infrastructure and registry-based data collection was established as feasible. The incidence of hospitalization for influenza or pneumonia and all-cause mortality was lower in the QIV-HD group compared with QIV-SD, however, these findings require replication in a future fully powered trial.

---

40. RSV-related health and economic outcomes associated with implementing an extended half-life monoclonal antibody for an all-infant population in Canada: A Static Model

Shin T, Lee J, Lam G, Kieffer A

Introduction/background: Respiratory syncytial virus (RSV) is a highly infectious respiratory virus and the leading cause of hospitalizations among infants <4 years in Canada. All children will be infected with RSV by 24 months, with a significant amount of burden experienced by healthy full-term infants. In order to protect all infants from severe RSV disease, an extended half-life monoclonal antibody (i.e. nirsevimab) was developed as a the basis for a universal immunoprophylaxis strategy. Modelling was utilized to assess the health and economic burden of RSV disease, comparing nirsevimab to the standard of care in Canada.

Methods: Utilizing a static decision tree model, various health outcomes (inpatient hospitalization, ICU, mechanical ventilation, ER, primary care, mortality) and associated direct healthcare costs were calculated over one RSV season for three infant categories (palivizumab-eligible, preterm, term). Scenario analysis explored four costing matrices ranging from conservative to liberal. All health-related parameters and costs were tailored to the Canadian environment with appropriate CPI adjustments.

Results and analysis: Implementing an immunization strategy with nirsevimab across all three infant categories (i.e. all-infant) during an infant's first RSV season may reduce healthcare-related outcomes in Canada by approximately 39,000 hospital-related admissions. Among the various scenarios, direct healthcare savings reached a maximum net amount of $64M CAD.

Conclusions and implications for policy, practice or additional research: All possible scenarios for an all-infant immunization strategy with nirsevimab (relative to the standard of care) resulted in reductions in RSV-related health and economic burden across Canada. Additional considerations pertaining to societal impact and downstream sequelae may optimize this model's final results.

---

41. Innovating ways to get immunization consent: Implementation of an electronic consent process for student clinics

Cuillerier M

Introduction/program need and objectives: With a continuous quality improvement approach to the immunization clinic process, York Region Public Health developed and implemented an online consent form for school-based student immunizations. The program goals are to improve efficiency and increase the number of completed consent forms.

Program methods, activities and evaluation: The online form was successfully rolled out for the 2022/2023 school year and a dashboard was developed for staff to monitor consent form data in real time. Since rollout, the program has collected ongoing feedback and adjusted the form and electronic consent process accordingly. Feedback has come from (1) informal, ongoing feedback collected from staff (2) passive feedback from parents collected via calls to Access York, and (3) ongoing monitoring of consent form data. A customer experience survey to collect feedback from parents is also underway with results expected in early 2023

Program results or outcomes: Over 20,000 electronic consent forms have been collected to date for the 2022/2023 school year, and the program is ongoing. YRPH has gained efficiencies by eliminating the amount of clerical staff hours required for the consent process, while information is stored in a central database, making it easier for staff to access and view completed forms, and developing a process to send electronic reminders about outstanding forms. The online form is also expected to improve customer experience for users (i.e. parents/guardians) by reducing the amount of time needed to access and complete a form.

Recommendations and implications for practice or additional research: YRPH recommends moving toward an electronic consent model to improve efficiency and user experience. Next steps include examining the impact of the electonic consent process on the number of consent forms received, which is linked to increasing the number of immunizations delivered and improving coverage rates for the relevant vaccine preventable diseases.

42. Educating Pharmacy Students about the CARD System™ (Comfort Ask Relax Distract) to Reduce Immunization Stress-Related Responses: Satisfaction and Utility for Practice

Logeman C, Crown N, Bucci L, Rocchi M, **Gudzak V**, Taddio A

Introduction/background: Community pharmacies are a common setting for vaccinations, including COVID-19. To date, there have been no systematic approaches to delivering vaccines in this setting that minimize the risk of Immunization Stress-Related Responses (ISRR) such as fear, pain, and fainting. We developed a vaccine delivery framework that promotes coping interventions called CARD (C-Comfort, A-Ask, R-Relax, D-Distract). CARD was created through a user-centered approach that encourages collaboration between health care providers and patients in the selection of interventions. We introduced CARD education to mandatory injection training for second year pharmacy students at the University of Toronto. The present study examined the perceptions of students that completed the training in 2022.

Methods: Eighteen (n=14 female) pharmacy students participated across three 1-hour focus groups between September 26 and October 2, 2022. Students were asked about what they learned and how they applied the knowledge and skills using a semi-structured interview guide. The Consolidated Framework for Implementation Research (CFIR) was used as the analysis framework.

Results and analysis: Participants believed CARD was effective and aligned with *patient needs and preferences*. Many CARD interventions were *compatible* with their practicum placements, and they reported higher *self-efficacy* in their ability to support patients during vaccination. Challenges were identified with implementation of some interventions, due to lack of *available resources* and *priority of the intervention*. While they appreciated the patient-centered approach of CARD, participants did not educate patients about CARD prior to vaccinations. Rather, they directed clients to select from a sub-set of CARD strategies that they believed were appropriate for them.

Conclusions and implications for policy, practice or additional research: Participants valued CARD education and applied aspects of CARD to their practicum experiences. Development of additional educational resources such as case studies/scenarios are recommended to deepen understanding of the role of patients to optimize their participation and, in turn, the impact of CARD.

---

43. VaxCheck: Development and testing of community pharmacy-based vaccination reviews using a continuous quality improvement approach

Houle S, Yang M, Vernon-Wilson E, Dolovich L, Waite N

Introduction: One in four Canadians is under-vaccinated. Identifying unimmunized or under-immunized individuals is an important public health strategy for preventing disease. The accessibility of community pharmacies and expertise of pharmacy staff place them in a pivotal position for delivering vaccination services. Pharmacists currently deliver a range of health monitoring services, including medications review or MedsCheck. This study aimed to develop and test the feasibility of a tool and process that would facilitate vaccination reviews and identification of immunization gaps - VaxCheck. Quality improvement methodology was used to drive rapid adaptation and evaluation of the VaxCheck tool in practice.

Methods: A comprehensive, concise VaxCheck tool was created reflecting NACI recommendations for adult vaccination and guidance on Ontario's publicly funded vaccination program. Nine community pharmacies in Ontario offered VaxCheck to patients. Each pharmacy undertook three rapid cycles of quality improvement adjusting the VaxCheck process for groups of 5-8 patients. Following VaxCheck, patients completed satisfaction surveys. Data on vaccination recommendations and uptake at 3 months were collected. Semi-structured interviews were used to explore VaxCheck feasibility and workplace adaptations made to accommodate the service.

Preliminary Results: Analysis of baseline interviews demonstrated pharmacists welcomed a concise, comprehensive tool for reviewing vaccinations and guiding recommendations. Time, workforce capacity and collecting sufficient vaccination history were recognised as obstacles. Perceived patient barriers included vaccine fatigue, concerns about cost of vaccines, vaccination risks and confusion about the role of different vaccine providers. Perceived benefits included giving structure to vaccine advisory services, adding significance and value to vaccination for patients.

Conclusions: VaxCheck offers a way of regularly and methodically reviewing vaccination status in community pharmacy settings. Preliminary findings indicate an appointment-based model adds structure and value to the process of reviewing vaccinations. Complete study results will be available for presentation at the conference.

---

44. Nova Scotia Health COVID-19 Immunization Pharmacist Consult Service: A Virtual Network for Nova Scotian Immunizers

Nodwell L, **Ramsey T**, West J, Merrick K

Introduction/program need and objectives: Using diverse models of delivery, over 900 community and hospital pharmacists partnered with nurses, physicians, and other providers in a comprehensive COVID-19 Immunization Strategy in Nova Scotia (NS). COVID-19 vaccine information is constantly evolving requiring immunizers to perform detailed assessments and conduct complex consent conversations. Lacking a consistent mechanism to process and document vaccine questions, NS immunizers were challenged to effectively and efficiently respond. The NSH COVID-19 Immunization Pharmacist Consult Service was founded to provide all practitioners with access to current vaccine information, grounded in best evidence, thereby empowering patients to make informed decisions and nurturing the value of vaccination to community wellness.

Program methods, activities and evaluation: The consult service functions to provide rapid response to questions regarding vaccine efficacy, safety, dosing, storage, stability and administration; supporting immunizers to navigate complex consent questions, and using frontline feedback to generate timely and practical resources.

Creating a COVID-19 vaccine information repository using REDCap® the consult service reports and evaluates quantitative metrics including number of questions, category, setting, practitioner and region, in addition to assessing qualitative measures related to user satisfaction and suggestions for quality improvement via an electronic survey.

Program results or outcomes: As of October 31, 2022, the consult service has responded to 2,702 vaccine questions, with 1,122 questions generated by pharmacists. Fifty-one percent of questions were related to vaccine intervals, eligibility and dosing, with 18% specific to clinical complexity or special populations. Vaccine information requests were noted in all four health regions, generated from community pharmacy, public clinics and outreach. Frontline feedback included, "This is an extremely valuable service which gives me confidence to provide covid vaccinations.

Recommendations and implications for practice or additional research: Providing real-time advice, the consult service facilitates collaboration, allowing patients, providers, and pharmacists to work as a team, achieving patient-centered goals. Embracing a virtual model, addresses inequity in access to vaccine care, and builds system capacity, seamlessly offering vaccine information in diverse settings.

---

45. Immunization Skills Checklist Improvement Project

Sharma B, Paterson H, **Guenther M**

Introduction/program need and objectives: BC's Immunization Competency Program consists of the BCCDC Immunization Competency Course and the Immunization Skills Checklist. The Immunization Skills Checklist is utilized by new and experienced immunizers across BC to demonstrate competence with administration of vaccine during a point-in-time in person assessment. The First Nations Health Authority (FNHA) conducted a literature review in 2020 which identifed the need to embed cultural safety and humility within BC's

Immunization Competency Program. It also identified the need for alternative mechanisms of assessments as well as considerations for immunizers working in rural and remote locations without on-site mentorship. The FNHA launched an Immunization Skills Checklist Improvement Project to incorporate these suggested changes.

Program methods, activities and evaluation: The project team reviewed materials identified in the 2020 literature review as well as additional significant references to support initial revisions to the checklist (e.g. BCCNM Indigenous Cultural Safety, Humility and Anti-Racism Practice Standard & BCPSQC 'What Matters to Indigenous Patient Partners' guidance document).

Further changes were made during an iterative process of consultations and revisions of the checklist. This involved two rounds of survey consultation on the proposed changes with the second survey being rolled out as part of a pilot. During the pilot, the proposed changes were evaluated in real-world immunization competency checklist sign-offs.

Program results or outcomes: The revised checklist now incorporates cultural safety and humility considerations and an expanded assessment of immunization competecies. It has been modified to include an option and parameters for virtual sign-off.

Recommendations and implications for practice or additional research: The project team recommends provincial adoption of the revised immunization skills checklist for use by all 5 regional health authorities in BC. Evaluation on the relevance of this checklist in an urban setting is recommended upon provincial adoption.

---

46. National safety monitoring of seasonal influenza vaccines from the Canadian Adverse Events Following Immunization Surveillance System and the Canada Vigilance Database, 2021/2022

Giang E, Xu Y, Naganathan T, Salim B, Bawolak M, Shaw A, Ogunnaike-Cooke S, **El-Jaouhari M**

Introduction/program need and objectives: Influenza vaccines authorized for use in Canada have all undergone rigorous regulatory assessment for safety and effectiveness. However, adverse events following immunization (AEFI) can occur. Post-marketing surveillance of adverse events remains critical for the detection of rare, late onset or unexpected events. In Canada, seasonal influenza vaccine (SIV) pharmacovigilance relies on passive and active surveillance mechanisms. Here, we summarize AEFIs following administration with SIV for the 2021/2022 influenza season.

Program methods, activities and evaluation: Adverse event reports between October 1, 2021 and March 31, 2022 were obtained from the Canadian Adverse Event Following Immunization Surveillance System (CAEFISS) and the Canada Vigilance Database (CVD). Descriptive analyses were performed and dose-based reporting rates were calculated and assessed against the previous 10 influenza seasons. Disproportionality analysis was used to identify potential vaccine safety signals.

Program results or outcomes: There were 449 AEFI reports received in CAEFISS and CVD. Seventy-two (16.0%) reports met the serious definition. The most frequently reported events were vaccination site pain (78; 17.7%), and urticaria (52; 11.6%). Most reports (286; 63.7%) listed SIV as the only vaccine administered. Of the reports listing at least one concomitant vaccine, the most common vaccines were COVID-19 (69), and pneumococcal 23-valent polysaccharide (33). Eleven reports included a specific adverse event of special interest (AESIs). The overall reporting rate was 2.7/100,000 doses distributed, a figure significantly lower ($p<0.05$) than reported in previous seasons. Elevated values for vaccination errors (non-serious) were identified using disproportionality analysis.

Recommendations and implications for practice or additional research: Safety surveillance of SIV distributed in 2021/2022 did not reveal any new safety concerns or unexpected events. Local Injection site reactions and self-limited symptoms were the most commonly reported. AESIs reported were rare, and consistent with pre- and post-licensure reports following SIV. Most vaccination errors involved the administration of vaccine at an inappropriate site. Training and education of providers on proper injection technique may help to prevent vaccination errors.

47. National safety monitoring of vaccines from the Canadian Adverse Events Following Immunization Surveillance system (CAEFISS), 2018-2021

El Jaouhari M, Wells C, Johnson K, Anyoti H, Xu Y, Giang E, Shaw A, Ogunnaike-Cooke S

Introduction/background: The Canadian Adverse Events Following Immunization Surveillance System (CAEFISS) is a comprehensive vaccine safety surveillance system that includes both passive and active surveillance for vaccines administered in Canada. This work presents a summary of adverse events following immunization (AEFI) nationally for the years 2018-2021.

Methods: Data extracted from CAEFISS included all AEFI reports received by April 30, 2022, for vaccines administered between January 1, 2018 to December 31, 2019, and all AEFI reports received by August 22, 2022, for vaccines administered between January 1, 2020 and December 31, 2021. Descriptive analyses were conducted by type of surveillance program, AEFIs reported, demographics, health care utilization, outcome and seriousness of adverse events.

Results and analysis: In 2018, 2019, and 2020, there were 2911 reports (11.9 per 100,000 doses distributed), 2964 reports (11.2 per 100,000 doses distributed), and 2383 reports (7.9 per 100,000 doses distributed) respectively. In 2021, there were a total of 42,640 reports received (36.2 per 100,000 doses distributed). The increase of AEFI reports in 2021 reflects the increase in vaccination and AEFI reporting from the COVID-19 vaccination campaign. Between 2018 and 2021, the majority of reports (90%) were non-serious events, involving vaccination site reactions, rashes and allergic events. There were 4,862 serious adverse events where the most common primary AEFIs reported were anaphylaxis, seizure, acute cardiovascular injury, and thrombosis. Safety issues identified in Canadian data related to COVID-19 vaccines included: thrombosis with thrombocytopenia syndrome and myocarditis/pericarditis. No safety issues were identified for the other non-COVID vaccines.

Conclusions and implications for policy, practice or additional research: The COVID-19 pandemic had a substantial impact on the numbers of AEFI reports received in 2021, which is likely associated with a combination of the high population COVID-19 vaccination uptake, increased media attention on the pandemic and vaccination campaign, and higher awareness of AEFIs. Vaccines marketed in Canada continue to have a favorable safety profile.

---

48. Preparedness Strategies of the National Advisory Committee on Immunization's High Consequence Infectious Disease Working Group

Killikelly A, **Forbes N**, Mauviel C, Tunis M

Introduction/program need and objectives: High Consequence Infectious Diseases (HCIDs) are those having a low probability of outbreak but high consequences for the individual or the society if an outbreak occurs, e.g., Ebolaviruses and orthopox viruses. Here we outline different processes of the National Advisory Committee on Immunization (NACI) for HCID preparedness, and implications for future work.

Program methods, activities and evaluation: Since its inception in 2018, the NACI HCID Working Group has completed two major work projects in addition to leading vaccine guidance on the COVID-19 pandemic throughout 2020-2022:

(1) Interim guidance for rVSV-ZEBOV vaccine (Merck) against a hypothetical outbreak of Ebola virus (February, 2020). This guidance took 8 months to develop.

(2) Two rapid responses for Imvamune vaccine (Bavarian Nordic) to address the Canadian outbreak of monkeypox (June, 2022, and September, 2022) in the context of an outbreak. The initial guidance was published 22 days from the date of the first monkeypox case in Canada.

Program results or outcomes: These two projects were similar in that they both provided guidance on the use of vaccine products federally stockpiled for emergency use and leveraged both pre- and post-exposure prophylaxis principles. Key differences were that Imvamune guidance was developed 10x faster than rVSV-ZEBOV guidance and development of the Imvamune guidance leveraged innovative stakeholder engagement to ensure guidance met the needs of individuals most affected by the ongoing outbreak.

Recommendations and implications for practice or additional research: These two case studies demonstrate different approaches to preparedness for HCIDs. In one case, rapid work can be undertaken to address urgent health threats to Canadians. In the other case, preliminary work can be undertaken to address a hypothetical threat and to preposition guidance for immediate use when needed. Canada will continue to face HCID threats and these varied approaches present useful templates to develop future vaccine guidance.

---

49. Understanding immunization program decision-making in Canada and the existing gaps in funding, access, and coverage

Sahakian S, Ling J, Tian T, Iconaru C, Tehran A, Milson B

Introduction/problem definition that demonstrates the need for a policy change: Timely and equitable access to vaccines for Canadians may be hindered by complex decision-making processes. The objective of this research was to understand current gaps in vaccine funding and access, and vaccination coverage in Canada.

Research methods: This research was conducted using information from IQVIA datasets, public data, and interviews with five stakeholders in November 2022. A non-exhaustive number of vaccines were selected as case studies based on the existence of quantifiable gaps in access (as per Canadian Immunization Guide recommendations) and high out-of-pocket spending. The incremental doses needed for existing populations with gaps in access were estimated, while accounting for existing coverage and predicted uptake.

Results and analysis: This research showed that routine vaccine procurement accounted for roughly 0.15% of total public sector healthcare funding in 2020, and that vaccine-related decision-making mechanisms are highly complex. Stakeholders indicated that immunization programs were underfunded and not prioritized. The current decision-making system was described as lacking formalization and transparency. This research indicated that vaccination coverage could be improved by addressing vaccine hesitancy and misinformation, enhancing surveillance, and leveraging digital tools to facilitate vaccine administration and improve reporting.

Infleunza vaccine, recombinant zoster vaccine (RZV), tetanus toxoid, reduced diphtheria toxoid, and reduced acellular pertussis (Tdap) vaccine, and pneumococcal conjugate 13-valent (Pneu-C-13) vaccine were selected as case studies. To provide universal access across Canada, an estimated 1.4 million additional doses of influenza vaccine may be required each year. An estimated 14 million additional doses of RZV, Tdap vaccine, and Pneu-C-13 vaccine in total may be required for existing populations with gaps in access.

Recommendations and implications for policy, practice or additional research: Several gaps related to funding, access, and coverage in the Canadian immunization landscape were identified. This research better informs the policy gaps decision-makers should address to achieve the objectives set forth in the National Immunization Strategy; specifically, ensuring Canadians have timely and equitable access to immunization.

---

50. The Canadian COVID-19 Vaccination Coverage Surveillance System: An overview of design, methodology and use

Hong C, Ho Mi Fane B, Jeevakanthan A, Gilbert N

Introduction/program need and objectives: The Canadian COVID-19 Vaccination Coverage Surveillance System (CCVCSS) is a federal/provincial/territorial collaborative system built in December 2020 to monitor COVID-19 vaccinations across Canada. This overview describes the structure, data processing and use of the system's output.

Program methods, activities and evaluation: Provinces, territories, and two federal organizations that conduct vaccination (Canadian Armed Forces and Correctional Service Canada) provide the Public Health Agency of Canada with aggregated cumulative numbers of doses administered (by dose rank) and people vaccinated (by vaccination status), broken down by age, sex, and vaccine product. Number of people vaccinated is used as the numerator to estimate vaccination coverage. Standardized definitions and common inclusion and exclusion

criteria are applied across data providers. Data are ingested, cleaned and summarized using a system hosted by a Health Canada server.

Program results or outcomes: With the evolving vaccination program, the CCVCSS was subject to changes over time, including finer age groups, more detailed vaccine schedule information, addition of booster dose and time since last dose data elements. Reports on doses administered by jurisdictions and vaccine product as well as on vaccination coverage by vaccination status are primarily shared with the Canadian Immunization Committee, internal stakeholders, and published online. CCVCSS also provides denominator tables for the surveillance of adverse events following immunization and COVID-19 cases in vaccinated people. Comparison of estimates over time is limited due to changes in data quality and heterogeneity in data processing across jurisdictions.

Recommendations and implications for practice and additional research: CCVCSS was successful in adapting to changing needs and tracking the progress of the vaccination campaign in a timely fashion, with significant contributions from provincial and territorial partners. The CCVCSS highlights how surveillance data can be used beyond its primary purpose; however, with missing information on socio-economic status, race and ethnicity, it should be complemented with studies on barriers to and inequalities in vaccination to orient promotion efforts for booster campaigns.

---

51. Sex-differences in adverse events following seasonal influenza vaccines: A meta-analysis of randomized controlled trials

Kiely M, Tadount F, MacDonald S, Lo E, Wei S, Rafferty E, Sadarangani M, Quach-Thanh C

Introduction/background: Despite being a vaccine-preventable disease, influenza infections remain a major public health threat in Canada with vaccine safety concerns reducing vaccine acceptability. Immune responses to vaccines differ between males and females, but most studies do not report results by sex. Using data from clinical trials, we explored sex-differences in adverse events following seasonal influenza vaccines.

Methods: We requested data for phase III randomized controlled trials identified from a previous systematic review and clinical trials registries and performed a two-stage meta-analysis. Risk ratios (RR) and 95% Confidence intervals (CI) comparing proportions for solicited reactions in females vs. males were pooled using Mantel-Haenszel method and a random effect model. The main analysis was done separately for younger (18-64 years) and older participants (≥65 years). I2 statistic was used to assess heterogeneity.

Results and analysis: The dataset for this analysis included 34 343 adults from 18 studies (12 with individual-level data and 6 with aggregated data). There was a higher risk of local reactions in females compared to males for both younger and older participants, with RRs of 1.29 (95%CI: 1.21;1.37) and 1.43 (95%CI: 1.28;1.60) respectively. Higher risk in females was also observed for systemic reactions, with RRs of 1.25 (95%CI: 1.20;1.31) and 1.27 (95%CI: 1.20;1.34) for younger and older participants respectively. We also observed elevated risks of grade 3 reactions in females, with higher RR in younger vs. older participants for systemic reactions (RRs 2.12 and 1.48 P=0.03, I2=79.7%). RRs were not found to vary between quadrivalent and trivalent vaccines for both local and systemic reactions.

Conclusions and implications for policy, practice or additional research: This meta-analysis suggested a higher risk of solicited reactions following influenza vaccines for females compared to males, irrespective of age and the vaccine type. Given that adverse events could impact acceptability and vaccination uptake, the higher risk of reactions observed for females should be considered in future research and recommendations.

---

52. Anaphylaxis following COVID-19 vaccination in Quebec and risk of recurrence after revaccination

Kiely M, Drescher O, Rouleau I, Roussel R, De Serres G

Introduction/background: Many cases of anaphylaxis following COVID-19 vaccination were reported to the provincial adverse events following immunization (AEFI) surveillance system. We described the clinical

characteristics of these cases and estimated the rate of anaphylaxis and the risk of recurrence among those revaccinated.

Methods: The Brighton Collaboration case definition (BCCD) was used to categorize the level of diagnostic certainty of anaphylaxis cases reported between December 14, 2020 and March 31, 2022. Cases meeting BCCD level 1 or level 2 were used to estimate rates.

Results and analysis: More than 18.5 million doses were administered during the study period. Among the 373 AEFIs reported as anaphylaxis, 239 met level 1 (N=35) or level 2 (N=204) of the Brighton definition, yielding an overall rate of 12.9 per million doses administered (95% CI: 11.2; 14.5). Most cases occurred within the first hour following vaccination (81%) and experienced skin (89%) or respiratory (98%) symptoms. For the two mRNA vaccines, rates per million doses were similar for the first two doses with higher rate for the first (~25) compared with the second (~7.5) or the third dose (<4). For the ChAdOx1 vaccines, the rate per million doses did not differ much between the first (15) and the second dose (12.5). The rate among females was almost eight times higher compared to males and varied much with age, peaking between 30 and 59 years of age. Epinephrine administration was reported for 48% of cases and medical consultation/hospitalisation for 67%. Among the 228 cases eligible for revaccination, 157 (69%) received another dose and 7 (4.5%) experienced a recurrence.

Conclusions and implications for policy, practice or additional research: Anaphylaxis was rare but reported at a higher rate than expected during the COVID-19 vaccination campaign in Québec. Given the observed risk of recurrence, patients with anaphylaxis should continue to be referred to allergists to ensure safe revaccination.

---

53. Determinants of Non-Vaccination Against Seasonal Influenza during Pregnancy

Guan D, Gilbert N, Guay M, Kokaua J, Lévesque I, Castillo E, Poliquin V, Maquiling A

Introduction/background: In 2019, flu vaccination coverage in pregnant women is estimated to be only 45% in Canada. Our objective is to identify the determinants of influenza non-vaccination among Canadian pregnant women in addition to examining their knowledge, attitudes, and beliefs (KAB) regarding vaccination.

Methods: We used data from the 2019 Survey of Vaccination during Pregnancy which is a new module of the Childhood National Immunization Coverage Survey. Via an electronic questionnaire or a telephone interview, biological mothers of children born between September 2018 and March 2019 were asked about vaccinations received during their pregnancy, their KAB regarding immunization, and their demographics.

Simple and multiple logistic regression models were used to measure associations between various sociodemographic factors and non-vaccination for flu, whereas associations between KAB and non-vaccination were measured using simple regressions only.

Results and analysis: Factors independently associated with non-vaccination included having a midwife as the primary maternity care professional (OR 1.91; 95% CI: 1.19-3.06) compared to having a family physician; not having a high school diploma (OR 2.87; 95% CI: 1.39-5.90) compared to a bachelor's degree or higher; and having a family income of less than $60,000 (OR 2.43; 95% CI: 1.55-3.81) compared to a family income of $140,000 or more. There were also significant differences between provinces and territories.

Mothers' confidence in the safety and effectiveness of flu vaccination during pregnancy was lower than in the safety and effectiveness of vaccines in general. Lack of confidence in the vaccine was strongly associated with non-vaccination.

Conclusions and implications for policy, practice or additional research: Despite universal access to influenza vaccines in Canada for pregnant women, regional variations and socioeconomic inequalities in vaccine uptake are still observable. More research is needed to understand mechanisms for overcoming the barriers to influenza vaccination.

---

54. Adapting an Australian intervention to improve vaccination in pregnancy to the Canadian context: A Logic Model to guide design and evaluation

Castillo E, Patey A, Donald M, Dubé È, Bettinger J, Danchin M, Kaufman J, Amarbayan M, McNeil D, **Surti M**, Lee K, Bruce M, Pringle W

Introduction/program need and objectives: Logic models (LM) are used to map the flow of a given program, link key activities/ inputs to outcomes and guide work. The objective of the represented program was to adapt an Australian intervention, MumBubVax, for the Canadian vaccination in pregnancy (VIP) landscape. MumBubVax offers healthcare providers a central repository of efficient training resources and patient-directed material to improve communication. This LM was created to ensure key processes i.e., evaluation and theoretically rooted implementation science methods, were incorporated comprehensively.

Program methods, activities and evaluation: The current LM was developed by the research team to explicitly map out the steps to 1) examine the existing intervention; 2) identify healthcare providers' barriers/enablers in Canada, both pre- and post-Covid and determine if and how MumBubVax addressed Canadian barriers; and 3) adapt and evaluate the Canadian intervention. The LM indicates what implementation science theory and method will be used, at what phase and how. Specifically, Phase 1 summarizes how the intervention works with a simultaneous understanding of the pre- and post covid Canadian context. Behavioural Science theories were used (i.e., BCT Taxonomy and Theoretical Domains Framework) to map website components to identified barriers and enablers to practice change. Phase 2 includes adapting/piloting the intervention (using the Consolidated Framework for Implementation Research). The LM incorporates a series of "if-then" statements to assess if adaptation is required before clinic-specific implementation and evaluation

Program results or outcomes: Currently in Phase 1: Intervention Design, the LM has served as a guide for our work and is a workable protocol that we continue to adapt to reflect our project and evaluation plans.

Recommendations and implications for practice or additional research: The LM was used to ensure integration of theory and behavioural sciences into an intervention that targeted VIP discussions in Canada. However, this is a useful tool that can be utilized for other projects involving quality improvement and implementation research in a variety of target populations.

---

55. Assessing measles maternal immunity in Ontario

Osman S, Science M, McLachlan E, Severini A, Deeks S, Halperin S, Wright J, Brown K, Richardson S, Bolotin S

Introduction/background: Measles is highly infectious and can result in serious complications. Infants too young to be vaccinated rely on antibodies transferred transplacentally for protection. If mothers do not have sufficient antibody titres, protection in infants will wane earlier, increasing their duration of susceptibility. In Canada, measles was eliminated in 1998, and therefore most individuals of child bearing age have vaccine induced immunity. Our study aim was to assess measles immunity in women of childbearing age and identify risk factors for susceptibility.

Methods: Using a prospective cross-sectional study design, we collected data and samples from admitted infants and their mothers at the Hospital for Sick Children in Toronto, Ontario between 2018 and 2020. We tested samples using an enzyme immunoassay and a plaque reduction neutralization test. Mothers with PRNT titres ≥120 mIU/mL were considered immune.

Results and analysis: We recruited 258 mothers (age range: 16-45 years), of whom 80.6% had antibodies above the threshold of protection. The proportion of mothers with antibodies above the threshold was lowest in the youngest age-group (<25 years) at 67.9%, and increased with age ($p<0.01$). Of those that reported vaccination status, 97% reported receiving MMR vaccine, with no statistically significant difference in the proportion of vaccinated individuals by age ($p=0.77$) or in the proportion immune by vaccination status ($p=0.71$). Assessing travel data, we did not find a significant difference in immunity by recent travel (last 5 years) to countries with endemic measles ($p=0.47$).

Conclusions and implications for policy, practice or additional research: In mothers younger than 30 years, nearly one-third of samples were found to be below the threshold of immunity. Higher susceptibility in younger individuals amongst a highly vaccinated cohort suggests waning vaccine immunity. However, despite low antibody levels, it is unclear whether their immune system would mount a protective response if challenged. Further research is needed to understand the significance of the high proportion of potential susceptibility in younger age groups.

---

56. Updated analysis of the cost-effectiveness of palivizumab for the prevention of severe respiratory syncytial virus (RSV) infection in Canadian infants born moderate-to-late preterm

Paes B, Fullarton J, Keary I, Rodgers-Gray B, Tarride J, Carbonell-Estrany X

Introduction/background: Palivizumab is cost-effective in 32-35 weeks' gestational age (wGA) infants at moderate-to-high risk of RSV hospitalization (RSVH) using the 7-variable Canadian risk scoring tool (CRST). A 3-variable International RST (IRST) was developed, which captures more RSVHs (85% vs 54% with CRST). The objective was to undertake an updated economic analysis of palivizumab in Canadian 32-35wGA infants using both the CRST and IRST.

Methods: A new semi-Markov cost-utility model was developed of palivizumab versus no intervention. Respiratory morbidity over 6-18 years across a lifetime horizon was assessed among RSVH, emergency room/outpatient attended RSV-infected (MARI), or uninfected/non-medically attended infants. Palivizumab efficacy (72.2% RSVH reduction) and hospital outcomes were drawn from the Canadian CARESS, PICNIC and RSV-Quebec studies. Mortality (0.43%) was applied to intensive care admissions. Palivizumab costs (50mg: CAN$752; 100mg: $1,505) were calculated from Canadian birth statistics combined with a growth algorithm. The base case included prophylaxis of moderate-to-high risk infants with no vial sharing (1.5% discounting).

Results and analysis: Cost per quality-adjusted life year (QALY) was $15,833 with the CRST (0.96 probability of being <CAN$50,000) and $29,789 with the IRST (0.79 probability). The model was most sensitive to utility scores, long-term respiratory morbidity and palivizumab cost. Vial sharing improved cost-effectiveness (CRST: $9,231; IRST: $22,319). An exploratory scenario extending IRST risk boundaries to capture 98% of expected RSVHs, resulted in a cost/QALY of $35,304.

Conclusions and implications for policy, practice or additional research: This new analysis demonstrates that palivizumab remains cost-effective in Canadian moderate-to-late preterm infants with the CRST. The IRST provides another option to guide cost-effective RSV prophylaxis in Canada.

---

57. Pre-Transplant Vaccination Status in Pediatric Solid Organ Transplant Recipients

Burton C, Lum S, MacDonald S, Vaudry W

Introduction/background: Optimizing pre-transplant vaccination in children receiving solid organ transplants (SOT) is critical to protect them from vaccine-preventable diseases. We sought to determine pre-transplant vaccination status for pediatric SOT recipients in Alberta in the context of having formal Alberta accelerated immunization guidelines for pediatric SOT candidates/recipients, routine pre-transplant pediatric infectious disease consultation and in-hospital vaccination.

Methods: Pre-transplant vaccination records and baseline characteristics, for children receiving SOT at the Stollery Children's Hospital from 2006-2019, were obtained from review of electronic medical records. Vaccination records were compared to Alberta Immunization Guidelines for children expecting SOT (accelerated schedule), and to the routine Alberta Immunization Schedule. Logistic regression was performed to investigate associations between patient factors (geographic location, sex, organ transplanted, waitlist time, age at transplant, donor type) and the probability of having up-to-date vaccinations per the accelerated schedule.

Results and analysis: We examined vaccination records for 190 SOT recipients. At the time of transplant, 71/190 (37%) and 134/190 (71%) had up-to-date vaccinations per the accelerated and routine immunization schedules respectively. Figure 1 illustrates the percent of children with up-to-date vaccination, per the accelerated schedule, by vaccine and organ. In univariate analysis, odds of having up-to-date immunizations were significantly lower for liver and heart/lung recipients, compared with renal recipients (heart/lung vs. kidney OR 0.22 95%CI 0.10-0.49 p <0.001, liver vs. kidney OR 0.37, 95%CI 0.17-0.77, p=0.009) and higher in recipients with living versus deceased donors (OR 2.36 95%CI 1.27-4.38, p=0.006). In multivariate analysis, only organ transplanted remained significant (heart/lung vs. renal OR 0.22, 95% CI 0.097-0.494, p=0.0003, liver vs. renal OR 0.364, 95%CI 0.172-0.77, p=0.0083).

Conclusions and implications for policy, practice or additional research: Despite guidelines, infectious disease consultation and in-hospital vaccination, the majority of pediatric SOT recipients were not optimally vaccinated prior to SOT. Opportunities exist to improve pre-transplant vaccination, especially in pediatric liver, heart and lung transplant recipients.

---

58. Events of myocarditis/pericarditis following BNT162b2 vaccination in individuals aged 12-17 in Ontario, Canada

Buchan S, Alley S, Seo C, Johnson C, Kwong J, Nasreen S, Thampi N, Lu D, Harris T, Calzavara A, Wilson S

Introduction/background: The highest risk of myocarditis and pericarditis following COVID-19 mRNA vaccines has been reported following a second dose in young males, including adolescents. There is some evidence to suggest increasing risk with shorter intervals between dose 1 and 2 (i.e., 'inter-dose interval').

Methods: We conducted a population-based cohort study using passive vaccine safety surveillance data linked to the provincial COVID-19 vaccine registry. All adolescents aged 12-17 years in Ontario who received ≥1 dose of BNT162b2 vaccine between December 14, 2020 and November 21, 2021 were included. We calculated the reported incidence of myocarditis/pericarditis meeting levels 1-3 of the Brighton Collaboration case definition per 100,000 doses of BNT162b2 administered by age group (12-15 vs. 16-17 years), sex, dose number and inter-dose interval. Further, we summarized clinical information documented in the provincial system related to symptoms, healthcare utilization, diagnostic findings, and treatment information at the time of the acute event.

Results and analysis: There were ~1.65 million doses of BNT162b2 administered and 77 reports of myocarditis/pericarditis meeting our inclusion criteria among those aged 12-17 years during the study period. Of these events, 81.8% occurred in males and 66.2% occurred following the second dose of BNT162b2. Overall, 96.1% of individuals with an event were assessed in the emergency room and 44.2% were hospitalized (median length of stay, 1 day). The majority (74.0%) were treated with NSAIDs only and 14.3% required no treatment. The highest reporting rate of myocarditis/pericarditis was observed in males aged 16-17 years following dose 2. Among those aged 16-17 years, the reporting rate was highest in those with a short (i.e., ≤30 days) inter-dose interval.

Conclusions and implications for policy, practice or additional research: There is variation in the incidence of myocarditis/pericarditis following BNT162b2 vaccine among adolescent age groups. However, the risk of these events following vaccination remains very rare and should be considered in relation to the benefits of COVID-19 vaccination.

---

59. Adverse events following immunization with mRNA COVID-19 vaccines among people 12 and older in Canada: A comparison of age and sex differences

Bansal S, **Yeung A**, Weeks A, Johnson K, Shaw A, Ogunnaike-Cooke S

Introduction/background: Post-market surveillance is important to continuously monitor the safety of marketed vaccines in Canada and to identify any increases in the frequency or severity of unidentified or previously identified vaccine-related events. Our objective was to describe and compare adverse events following

immunization (AEFI) reports following mRNA vaccination among individuals aged 12-17 years and 18+ years who were vaccinated in Canada.

Methods: We analyzed data up to and including September 16, 2022 from the Canadian Adverse Events Following Immunization Surveillance System (CAEFISS). Descriptive analyses were used to compare AEFI reports for individuals aged 12-17 years to people 18 years and older at the time of vaccination in terms of: sex, seriousness, dose number in vaccine series, rates of top 10 AEFIs, most frequently reported adverse events of special interest (AESIs), and highest level of care obtained. Doses administered for rate denominators were obtained from the Canadian COVID-19 Vaccination Coverage Surveillance System using data as of September 11, 2022.

Results and analysis: The cohort included 1,506 reports in the 12-17 year age-group and 38,422 reports in the 18+ age-group. The top 10 AEFIs across both groups were mild (e.g. urticaria and vaccination site pain) and the most frequently reported AESIs were myocarditis/pericarditis and anaphylaxis. Rates of non-serious and serious AEFIs per 100,000 doses administered were significantly lower in the 12-17 age-group compared to 18+. However, the rate of myocarditis/pericarditis was significantly higher in the 12-17 age-group, especially males. Reporting rates among females 18+ were significantly higher than males 18+, whereas rates for males and females aged 12-17 years were similar.

Conclusions and implications for policy, practice or additional research: Our data indicate AEFI reporting rates following COVID-19 vaccination with an mRNA vaccines for people aged 12 and older are generally mild and non-serious, and reporting rates are lower in those 12-17 years olds, with the exception of myocarditis/pericarditis.

---

60. Routine vaccine uptake in school-aged autistic and non-autistic youth: A linked database study

Dodds L, Filliter C, Campbell L, MacDonald N, Shea S, Dubé E, Smith I, Filliter J

Introduction/background: School-based vaccination programs are employed in Nova Scotia, as in much of Canada, but vaccine uptake in autistic youth has not been studied in the context of school-based delivery models. This study was conducted to determine whether school-aged autistic youth received routine vaccines at a lower rate than their non-autistic peers.

Methods: In Nova Scotia (NS), Canada, vaccines routinely delivered in early adolescence are administered to Grade 7 students through a school-based Public Health vaccination program. NS youth eligible to receive Grade 7 vaccinations between 2011 and 2017 were included in this study. Autism spectrum disorder (ASD) diagnoses were determined from administrative health data. Rates of receipt of any Grade 7 vaccine and of individual vaccines were compared between autistic and non-autistic youth. Subgroup analyses included comparing Grade 7 vaccine receipt between autistic youth and their non-autistic siblings and early childhood vaccine receipt between autistic and non-autistic cohorts.

Results and analysis: The rate of receipt of any vaccine was 73% among 916 autistic youth and 82% among 49,599 non-autistic youth (relative risk = 0.90; 95% confidence interval = 0.86-0.94). Similar results were found for individual vaccines. Subgroup analyses revealed lower rates of Grade 7 vaccine receipt among autistic youth compared to their non-autistic siblings. Rates of early childhood vaccine receipt did not differ between those later identified as autistic and non-autistic.

Conclusions and implications for policy, practice or additional research: Autistic youth were under-vaccinated compared to their non-autistic peers for Grade 7 vaccinations. Lower vaccination rates in autistic youth compared to their non-autistic siblings suggest that vaccine delivery-related factors may contribute more to the under-vaccination of autistic youth than parental vaccine hesitancy. Barriers to vaccine uptake for school-aged autistic youth, including those unique to school-based vaccination programs, must be explored and addressed.

61. Will the COVID-19 pandemic fix the problem of routine childhood vaccine hesitancy?

Humble R, Dubé È, Scott S, Olson J, MacDonald S

Introduction/background: A decline in routine vaccination was reported in many nations early in the COVID-19 pandemic. In the context of the pandemic, determinants of routine childhood vaccination may have changed. Changes over time in parents' perceptions of routine vaccines and intentions for their children during the pandemic have not been fully explored. Understanding changes provides opportunities to promote vaccination during and after the pandemic and address factors that compromise parents' acceptance.

Methods: We conducted longitudinal analysis of two sequential national surveys during the pandemic (Dec 2020 and Oct/Nov 2021) to assess changes over time in Canadian parents' perceptions of routine childhood vaccines, intentions to vaccinate, access for their children ≤17 years, and differences by sociodemographic characteristics. A McNemar-Bowker test was used to determine changes in parents' responses collected at two time points.

Results and analysis: Of the 650 parents in the sample, 25.1% of those with a child ≤6 years and 20.5% of those with a child 7-17 years perceived that routine childhood vaccination was more important because of the pandemic. Between the two time points, parents' confidence in the safety (72.8% to 80.2%, p<.001) and effectiveness (81.7% to 85.2%, p=.007) of routine vaccines increased, parents were more engaged in vaccine decision-making (73.4% to 79.8%, p=.006), and everyday stress preventing vaccination decreased (78.8% to 68.5%, p<.001). Acceptance of routine vaccines increased (82.9% to 86.5%, p=.021), but more parents were undecided about influenza vaccination (12.6% to 20.3%, p=.002). Compared to parents with one child, those with two children reported increased vaccination acceptance (82.6% to 87.4%, p=.024).

Conclusions and implications for policy, practice or additional research: Under the spotlight of COVID-19, parents' confidence in routine vaccines, engagement in decision-making, and vaccination acceptance increased. Vaccination providers should support parents' decision-making as they navigate vaccine uncertainties. Differences in parents' acceptance of routine and influenza vaccines for their children highlight the need for targeted communication strategies for specific vaccines.

---

62. Routine childhood vaccination among ethnocultural groups in Canada during the COVID-19 pandemic: A national cross-sectional study

Humble R, Scott S, Olson J, Dubé È, MacDonald S

Introduction/background: Some ethnocultural groups in Canada have experienced low routine childhood vaccine uptake, with social location and discrimination perhaps contributing to inequities. This study aimed to characterize routine childhood vaccination in the context of the COVID-19 pandemic, including the influence of discriminatory experiences when accessing health services.

Methods: We conducted a cross-sectional national survey to assess parents' acceptance of routine vaccines for their children aged ≤17 years in Oct/Nov 2021. Descriptive statistics were used to explore differences among ethnocultural groups, including parents' perceptions and access to vaccines, and logistic regression to assess associations among parents' low acceptance of routine vaccines.

Results and analysis: Among the 2531 parents in the sample, 21.8% self-identified as Racialized minorities, 7.7% Indigenous, 23.3% were newcomers to Canada, 10.0% spoke minority languages most often, and 69.6% belonged to a reference group who did not report these characteristics. Statistically significant findings included 36.6% of Indigenous parents who reported that the pandemic made them realize that routine vaccines were more important, compared to 16.7% of newcomers and 16.9% of the reference group. Discrimination/racism when accessing health services was most often experienced by Indigenous (27.8%) and Racialized minority (20.2%) parents, compared to the reference group (4.8%). Racialized minorities were twice as likely to report low acceptance of routine childhood vaccination (aOR=2.06, 95% CI: 1.12–3.78), and younger parents were less likely to experience low acceptance of vaccination (aOR=0.25, 95% CI: 0.14–0.44). Low acceptance of routine

vaccination was associated with parents' perceptions that vaccination was unnecessary (aOR = 2.28, 95% CI: 1.52–3.40) or unsafe (aOR=2.73, 95% CI: 1.63–4.57), and that everyday stress would prevent vaccination (aOR = 2.18, 95% CI: 1.41–3.38).

Conclusions and implications for policy, practice or additional research: Public health decision-makers should ensure equitable access to routine childhood vaccination that targets the inclusion of ethnocultural groups, who may experience disproportionate barriers to services.

---

63. Understanding Vaccine Coverage in a First Nations Community: Learning from the Early Years Program

Rattlesnake C

Introduction/program need and objectives: Routine vaccination programs in Canada have generally contributed to increased uptake of vaccines. However, certain populations remain underrepresented among children with up-to-date vaccinations, in particular, First Nations children living on-reserve have lower vaccination coverage in comparison to the general Canadian population.

Program methods, activities and evaluation: The Early Years (EY) program was developed by the Martin Family Initiative in partnership with Maskwacis Health Services, Maskwacis Education Schools Commission and Ermineskin Cree Nation with funding from the Brain Canada Foundation. The EY is an innovative, evidence-informed prenatal to preschool program founded on the recognition that supporting strong Indigenous families and communities is integral to fostering healthy child development, supporting cultural identity and achieving long term health and wellbeing. Started in Maskwacis, Alberta in 2018, the program uses a comprehensive curriculum that integrates health, early childhood education and culture to support Indigenous parents/caregivers throughout the first years of their children's lives. Relationships have been prioritized throughout the program. EY staff form trusting relationships with program participants and provide referrals to immunization clinics, transportation to appointments and advice and information.

Program results or outcomes: The immunization rate of children participating in the EY is higher than that of the rest of the community. Through the EY, research has focused on examining the program's impacts in terms of participant and community engagement; supporting healthy pregnancies and maternal wellness; enhancing children's language development and school readiness; providing play-based learning opportunities; enriching children's pride in identity and culture; and strengthening parenting capacity and family wellbeing. Unexpectedly, we have also documented a six-fold increase in routine vaccination rates among children participating in the program as compared to children in the wider community.

Recommendations and implications for practice or additional research: Considering the immunization results for children in the EY, it would suggest that the relationship-driven nature of the program supports families to attend immunization appointments and stay up to date with their child's immunizations.

---

64. Locating Indigenous voices: Inclusion of Indigenous perspectives in studies of barriers and supports for HPV vaccination in Indigenous people globally

Kenzie L, Letendre A, Bill L, Nelson G, MacDonald S

Introduction/background: Cervical cancer burden remains disproportionately high among Indigenous people globally. While human papillomavirus (HPV) vaccines reduce cancer risk, coverage rates remain low in this population. Therefore, it is critical to understand the context in which HPV vaccination barriers exist for Indigenous people, in order to develop and implement successful and culturally appropriate vaccination programs.

Methods: We first conducted a systematic review to identify the documented barriers and supports to HPV vaccination in Indigenous people worldwide. Recognizing that those most affected by barriers and supports to

HPV vaccination are best positioned to provide context on the impacts of the social and structural determinants of health, our secondary aim was to locate the Indigenous voices in the literature we had reviewed.

Results and analysis: Forty-three studies were included and an inductive, qualitative, thematic analysis was applied. Grounding observations in the contextual insights and expertise of Indigenous people, two Indigenous team members contributed to the synthesis of key themes and subthemes. Barriers and supports were mainly reported by parents/caregivers (15 studies), while the voices of other key informant groups, such as vaccine-eligible youth (3 studies), were underrepresented in the literature. Indigenous people were involved in 47% of the studies identified in this review. However, only 14% of studies reported explicit or formal consultation with, or involvement of, Indigenous people at any stage of the research process.

Conclusions and implications for policy, practice or additional research: In seeking to identify and address barriers and supports to HPV vaccination in global Indigenous contexts, we must consider Indigenous perspectives in order to mitigate dominant or stigmatizing biases toward these underserved populations. Guided by Indigenous voices, we propose that intergenerational and gender-equitable HPV vaccine community education programs are necessary to support culturally-safe HPV vaccination programs in Indigenous populations.

---

65. COVID-19 vaccine coverage amongst immigrants in Alberta, Canada: A population-based cross-sectional study

Du C, Paudel Y, MacDonald S

Introduction/background: Foreign-born immigrants have historically lower vaccination coverage in comparison to non-immigrants. There is limited data examining COVID-19 vaccination coverage specifically within immigrant populations.

Methods: In this cross-sectional study, we analyzed population-based linked administrative health data for 3,931,698 residents in Alberta, Canada, of which 731,217 were immigrants. We examined COVID-19 vaccination coverage as of November 29, 2021. We used a multivariable logistic regression model to analyze the association of vaccine coverage with migration status (non-immigrants, and four categories based on time since migration), adjusting for age, sex, income quintile, and place of residence.

Results and analysis: Overall, immigrants had higher COVID-19 vaccine coverage compared to non-immigrants, with 78.2% (95% CI: 78.1% - 78.3%) of eligible immigrants and 76.0% (95% CI:75.9% - 76.0%) of non-immigrants having received at least one dose of the COVID-19. Immigrants from North America, Oceania, and Europe overall had the lowest vaccine coverage (62.9-67.7%), while immigrants from Asia and Africa had the highest coverage (79.3-83.3%). There was a significant interaction between age category and migration status ($p<0.0001$); among immigrants, younger age groups that immigrated most recently (10 years or less) had higher coverage (78.2-82.2%) than those who immigrated more than 10 years ago (70.6-77.7%). This trend changes after 50 years of age when coverage for more recent immigrants (49.7-76.5%) starts to drop below those who immigrated more than 10 years ago (55.9-84.1%). Vaccine coverage was relatively similar across income quintiles; however, immigrants living in rural areas had lower vaccine coverage in comparison to non-immigrants living in rural areas (65.5 vs 68.1%).

Conclusions and implications for policy, practice or additional research: Overall, immigrants had higher COVID-19 vaccination coverage in comparison to non-immigrants. COVID-19 vaccination strategies should focus on immigrants that are older, living in rural areas, and from North America, Oceania, and Europe.

---

66. Ethnic disparities in COVID-19 vaccination in Canada: Results from the Canadian Community Health Survey (CCHS)

Chen R, Guay M, Maquiling A, Lavergne V, Baysac D, Gilbert N, McDonald H, Dubé E, MacDonald S, Driedger M

Introduction/Background: The COVID-19 pandemic has highlighted social and racial injustice as COVID-19 has unequally affected many racialized groups. The purpose of the study is to assess inequalities in COVID-19 vaccination coverage among Indigenous and racialized people 12 years and older living in the ten provinces in Canada using data drawn from three collection periods of the Canadian Community Health Survey (CCHS).

Methods: The CCHS is an ongoing cross-sectional and nationally representative survey conducted by Statistics Canada, which collects health-related information. Questions related to the COVID-19 pandemic have been asked in the survey since September 2020. The present analysis used data collected from June 1, 2021 to February 7, 2022 for a total sample of 34,764 participants. To measure associations between racialized groups and non-vaccination, a multiple logistic regression model adjusted for region, age group, gender, level of education, and collection period was fitted and adjusted odds ratios (aOR) of being unvaccinated versus having received at least one dose were generated.

Results and analysis: At the time of the survey, only 7.7% (95%CI 7.2-8.3) of the eligible population aged 12 years and older in Canada had not received a COVID-19 vaccine. The aORs suggest a greater risk of being unvaccinated in First Nations (aOR 2.0, 95%CI 1.2-3.3), Blacks (aOR 2.2, 95%CI 1.4-3.5), and Arabs (aOR 2.2, 95%CI 1.1-4.3) and lower risk in South Asians (aOR 0.5, 0.2-0.9) when compared to those who are neither part of racialized groups nor Indigenous.

Conclusions and implications for policy, practice or additional research: The study demonstrated the existence of ethnic disparities in COVID-19 vaccination coverage in Canada highlighting the crucial role of ongoing monitoring of inequalities in COVID-19 vaccination coverage. Additional studies determining the factors significantly contributing to non-vaccination among different racialized groups are needed to identify vaccination barriers to inform vaccination promotion strategies as well as to suggest and implement solutions.

---

67. Implementing the CARD (Comfort Ask Relax Distract) system to support vaccination of people with needle fear and anxiety: Experiences from the Centre for Addiction and Mental Health

Taddio A, **Ledrew E**

Introduction/background: The Centre for Addiction and Mental Health is an urban tertiary psychiatric care facility. During 2021 and 2022, the hospital organized and led specialty COVID-19 vaccination clinics for children (>5 years old) and adults with high needle fear and anxiety who are vaccine hesitant. A framework for delivering vaccinations was needed to adequately serve this unique and vulnerable population. The purpose of this quality improvement project was to determine how implementation of the CARD (Comfort Ask Relax Distract) system as a framework for vaccination delivery (www.cardsystem.ca) impacted patient decision-making and experiences with vaccination.

Methods: The CARD framework consisted of multiple steps and actions aimed at making vaccinations a more positive experience for patients, including i) educating staff about CARD (via team huddles and printed materials), ii) educating patients (via hospital appointment booking system), iii) environmental interventions (e.g., diming overhead lights, limiting appointments and staff, providing privacy booths, spaces for a support person, and distraction items), iv) reducing visual fear triggers (obscuring needles, hiding sharps containers); v) inviting patients to participate (greeters solicit preferred coping strategies using the CARD coping checklist). Patients provided feedback immediately after vaccination via a voluntary self-administered structured survey. Data are summarized descriptively.

Results and analysis: Altogether, 65% of patients reported reviewing CARD information ahead of time, and 72% reported that CARD positively affected their decision to attend the clinic by a moderate to great extent. Ninety-two percent reported that CARD helped and 95% would return for another vaccine. The sample size ranged from 59-116 for individual survey questions.

Conclusions and implications for policy, practice or additional research: CARD positively impacted decision-making regarding attending the clinic for COVID-19 vaccination and was associated with positive experiences in individuals with high needle fear and anxiety. These results have led to plans to expand hospital-based services to include vaccinations.

---

68. Applying the Theoretical Domains Framework to identify factors influencing COVID-19 vaccination decisions

Bruce M, Castillo E, Patey A, Donald M, Lee K, Surti M

Introduction/background: Understanding the factors that influence COVID-19 vaccination decisions by pregnant and lactating individuals is a critical first step to develop tools to support and improve COVID-19 vaccination behaviour change. Applying a theoretical lens to intervention design improves the likelihood that the interventions will successfully address the identified barriers and lead to behaviour change. The Theoretical Domains Framework (TDF) is a framework, grounded in psychological theories, that can be applied to help understand individual, socio-cultural and environmental influences on behaviour in specific contexts.

Methods: We conducted a provincial, prospective, internet-based survey, Nov. 2021 to Mar. 2022, including both multiple choice and open-ended free text questions (N = 229 participants) aimed at understanding vaccine decision making during pregnancy. Answers to open-ended questions were deductively coded using the TDF and themes were identified. Conflicting themes, impact on changing behaviour and frequency of the themes identified, determined relevant domains.

Results and analysis: Seven TDF domains were identified as relevant to COVID-19 vaccination decisions: Knowledge, Social/professional role and identity, Beliefs about consequences, Reinforcement, Environmental context and resources, Social influences and Emotion. The strongest driver for vaccination decision was being advised to get vaccinated by one's healthcare provider (Social influences; n=29). Respondents were also concerned about lack of long-term research or accurate information (Knowledge; n=54). Participants noted feeling coerced (Social Influences; n=34), believing that the vaccine was ineffective (Knowledge; n=22), concern about segregation and discrimination related to vaccine status (Social/Professional role and identity; n=30), and concern about undesirable side effects (Belief about consequences; n=40).

Conclusions and implications for policy, practice or additional research: We identified several factors influencing COVID-19 vaccination for pregnant and lactating individuals, including the influence of a trusted healthcare provider to promote vaccination and the perceived negative consequences from external sources discouraging vaccination. Using the TDF to categorize barriers and enablers to vaccine acceptance provides a robust framework to guide the design of theory-informed intervention.

---

69. Workplace Absenteeism due to COVID-19 and Influenza: A Mathematical Model

Mosleh R, Avusuglo W, Fall A, Ghimire S, K. H. Lee J, Li A, Ramaj T, Sintayehu Sharbayta S, Thommes E, Shi F, Shin T, Wu J

Introduction/background: Co-circulation of COVID-19 and influenza may increase workplace absenteeism leading to additional economic loss. The present work aims to quantify the collective impact of the co-circulation of COVID-19 and influenza on productivity amid various healthcare interventions, particularly diagnostic tests and vaccination.

Methods: Using ordinary differential equations (ODEs), a mathematical compartmental disease model incorporated population screening and COVID-19 and influenza vaccinations. Model parameters were estimated using complementary approaches, a literature review, and a Markov Chain Monte Carlo (MCMC) estimation scheme.

Results and analysis: For COVID-19 PCR testing, there may be a critical threshold where additional tests may result in diminishing returns. The effects of asymptomatic infected individuals on absenteeism was more pronounced relative to those who were symptomatic and infected. Increasing COVID-19 and influenza

vaccination rates resulted in seasonal decreases in total absenteeism. Influenza vaccination conferred indirect benefits by reducing the total number of symptomatic individuals using PCR testing resources. Upon comparison of COVID-19 to influenza, decreasing the contact rates had a less significant impact on reducing COVID-19 versus influenza absenteeism. Overall, the results suggest that the two most important factors in reducing the total absenteeism are COVID-19 vaccination rates and the PCR testing capacity. The next important factors are influenza vaccination rates, followed by contact rates.

Conclusions and implications for policy, practice or additional research: Testing and vaccination for influenza and COVID-19 have a tremendous impact on workplace absenteeism. PCR testing and ongoing vaccination should be significant components of public health interventions. Sensitivity analyses will be necessary to determine the optimal thresholds for both testing and vaccine coverage. Future research regarding the co-circulation of influenza and COVID-19 will consider additional outcomes such as hospitalizations and deaths.

---

70. Immunization Uptake and Post-Immunization Monkeypox Cases in Ontario, 2022

Lim G, Buchan S, Saunders A, Zygmunt A, Pritchard J, Rey J, Harris T, **Navarro C**

Introduction: We describe immunization uptake for Imvamune® in Ontario during the 2022 multi-jurisdictional monkeypox (MPX) outbreak and compare cases who were immunized prior to symptom onset (post-immunization cases) with those who were unimmunized.

Methods: Confirmed MPX cases reported through the integrated Public Health Information System (iPHIS) and MPX immunizations entered in the Digital Health Immunization Repository (Panorama) were extracted on October 24, 2022. Immunization histories were determined through a review of iPHIS data and by linking case data with immunization records using health card number, name and date of birth. Data analyses were conducted using SAS version 8.2.

Results and Analysis: In total, 37,470 doses of Imvamune® vaccine were administered in Ontario among 35,545 people between May 4 and October 24, 2022; 1,925 doses (5.1%) were administered as second doses. Almost all doses were administered for pre-exposure prophylaxis (97.2%), while 1.2% were for post-exposure prophylaxis. The majority of immunized individuals were male (92.0%) and most doses were administered among 30-39 year olds (33.4%).

There were 687 confirmed MPX cases during the same period. While 31.3% (n=215 cases) of cases received at least dose of vaccine, they represented just 0.6% of immunized individuals. Among cases who received at least one dose, 143 (66.5%) were post-immunization cases while 72 (33.5%) received their vaccine on/after their symptom onset; 472 cases were unimmunized. Among post-immunization cases, most occurred between one and 13 days after immunization (n=65, 45.5%). All post-immunization cases were male (n=143) and slightly older than unimmunized cases. Post-immunization cases were less likely to report a hospital and/or ICU admission (3.8% versus 0.7%, respectively) or any symptoms (90.9% versus 79.0%, respectively) compared to unimmunized cases.

Conclusion: During the MPX outbreak in Ontario, cases who had received at least one dose of Imvamune® vaccine prior to onset of illness reported fewer symptoms and less severe outcomes.

---

71. Response to a Serogroup C Meningococcal Disease Outbreak – Toronto, Ontario 2022

Coghill C, Kus J, Shahin R, Padhi S, Dubey V, Lim G, Paul L, Zhang H, Tsang R, Law D, Zhou J, Wilson S, Paget E, Navarro C

Introduction/program need and objectives: The incidence of invasive meningococcal disease attributable to serogroup C (MenC) has declined in Ontario since the introduction of publicly funded meningococcal conjugate vaccines, from 0.3 cases/100,000 in 2001 to 0.01/100,000 in 2019. Outbreaks are rare. We describe a 2022 cluster of MenC cases in Toronto, Ontario and the public health response.

Program methods, activities and evaluation: Toronto Public Health (TPH) conducted case investigations to determine epidemiological links and risk factors to inform public health actions. Genetic similarity of isolates were assessed using traditional serotyping as well as whole-genome sequencing (WGS) of the cultured Neisseria meningitidis isolates to distinguish the relatedness of strains.

Program results or outcomes: Epidemiologic analysis demonstrated Toronto experienced a significant increase of MenC. Five cases were reported, with symptom onset between June 24 and August 26. Median age was 30 years (range: 23-60). Case fatality rate was 40%. Serotyping data demonstrated all five cases were the same highly virulent strain—Serogroup C, Serotype 2a, Subtype P1.5, MLST ST-11, Lineage 11.2. WGS determined isolates belonged to two distinct clusters. Investigations did not reveal clear epidemiological linkages. All cases had no records of meningococcal vaccination and emigrated from countries where it is not part of routine schedules. Public health actions for outbreak response included targeted vaccination, community outreach and communications. Vaccine uptake has been low (270 doses given to date).

Recommendations and implications for practice or additional research: Routine vaccination in childhood and adolescence with meningococcal vaccines was likely protective to most young adults in Toronto during a community outbreak. Vaccination challenges during outbreak response included defining the target population, vaccine eligibility/access and uptake. Vaccine fatigue and competing vaccination initiatives also likely contributed. Policies ensuring eligibility and vaccination of newcomers should be considered to prevent outbreaks and preventable mortality. While traditional bacterial typing identified isolates as closely related, WGS analysis enabled determination of two distinct clusters, thus allowing for a more informed public health response.

---

72. The Intersection of Sex and Gender in Adverse Events Following Seasonal Influenza Vaccination in Older Adults

Shapiro J, Seddu K, Leng S, Morgan R, Klein S

Introduction/background: Women/females report more adverse events (AE) following immunization than men/males for many vaccines, including the influenza and SARS-CoV-2 vaccines. This discrepancy is often dismissed as a gendered reporting bias, yet the relative contributions of sex and gender are poorly understood. We aimed to understand how sex and gender contribute to the occurrence of AE following immunization.

Methods: In an influenza vaccine cohort of older adults (≥75 years), we implemented an AE questionnaire 5-8 days post-vaccination. Participant sex (male or female) was determined by self-report and the short-form Bem Sex Role Inventory was used to determine gender category (feminine, masculine, androgynous, or undifferentiated). Plasma sex steroid concentrations were measured pre-vaccination.

Results and analysis: 312 vaccines were administered to 149 participants over 3 influenza seasons (2019-21) and gender data were available for 230 of these vaccinations (2020-21). At least one AE was reported following 75 vaccinations (24%), by 16 males and 59 females. The majority of AE occurred at the site of injection (85%), were mild (75%), and lasted less than 48 hours (84%). The odds of experiencing an AE were 6-times greater in females than males ($p=0.003$) and decreased with age ($p<0.001$). The effects of gender, however, were not statistically significant. Together these data support a central role for biological sex in the occurrence of AE. We thus turned to the role of hormones in mediating this sex difference. The probability of experiencing an AE increased as estradiol concentrations increased in males ($p=0.015$) but not females ($p=0.912$), leading to a significant sex difference in the effect of estradiol ($p=0.029$).

Conclusions and implications for policy, practice or additional research: Together, these data support a central role of biological sex in the occurrence of AE such that vaccine safety must be assessed separately for males and females.

---

73. Vaccine Effectiveness of adjuvanted vs. non-adjuvanted standard dose inactivated influenza vaccines in preventing influenza-related hospitalization in older adults: A CIRN SOS Network pooled analysis over three influenza seasons (2012/13;2013/14;2014/15)

Pott H, **Andrew M**, Shaffelburg Z, Nichols M, LeBlanc J, Ye L, McGeer A, Ambrose A, ElSherif M, Hatchette T, Loeb M, Katz K, McCarthy A, Trottier S, Valiquette L, Smith S, Boivin G, McNeil S, OnBehalfOfSOSNetworkInvestigators

Introduction/background: Influenza vaccines prevent influenza-related morbidity and mortality; however, suboptimal vaccine effectiveness (VE) of trivalent and quadrivalent standard-dose inactivated influenza vaccine (TIV and QIV) in older adults has prompted the use of enhanced products such as high dose TIV/QIV (HD-TIV/QIV) and adjuvanted TIV (aTIV). Here, we present data on the overall effectiveness of aTIV compared to non-adjuvanted standard-dose TIV (NA-TIV) for preventing laboratory-confirmed influenza-associated hospitalization among older adults.

Methods: Test-negative design study using pooled data from the SOS Network-CIRN 2012-2015 influenza seasons. To deal with the numerical imbalance between groups, an inverse probability of treatment-weighted (IPT) logistic regression estimated the Odds Ratio (OR) for laboratory-confirmed influenza infection. VE was calculated as (1-OR)*100% with 95% confidence intervals. Clinical and demographic data collection included age, sex, comorbidity, smoking status, and Clinical Frailty Scale.

Results and analysis: Of 7,101 adults aged ≥65, 526 received aTIV, whereas 3,364 received NA-TIV. The overall IPT-weighted VE against hospitalization for laboratory-confirmed influenza was 45.9% (95% CI: 40.3%–51.0%) for NA-TIV compared with 53.5% (43.0%–62.1%) for aTIV. There were non-significant differences in VE estimated between aTIV and NA-TIV by age group, and influenza season, though there was a trend favoring aTIV over NA-TIV. Whereas aTIV recipients were more frail than NA-TIV recipients, an exploratory analysis revealed that frailty affected the effectiveness of the influenza vaccine: VE adjusted for frailty was 58.3% (48.6%–66.2%) for aTIV compared with 44.8% (39.1%–50.0%) for NA-TIV; the overall relative VE for NA-TIV against laboratory-confirmed influenza was 0.78 (0.64–0.96), demonstrating statistically significant benefit favouring aTIV.

Conclusions and implications for policy, practice or additional research: aTIV showed better protection against influenza-associated hospitalizations in older adults than NA-TIV, with relative VE of 22% achieving statistical significance when adjusted for frailty. Frailty has a meaningful effect on vaccine effectiveness and should be considered in future clinical and surveillance studies of VE.

---

74. A systematic literature review and meta-analysis comparing relative vaccine effectiveness of enhanced trivalent seasonal influenza vaccines in older adults

Coleman B, McGovern I, Haag M

Introduction/background: Immunosenescence in older adults results in a lower immune response to vaccination, and sub-optimal effectiveness of non-enhanced vaccines. The MF59-adjuvanted trivalent influenza vaccine (aTIV) and high-dose influenza vaccine (HD-TIV) were both developed to improve response to influenza vaccination for adults ≥ 65 years of age. This systematic review and meta-analysis evaluated the relative vaccine effectiveness (rVE) of these two enhanced vaccines over a multi-season period.

Methods: Peer-reviewed and grey literature published between January 1, 1997 and September 17, 2021 were included. Observational studies evaluating the rVE of aTIV vs HD-TIV among adults ≥65 years of age were eligible. Paule-Mandel random-effects meta-analysis was used for all analyses in anticipation of variable rVE due to viral, vaccine, and host factors.

Results and analysis: After removal of duplicates, 4,627 publications were screened for eligibility and a total of 11 publications reporting the rVE of aTIV vs HD-TIV were identified, 9 of which were included in at least one meta-analysis. Of the two publications that were not included in any meta-analysis, one reported rVE among high-risk patients while the other evaluated rVE against any respiratory outcome. The remaining 9 studies reported rVE estimates for prevention of influenza-related medical encounters in different clinical settings. The

pooled rVE of aTIV vs HD-TIV for prevention of influenza-related medical encounters was 8.5% (95%CI: -3 to 18.8) for outpatient visits and 1.2% (-1.3 to 3.8) for hospital/emergency department (ED) visits.

Conclusions and implications for policy, practice or additional or additional research: Pooled estimates from multiple real-world evidence studies conducted over a 4-season period suggest that aTIV and HD-TIV have comparable vaccine performance for prevention of influenza-related outpatient and hospital/ED visits.

---

75. Cost-effectiveness and public health impact of recombinant zoster vaccine in immunocompromised adults in Canada

George S

Introduction/background: Immunocompromised (IC) individuals are at increased risk of herpes zoster (HZ) and its complications. Recombinant zoster vaccine (RZV) received regulatory approval for use in the Canadian IC population in 2021. We evaluated the cost-effectiveness and public health impact (PHI) of RZV versus no-vaccination in the Canadian IC population aged ≥18 years.

Methods: The Zoster ecONomic Analysis Immunocompromised (ZONA IC) model was used to follow a base-case scenario cohort of 1,600 patients with hematopoietic stem-cell transplant aged 55 years, who maintain an IC status for 5 years, from a societal perspective. Scenario analyses were conducted for patients with human immunodeficiency virus (HIV), renal transplant, Hodgkin lymphoma and breast cancer. A life-long time horizon and a discount rate of 1.5% for costs and quality-adjusted life-years (QALY) were applied. Coverage was set to 60% and second dose completion rate to 100%. Probabilistic and deterministic sensitivity analyses were run.

Results and analysis: In the base case analysis, RZV vaccination prevented 116 HZ and 27 postherpetic neuralgia (PHN) cases respectively compared with no vaccination. The median ICER was CAD 22,648 per QALY gained and was most sensitive to assumptions in HZ incidence, direct medical costs, QALY loss due to PHN, RZV efficacy against PHN and waning. Scenario analyses in other IC populations yielded the highest median ICER for people with Hodgkin lymphoma (CAD 81,470), followed by HIV (CAD67,207), renal transplant (CAD 27,237) and breast cancer (CAD 24,328).

Conclusions and implications for policy, practice or additional research: RZV vaccination in Canada improves public health outcomes and is cost-effective for several IC conditions considering a CAD50,000 willingness-to-pay threshold.

---

76. Developing multimedia tools to address concerns re COVID-19 vaccine's impact on fertility: a mixed methods approach

Waite N, Hussein R, Vernon-Wilson E, Grindrod K, Tetui M, Wiens B, MacDonald S

Introduction/background: Vaccine hesitancy, including circulation of misinformation through social media, has contributed to delay in COVID-19 vaccine uptake. This has included concerns about the vaccine's impact on fertility. The aim of this study was to collect feedback on evidence-informed infographics created to address vaccine hesitancy related to fertility concerns.

Methods: A mixed method study was conducted using a short survey and focus group discussion. Public feedback was invited via a social media survey link on a 1-page infographic (Facebook, Twitter and Instagram). Descriptive statistics were used to analyze results. Separately, community leaders collaborating with public health participated in a focus group regarding a modified infographic. Inductive thematic and sentiment analyses were conducted.

Results and analysis: 39 participants completed the survey (average age 39, 80.6% women, 82% had a college/university degree). Five people participated in the focus group. Approximately half the survey respondents felt that the infographics were clear, and 88% felt that they could trust the information provided. Both survey and focus group participants made suggestions to improve readability and visual simplicity so that key messages could be read "at a glance". Respondents requested additional evidence regarding the impact of

COVID-19 vaccines on menstruation and long-term side effects. The survey and focus group participants provided mixed responses on the use of gender-inclusive language. Community representatives indicated binary gender labels such as "men's fertility" and "women's fertility" provided more clarity than gender-neutral labeling such as "fertility of a person with a uterus" or "fertility of people who have sperm".

Conclusions and implications for policy, practice or additional research: This study demonstrated the value of gathering public feedback to tailor vaccination tools. There can be a tension between the dual needs for gender-inclusive and simpler language when working with diverse groups. Creating tailored versions of vaccine materials to address specific group's concerns and align with cultural norms must be considered.

---

77. Influence of prenatal care provider type on routine vaccination in first two years of life in British Columbia (BC)

Twohig K, Dalati H, David S, Bettinger J, **Naus M**

Introduction/background: Decision-making about early childhood vaccination often starts during pregnancy. Advice from a trusted healthcare provider is a key determinant of parental decisions. Physicians and midwives can hold differing views on what and how to communicate about vaccination. We sought to understand whether prenatal care provider type in BC, where 22% of pregnancies involve care by a registered midwife, is associated with receipt of routine vaccines.

Methods: Using linked data from BC's Perinatal Data and Immunization Registries and medical service plan billing, we analysed the association between maternal care provider and vaccination up to age 2 years for a cohort of children born Jan 1, 2010 through Dec 31, 2015. Binary outcomes were analysed using a Poisson regression model and included up-to-date status for all recommended vaccinations, refusals, and delays of 30 days or more from the provincial vaccination schedule. Time to first vaccination was also analysed with a Cox proportion hazards model.

Results and analysis: There were 180,087 children included in the analysis, 16.6% of whose mothers had majority-midwife prenatal care. Majority-physician care during pregnancy was associated with higher completion of all recommended vaccinations by age 2 (aRR for up-to-date for age = 1.23 95%CI 1.22-1.24), fewer refusals (aRR refusal to any vaccinations = 0.40, 95%CI 0.38-0.42) and greater likelihood of on-time first vaccination (aHR 1.72 95%CI 1.69-1.74) compared with majority-midwife pregnancy care.

Conclusions and implications for policy, practice or additional research: Majority-midwife care during pregnancy was associated with delays, lower overall vaccination rates, and greater refusals than majority-physician care. A causal association between provider type and infant immunization cannot be concluded from our study, as parents inclined to delay or refuse vaccines may prefer the care of a midwife, believing it to be a more natural type of care. Regardless of the directionality of this relationship, our findings support the need to strengthen immunization communication skills for midwives in BC.

---

78. Inequities in measles and pertussis vaccination among Canadian toddlers

Bell C, MacDonald S, Wilson S, Kokaua J, Samson E, Gilbert N

Introduction/background: Vaccination coverage in Canadian children continues to be below the national vaccination coverage goals of 95% for two-year-old children. Suboptimal vaccine coverage increases the risk of vaccine-preventable disease transmission and outbreaks within Canada. We sought to identify sociodemographic and household factors associated with the vaccination status of Canadian toddlers at two years of age.

Methods: We analysed data from the 2017 Canadian childhood National Immunization Coverage Survey (cNICS). Vaccination status of both pertussis-containing (4 doses) and measles-containing (1 dose) vaccines at two years of age was assessed. A multivariable logistic regression model was used to determine the association between under-vaccination and household income, region within Canada, marital status, birthplace of child, immigration status of parent, number of household children <5 years of age, parental age, sex, and rural/urban residence.

Results and analysis: Of the 4,072 children included in the analysis, 9.8% reported to not be vaccinated against measles, and 24.2% reported receiving <4 doses of pertussis vaccine. Factors associated with incomplete vaccination for measles included household income <$40,000 [aOR 2.33 (95% CI 1.09-4.98)] compared to >$160,000 , being born outside Canada [aOR 5.45 (95% CI 2.54-11.7)], and rural residence [aOR 1.67 (95% CI 1.11-2.52)]. Factors associated with incomplete vaccination for pertussis (< 4 doses), in addition to lower income and being born outside of Canada, included parental age at child birth <25 years [aOR 2.3 (95% CI 1.53-3.45)] compared to 30-34 years, and households with three or more children aged <5 years [aOR 2.36 (95% CI 1.37-4.08)] compared to one.

Conclusions and implications for policy, practice or additional research: There are a number of socioeconomic, household, and regional characteristics associated with the uptake of childhood vaccines in Canada. The determinants of under-vaccination highlighted in this analysis may provide public health with subsets of the population who would benefit most from interventions to improve vaccination coverage in Canada.

---

79. Parental attitudes and perceptions regarding pediatric influenza vaccination in Canada and the role of health care providers

Chawla R, Johal A, Roy B, **Boivin W**

Background: A national survey of parents' attitudes and perceptions regarding the importance of pediatric influenza vaccination, as well as the role of health care providers (HCPs) in influenza vaccination was fielded to increase our understanding of factors influencing uptake.

Methods: An online survey instrument collected data from 1,500 parents of children between the age of 6 months and 17 years. Data was collected between February 10-19, 2022. All respondents were adult residents of Canada who were parents or guardians of at least one child between the ages of 6 months and 17 years on September 1, 2021.

Results: Key attitudinal and vaccination status findings indicated: 1. A lack of perceived threat of influenza; 2. Parents' influenza vaccination status strongly corelated to children's vaccination status; 3. HCPs were key to increasing influenza vaccination rates among children.

Notably, 30% percent of Canadian children received an influenza vaccination every year, while 50% never received one. A strong correlation was found between parents' vaccination status and their child's. Survey respondents that spoke to any HCP about influenza vaccination, were more likely to get their child vaccinated. Conversely, approximately one-third of those whose child did not receive an influenza vaccine indicated not having this discussed by their child's HCP was the reason. Outside of Quebec, one-third of children received their last influenza vaccination at a pharmacy and one-third at a physician's office. In Quebec, 40% of children received vaccination at local community service centre and 25% at a pharmacy.

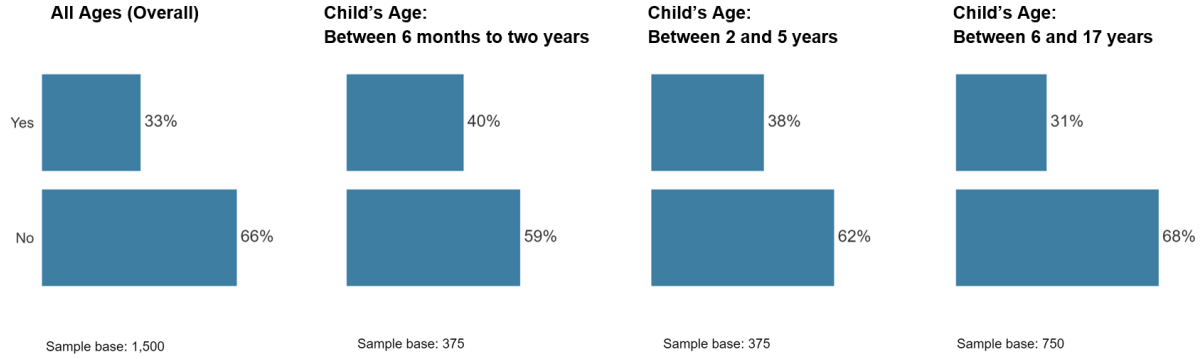


Figure 1: Proportion of children who were vaccinated during the 2021-2022 influenza season, stratified by parental influenza vaccine uptake. Parents whom were vaccinated were more likely to have their children vaccinated. Parents who were vaccinated every year had the highest child vaccination rates.

Conclusions: Canadian parents perceive a lack of threat of influenza for their children. HCPs have the opportunity to increase vaccination awareness and uptake rates in adults, and high-risk (6 to 59 months) and general pediatric populations through direct communication. Increasing accessible healthcare providers to discuss and administer vaccinations may improve immunization rates.

---

80. A comprehensive review of Canadian online resources for caregivers of information on SARS-COV-2 vaccinations for children aged 5-11 years

Karimi Shahrbabak E, Piché-Renaud P, Low B, Abu Fadaleh S, Peresin J, Tailor L, Wong N, Lee K, **K Morris S**

Introduction/background: Caregivers report online resources as one of their main sources of information on SARS-CoV-2 vaccines. Evaluating the reliability, understandability and content of available online resources would provide important insights on how these tools may be improved to increase vaccine confidence.

Methods: A search of online Canadian public-facing webpages from different levels of government, public health units, academic pediatric hospitals, and selected professional organizations on SARS-CoV-2 vaccines targeting caregivers of children aged 5–11 years was conducted between March 21 to April 22, 2022, during a period of Omicron predominance. Pre-determined inclusion and exclusion criteria and site mapping were used to screen and identify primary and secondary weblinks. A content checklist was used to assess key vaccine topics (e.g., effectiveness and safety), and reliability, readability, and understandability/actionability were assessed using JAMA Benchmark, Flesch-Kincaid Grade Level, and Patient Education Material Assessment Tool for Printable and Audiovisual materials. Two authors screened and assessed webpages, and discrepancies were resolved by a third author.

Results and analysis: A total of 44 primary webpages and 141 secondary pages were included. Although most of the printable materials (43/44) were rated highly understandable, only seven (16%) resources provided actionable information. Resources that included audiovisual materials (19) scored highly for understandability and actionability. Only 22 (50%) main pages achieved the maximum reliability score. The overall mean for readability score ranged from 3.40 to 11.70. Only 5 clusters of resources were easy to read (score at or below 6th grade). Although most resources addressed important aspects of SARS-CoV-2 vaccination such as vaccine approval process and effectiveness, some lacked key parental safety concerns, including myocarditis (not addressed by 25%) and infertility (not addressed by 52%).

Conclusions and implications for policy, practice or additional research: Although most Canadian webpages on SARS-CoV-2 vaccines received high scores in understandability and reliability, areas of improvement in actionability, readability, and content were identified.

---

81. School-based immunization coverage in Ontario, 2019-20, 2020-21, 2021-22

Lim G, **Paul L**, Wilson S, Harris T, Navarro C

Introduction: We present coverage estimates for Ontario's school-based immunization programs - Hepatitis B (Hep B), human papillomavirus (HPV) and quadrivalent meningococcal conjugate (MCV4) – for the school years affected by school closures due to the COVID-19 pandemic response (2019-20, 2020-21) and thereafter (2021-22).

Methods: Ontario's Hep B, MCV4 and HPV publicly-funded programs are typically delivered by public health units (PHUs) in schools to grade 7 students (12-year-olds), with catch-up until grade 12 (17-year-olds). MCV4 is a one-dose program while Hep B and HPV generally follow two-dose schedules. Adolescent immunizations administered in school-based programs are entered directly by the PHUs into the Digital Health Immunization Repository (DHIR). Data were extracted for 12-17-year-olds and up-to-date coverage was assessed as of August 31 of the relevant school year.

Results and Analysis: There was a significant decline in coverage during all three school years compared to pre-pandemic years, particularly among 12-year-olds. Provincial up-to-date coverage for 12-year-olds for 2019-20,

2020-21 and 2021-22 were 26.2%, 19.2% and 29.8% for Hep B, 5.8%, 2.6% and 15.6% for HPV, and 67.8%, 21.2% and 42.8% for MCV4, respectively. For 17-year olds, these estimates were 77.3%, 77.8% and 74.9% for Hep B, 63.4%, 63.4% and 64.1% for HPV, 93.9%, 93.8% and 90.6% for MCV4, respectively.

The proportion of 12-year old students who initiated their immunization series (ie received at least one dose) was 81.5%, 40.8% and 54.0% for Hep B, and 70.1%, 19.8% and 38.9% for HPV in 2019-20, 2020-21 and 2021-22, respectively. A high proportion of students did not complete their series across all years. There was tremendous geographic and temporal variability, with few PHUs achieving coverage similar to pre-pandemic levels in 2021-22.

Conclusion: Disruptions to the delivery of school-based immunization programs due to the COVID-19 pandemic had a significant impact on immunization coverage, demonstrating the need for routine immunization catch-up programs.

---

82. Vaccine Education in Schools: How to Handle Your Shots Like a Champ with Kids Boost Immunity

Roe I, Haines C, Betancourt J

Introduction/program need and objectives: KBI is a national online learning platform for schools funded through PHAC consisting of 350 interactive lessons and quizzes. Students earn vaccines for children in other countries for every quiz they complete.

KBI's "How to handle your shots like a champ" lesson is offered to Canadian classrooms for grades that offer school-based clinics. This lesson takes advantage of the opportunity to provide an educational resource that targets the right people (students) in the right place (school), at the right time (just prior to vaccination day).

Lesson objectives:

- Increase students' knowledge/confidence in the importance of vaccination, including HPV
- Decrease students' anxiety associated with vaccinations through learning strategies to cope with needle fears

The long-term goal is to improve vaccination rates through education that boosts resilience against misinformation among youth.

Program methods, activities and evaluation: Teachers are asked to do the lesson and quiz with their students the week before vaccination day. It covers how vaccines work, why students need vaccines, what students can expect on vaccination day, and tips for coping with needle fears/anxiety using the CARD system. After the clinic, students do a quick review of what they learned and fill out a quiz/survey on their experience at the clinic.

The evaluation is BC-specific and examines the impact of the lesson on students:

- Knowledge of vaccines and coping strategies
- Perceptions about vaccines and getting vaccinated

Program results or outcomes: The program evaluation is currently underway with 20 grade six classes in BC with early encouraging results. Final results will be available by March 2023.

Recommendations and implications for practice or additional research: Will be determined based on final evaluation but may include advocating for including vaccine specific curriculum in grades that align with routine school clinics and further research scale up program to all provinces.

---

83. COVID-19 vaccine uptake and antibody response among a cohort of children and adolescents in Montreal

Pierce L, Zinszer K, Charland K, Saucier A, Barbosa Da Torre M, Nguyen C, Papenburg J, Quach C

Introduction/background: In Quebec, COVID-19 vaccination uptake among 12-17 year olds has been similar to that of adults, with 79% having completed the basic immunization series by November 2022. However, only 44% of 5-11 year-old children have completed the basic immunization series despite being eligible for almost one

year. In a cohort of children and adolescents from Montreal, we explore the reasons given by parents and teens for their COVID-19 vaccination decisions, and report the proportion of vaccinated children with detectable levels of antibodies.

Methods: The EnCORE study is a cohort of children aged 2-17 years who have provided repeated blood samples for antibody detection between 2020 and 2022. Serostatus for infection-induced and vaccine-induced antibodies is determined by enzyme-linked immunosorbent assays (ELISAs) using three antigens. Parents and adolescents complete questionnaires regarding vaccine uptake and acceptability (e.g. for mandatory vaccination in certain workplaces and views on the vaccine passport system). In the latest round of data collection (May - September 2022), parents reported on the vaccination status of 922 children and adolescents, and 545 children vaccinated with two or more doses provided blood samples for serological analysis.

Results and analysis: COVID-19 vaccine acceptance is relatively high in our cohort compared to youth in Quebec: 74% of participants received least two doses and 79% received at least one dose. Only 3% of 12-17 year olds were unvaccinated when last surveyed compared to 12% of 5-11 year-olds; 21% of 2-4 year-olds were unlikely to be vaccinated. Fear of adverse effects was the top reason given by parents and adolescents for remaining unvaccinated. All children who received two or more doses of COVID-19 vaccine had antibodies detectable from their vaccination.

Conclusions and implications for policy, practice or additional research: Understanding the nuances of COVID-19 vaccine uptake among different age groups and the reasons behind parental vaccination decisions can inform strategies for building trust in current and future vaccination campaigns.

---

84. Assessing the impact of school closures and the COVID-19 pandemic on cancer prevention vaccine uptake

Kadri O, Ridsdale T, Murray J, Beckermann K, Vanderlinden L, **Dubey V**

Introduction/program need and objectives: Human papilomavirus (HPV) infections are common. While some infections can lead to cancer, they can be prevented through vaccination. During the pandemic, capacity to deliver school-based vaccinations was reduced, resulting in lower coverage.

Program methods, activities and evaluation: Before the pandemic, HPV vaccination coverage was trending upward in Toronto. Beginning in the 2007/08 school year coverage was only 58.1% among grade 7 female students; in 2017/18, 65.8% of eligible Grade 7 students (female=68.7%, male=63.1%) received the HPV vaccine series and 72.1% of eligible 17-year-olds were up-to-date on the series as of the 2020/21 school year. The impact on HPV vaccination coverage since the COVID-19 pandemic was assessed using Panorama.

Program results or outcomes: Due to school closures and public health staff redeployment to COVID-19, school-based clinics were not held from March 2020 to June 2022 in Toronto. As a result, HPV vaccine coverage decreased substantionally. HPV vaccination coverage for grade 7 students in the three pandemic school years was: 0.8% for 2019/20 (born 2007), 0.1% for 2020/21 (born 2008) and 13.1% for 2021/22 school year (born 2009). Coverage for eligible grade 12 students was also impacted as catch up during the pandemic was minimal: 83.6% for 2019/20 (born 2002), 72.1% for 2020/21 (born 2003) and 65.8% for 2021/22 school year (born 2004).

Recommendations and implications for practice or additional research: It will take time to get coverage rates back to pre-pandemic levels and higher. It took time to increase HPV vaccine coverage rates through vaccine knowledge, social values and norms, media coverage, organizational resourcing, and vaccine policies. Missed school-based vaccinations can exacerbate existing inequities. People living on low incomes, minority populations, recent immigrants and refugees, and other marginalized populations experience inequities in immunization coverage rates and higher rates of cancer. It is important for public policies to achieve Canada's target of 90% HPV vaccination coverage for 17 year olds.

---

85. An assessment of COVID-19 vaccine communication from Canadian federal actors' Instagram accounts and the implications for vaccine-hesitant young adults

Ford C, MacKay M, Thivalappil A, McWhirter J, Papadopoulos A

Introduction/background: In Canada, young adults remain one of the least vaccinated adult age groups against COVID-19. As such, targeting vaccine messages towards this demographic is important for encouraging them to get vaccinated. Because young adults are a prominent user group on social media, we sought to understand if the vaccine messages from Canadian federal actors on Instagram were effective in promoting vaccine uptake based on best practices. Best practice messaging strategies include implementing guiding principles for crisis communication (i.e., transparency, compassion and empathy, conversational tone, clarity, correction of misinformation, call to action) and addressing the 5C model for vaccine hesitancy (i.e., complacency, confidence, risk calculation, constraints, collective responsibility).

Methods: We performed a content analysis on 159 Instagram posts that mentioned COVID-19 vaccines from eight key federal accounts. In addition, we performed a sentiment analysis on the comment sections of these posts to understand public reaction to the messages being shared.

Results and analysis: Across the 8 federal accounts and 159 Instagram posts that mentioned COVID-19 vaccines, federal actors did not widely incorporate best practices for vaccine communication. Further, the accounts did not adopt a unified approach to vaccine communication, and overall public sentiment was neutral.

Conclusions and implications for policy, practice or additional research: The assesment has highlighted gaps in the social media communication strategy for COVID-19 vaccines. As such, these results can encourage future vaccine communication campaigns that reach young adults to be informed by best practices and strategies to encourage vaccination.

---

86. Characterization of vaccine confidence amongst teachers in BC: A population-based survey

Racey C, Donken R, Fox E, Porter I, Bettinger J, Mark J, Bonifacio L, Dawar M, Gagel M, Kling R, Mema S, Mitchell H, Roe I, Ogilvie G, Sadarangani M

Introduction/background: Teachers are an important group to consider when addressing vaccine confidence and uptake for school-aged children due to their proximate role within school-based immunization programs. The objectives of this study were to characterize and identify factors associated with vaccine confidence and describe teachers' knowledge of and perceived role in the school-based immunization program, with the aim of informing public health policy and identifying opportunities for supporting teachers in their role in school-based immunization programs.

Methods: A cross-sectional survey of elementary and secondary public-school teachers in British Columbia was completed from August - November 2020. Respondents provided sociodemographic information, past vaccination experience, vaccine knowledge, and perceived role in the school-based immunization program. Vaccine confidence was measured using the validated World Health Organization's Vaccine Hesitancy Scale (VHS). Characteristics associated with the VHS sub-scales 'lack of confidence in vaccines' and 'perceived risk of vaccines', were explored using ANOVA. Descriptive analysis was completed for teachers' perceived role in the immunization program.

Results and analysis: Of the 5,095 responses, overall vaccine confidence was high, with vaccine hesitancy being related to the perceived risk of vaccines rather than a lack of confidence in vaccines. The mean scores on the 'perceived risk' sub-scale were significantly different by age, sex, visible minority status, and educational background, however, the strength of the associations was generally small. Higher vaccine confidence and lower perceived risk of vaccines were significantly associated with high general vaccine knowledge and never having delayed/refused a vaccine in the past. Overall, teachers reported a lack of clarity in their role within the school-based program.

Conclusions and implications for policy, practice or additional research: Using a validated scale, we found that overall, teachers are highly accepting of vaccines, and well situated as potential partners with public health to address vaccine hesitancy. This large population-based observational study highlights a number of key engagement opportunities between public health and the education sector.

---

87. Criterion Validity of the World Health Organization Vaccine Hesitancy Scale for COVID-19 vaccine delay in a vaccinated cohort

Racey C, Booth A, Albert A, Smith L, Krajden M, Murray M, Cote H, Gottschlich A, Goldfarb D, Sadarangani M, Galea L, Kaida A, Ogilvie G

Introduction/background: Vaccine hesitancy is increasingly a barrier to the control of vaccine-preventable diseases. The validated vaccine hesitancy scale (VHS), developed by the World Health Organization, has been used as a measure of vaccine hesitancy globally; however, limited evidence exists on its criterion validity regarding vaccine decision-making on the hesitancy continuum. This analysis aimed to determine the criterion validity of the VHS for discrimination between those who accepted a COVID-19 vaccine immediately and those who delayed.

Methods: An adult cohort completed surveys at two time-points (T1: 2020-2021; T2: 2022). T1 was before widespread availability of COVID-19 vaccines with data collected on 9-item VHS, intention to vaccinate, and socio-demographics. T2 collected data on COVID-19 vaccine uptake, including delay in booking a vaccine appointment (≥ 8 days after notification of vaccine eligibility). Criterion validity was assessed using a receiver operating curve (ROC) to determine scale score cut-offs and sensitivity and specificity for vaccine delay.

Results and analysis: A total of 2,758 invited participants with at least 1-dose of a COVID-19 vaccine who completed both surveys were included in this analysis. The majority of participants (88%) booked their vaccine appointments promptly, with 330 (12%) reporting a delay of ≥8 days (range 0 days – greater than 6 months). Mean scores on the VHS subscales were significantly different ($p<0.0001$) based on vaccine delay, with an optimal cut-point of 1.20/5.00 (AUC = 0.67) for "lack of confidence in vaccines" and 3.04/5.00 (AUC = 0.63) for "perceived risk of vaccines", with higher scores indicating a delay. Sensitivity ranged from 0.50-0.63 and specificity from 0.54-0.80 for vaccine delay.

Conclusions and implications for policy, practice or additional research: The VHS had limited ability to discriminate between immediate and delayed vaccine acceptors on the vaccine hesitancy continuum when using the VHS. Refinement of validated scales to be able to measure and predict vaccine delay, and acceptance, during a pandemic would inform future vaccine program implementation.

---

88. The Barriers and Facilitators in Promoting Vaccination with Culturally-Safe Approaches amongst Underserved Immigrants, Refugees, and Marginalized Communities (IRM) in Metro Vancouver

Abasta J, Huang D

Introduction/program need and objectives: The Immunization Uptake Project (IUP) aims to promote vaccination and guide patients on the topic of vaccination in general, increasing their confidence in vaccines and addressing barriers to acceptance and uptake of COVID-19 vaccines in a culturally safe and linguistically accessible manner.

IUP started in September 2021, and it is currently serving at least ten underserved ethnocultural groups - Amharic, Arabic, Chinese, Farsi, Hindi, Pashto, Punjabi, Tamil, Tigrinya, and Urdu-speaking communities in Metro Vancouver Area.

Objectives: Gather information from underserved IRM residents regarding their knowledge and attitudes about vaccines including COVID-19 immunization.

- Mitigate vaccine hesitancy and promote vaccine awareness by adapting culturally appropriate approaches
- Increase knowledge and skills amongst health and community service professionals on culturally-appropriate methods.

Program methods and activities :

- Conducting Focus Groups (FG) to ten underserved ethno-cultural groups
- Provide culturally and linguistically appropriate educational materials.
- Deliver information workshops and in-service "train the trainers" presentations
- Deliver culturally sensitive and linguistically accessible information workshops

Program results or outcomes: The findings from our analysis suggest that the barriers were fear and distrust of the COVID-19 booster vaccine. However, our FG groups found that authority figures were trustworthy and the best source of information. Many groups thought that the vaccine has not been researched enough so they tended to not 'trust' it. Also, side effects from COVID-19 vaccines were barriers to getting future vaccinations, our participants were worried about long-term effects which also increased barriers to children getting immunized.

Recommendations and implications for practice or additional research:

- The information ought to be delivered by authority figures who are knowledgeable and trusted
- The continual clear and factual information provided by both the Federal and Provincial Governments ensures language diversity.
- Older groups are not used to seeking out information if they came from countries where free choice is not an option
- Information and knowledge ought to be provided to communities are influenced by cultural group norms.

---

89. Nova Scotia Strong: Why communities joined to embrace COVID-19 public health measures

Steenbeek A, Graham J, MacDonald N, Curran J, Gallant A

Introduction/background: The effects of the COVID-19 pandemic have been felt by many Canadians, with lasting effects on the country's healthcare systems. While each province and territory has been affected by the pandemic, the burden of disease has varied across the country. Among the Maritime provinces, Nova Scotia had a unique experience as they maintained relatively low cases through much of the pandemic, thanks in part, to strict public health measures (PHM). We set out to explore Nova Scotians' experiences, barriers and facilitators associated with pandemic PHM, including COVID-19 vaccination.

Methods: We conducted semi-structured, individual interviews with Nova Scotian decision makers, community leaders and community members, between May and August 2021, during the 3rd wave of COVID-19 cases and provinical lockdown. Direct content analysis and thematic analysis were used to identify key themes via the Theoretical Domains Framework.

Results and analysis: The experiences of 30 participants clustered around 4 themes: communication of PHM, responsibly observing PHM: a community coming together, navigating PHM and vaccine confidence & hesitancy. Consistent communication of PHM through briefings with the Chief Medical Officer of Health and provincial channels reduced misinformation and encouraged compliance. Inconsistent enforcement of these measures proved challenging.

Conclusions and implications for policy, practice or additional research: A high level of vaccine confidence and acceptance was identified, along with strong provincial pride and value in caring for each other. Provincial public health experts and government leaders communicated PHM with various levels of success. Future work should aim to include under-represented communities to facilitate broader inclusion.

---

90. Using the Poisson maximized sequential probability ratio test to monitor potential safety signals following vaccination in Canada

Spruin S, Boukkouri K, Ogasawara H, Shaw A, Proctor T, Wijayasri S, Abraham N, Silva I, Montalban J, Maro J, Ogunnaike-Cooke S

Introduction/background: With the approval of novel COVID-19 vaccines, the need for post-licensure vaccine safety surveillance is critical, as pre-licensure clinical trials are often underpowered, and their duration limited, to detect small risk increases, especially in rare or long-latency events. Quickly detecting increases in adverse events following immunization (AEFI) and assessing if they occur more frequently than expected is essential to vaccine safety surveillance. As data requires real-time, continuous investigation, a methodology is needed that maintains the correct alpha-level while allowing for multiple testing throughout the surveillance period, thereby limiting the probability of false signals.

Methods: Observed AEFI reports submitted to the Canadian Adverse Events Following Immunization Surveillance System and the Canada Vigilence Database within the at-risk period were compared to expected events (EE) in the population. EE were calculated using Canadian background rates, doses administered and an at-risk period. The Poisson Maximized Sequential Probability Ratio test (PMaxSPRT) was performed approximately weekly using the R Sequential package to determine if observed events (OE) were significantly greater than EE (alpha-level=0.01). Three OE were required to initiate the analysis. The stopping boundary for PMaxSPRT was estimated by requiring a minimum power (80%) to detect various relative risks ranging from 1.25 – 3 depending on the rarity of the event in the strata. A power-type alpha spending function (ρ=1) was used to adjust the analysis for how data came in (continuous versus segmented) and preserve alpha for further tests, which preserves power and minimizing time to signal.

Results and analysis: Risk of myocarditis and/or pericarditis following COVID-19 vaccination from June 4, 2021 to May 13, 2022 was analyzed using PMaxSPRT and stratified by vaccine type, age, sex, dose, and 7-day at-risk period. OE were significantly greater than EE following dose 1, 2, and all doses of mRNA vaccines, primarily in younger ages (12-39 years) as early as June 18, 2021 after 26,871,513 mRNA doses were administered in Canada.

Conclusions and implications for policy, practice or additional research: PMaxSPRT can be used to identify statistical signals as soon as possible to ensure timely follow-up, assessment and action. Identifying safety issues as early as possible and avoiding false signals will minimize injury to the public and improve the public's vaccine confidence.

---

91. "There was a lot of that [coercion and manipulation] happening and well, that's not very trustworthy": a qualitative study on COVID-19 vaccine hesitancy in Canada

MacKay M

Introduction/background: Although a large proportion of the Canadian population is fully vaccinated against COVID-19, millions of eligible individuals remain unvaccinated. Trust in public health and government impacts the effectiveness of crisis communication and the public's willingness to follow health recommendations.

Methods: The research utilized a qualitative approach with semistructured interviews to understand the views and perspectives of vaccine-hesitant adults during COVID-19 in Canada. The interview questions were focused on questions about the key principles of the CDC's Crisis and Emergency Risk Communication Framework. Thematic analysis of the interviews was completed.

Results and analysis: 12 participants were interviewed, contributing to four interrelated themes as important to COVID-19 vaccine hesitancy: (1) perceived low use of crisis communication guiding principles by public health and government is contributing to distrust of the spokesperson and message; (2) risk perception and decision-making around vaccine uptake are influenced by many sources and concerns surrounding vaccine research and

development; (3) the pharmaceutical industry and perceived politicization of vaccine efforts are causing distrust; and (4) stigmatization related to COVID-19 vaccine status further entrenches views and erodes trust.

Conclusions and implications for policy, practice or additional research: This study highlights the importance of trust and how vaccine hesitancy is fueled by perceived ineffective crisis communication by officials. Crisis information that is targeted and tailored and evidence-based must reflect vaccine-hesitant individuals' information needs and values, rather than a one-size fits all approach.

---

92. Moral injury and public health: A focus on immunizers

MacDonald N, Ricardelli R, Comeau J

Public health attracts health care professionals strongly motivated to improve the health and well-being of the public as opposed to only individuals. Public excitement when COVID vaccines became available included high value and support for public health and immunizers. Many worked long and extra hours to ensure access to these vaccines. They sought to do their job well and keep true to their values.

Sadly, there was a seismic shift from the initial strong community support for public health professionals and immunization to anger and aggression against these workers by some in the community and, the devaluing of their work by others. Vaccine mandates made this anger increase. While others lamented, they were not immunizing fast enough. The outcome of such tensions can be a sense of betrayal by the very population that public health and immunizers are striving to serve leading to moral injury. Too many are labelling this burnout. Moral injury is different. This presentation will discuss the antecedents to moral injury here, define moral injury and differentiate form burnout and suggest strategies for addressing this problem.

---

93. SARS-CoV-2 vaccine acceptance and uptake among caregivers of children 5-11 years of age: a cross-sectional survey

Piché-Renaud P, Karimi-Shahrbabak E, Farrar D, Peresin J, Abu Fadaleh S, Low B, Morris S

Introduction/background: Although vaccination of children aged 5-11 years against SARS-CoV-2 is recommended in Canada, nearly half of Ontarian children this age remain unvaccinated. This study aimed to assess caregivers' vaccine acceptance and uptake for children in this age group and to identify factors associated with vaccine non-acceptance in Ontario.

Methods: A multi-language self-administered survey was sent to caregivers of children aged 5-11 years through schools and community health centers within the Toronto Area from April 5th–July 4th, 2022. Socio-demographic characteristics, acceptance of routine childhood and influenza vaccines, and current SARS-CoV-2 vaccine status for parents and older siblings were collected. Data were analyzed using multivariable logistic regression.

Results and analysis: Overall, 807 caregivers (170 fathers, 629 mothers) of children aged 5-11 years answered the survey. Although 748 (93%) caregivers had received at least two doses of COVID-19 vaccine, only 618 (77%) had a child 5-11 years old who had received at least one dose of the vaccine. Caregivers who received at least one dose of vaccine against COVID-19 were more likely to get their children vaccinated. Adjusted odds ratios for vaccine acceptance were higher among caregivers older than 40 years of age, children living in areas with high vaccine coverage, and children who received at least one influenza vaccine in the past two years. Reasons for caregivers not vaccinating their children were concerns about long-term side effects (60%), child already contracted SARS-CoV-2 (46%), and concerns that vaccines were developed too quickly (34%).

Conclusions and implications for policy, practice or additional research: We describe factors associated with SARS-CoV-2 vaccine non-acceptance in caregivers of children 5-11 years old and the barriers to vaccine acceptance in this population. These findings provide insights on groups of caregivers that should be targeted

for educational and public health interventions, and identify parental concerns that ought to be addressed to increase vaccine confidence.

---

94. Community Vaccination Promotion – Ontario (CVP-ON) Equity, community and trust: Building vaccine confidence with marginalized populations

Appleyard T, Rayner J, Kinnaird A, Pham J

Introduction/program need and objectives: Beginning in April 2021, the Alliance for Healthier Communities (the Alliance), a network of team-based comprehensive primary health care organizations across Ontario, received funding from the Public Health Agency of Canada's Immunization Partnership Fund to implement the Community Vaccination Promotion (CVP-ON) project. Twelve Alliance members have been funded to advance vaccine uptake in their communities (including boosters) through communication and promotion, and outreach initiatives rooted in an equity-informed approach, community leadership, and trusted relationships. Clients of these primary health care organizations include marginalized communities who, despite being most affected by the pandemic, face the greatest barriers to vaccination.

Learning objectives:

- Understand the barriers to COVID-19 vaccination faced by marginalized populations
- Learn how to build equity and community-informed practices into vaccine outreach uptake promotion

Program methods, activities and evaluation: The CVP-ON project has included 12 Alliance member organizations to lead tailored vaccine promotion and outreach initiatives. These organizations fostered vaccine confidence and uptake via a variety of hyper-local approaches. Implementing organizations conducted focus groups, key informant interviews, and surveys to understand barriers and facilitators for vaccine outreach for various populations. Activities have included door-to-door outreach with community ambassadors, providing transportation to vaccination clinics, information-sharing events in faith-based and other cultural spaces, and opportunistic vaccination during local community events.

Program results or outcomes: Results have found that participating organizations held 279 online or in-person public events, connected with 32007 individuals and families through phone, text and door-to-door visits, and reached a broader audience of 253293 individuals through social media and local advertising. Approximately 19317 individuals booked vaccine appointments or were vaccinated directly because of these initiatives.

Recommendations and implications for practice or additional research: Culturally and linguistically appropriate outreach including outreach done by members of the community and other local ambassadors, and reducing barriers such as lack of transportation, childcare, and digital inequity were all key factors for enhancing vaccine uptake in marginalized communities. Ensuring that equity, community, and trust are at the forefront to healthcare delivery is key toward overcoming systemic barriers to health and wellbeing in Ontario during COVID-19 and beyond.

---

95. Plateaus in COVID-19 vaccination coverage of additional doses received following the primary series in Canada

Lavergne V, Baysac D, **Ho Mi Fane B**, Hong C

Introduction/background: This analysis aims to describe COVID-19 vaccination coverage for at least one dose, primary series completion, and additional doses across Canada.

Methods: Aggregate data from provincial and territorial immunization registries as of September 11, 2022, were reported to the Public Health Agency of Canada by provicial and territorial partners. As the fall booster campaign is rolling out, the data will be updated closer to the presentation date. Since registries are not able to completely distinguish booster doses from additional doses administered for other purposes, the metric used in this analysis was additional doses rather than boosters.

Results and analysis: After a steep increase over 9 months, vaccination coverage of the Canadian population for at least one dose reached a plateau in September 2021 at 76.0%, primary series completion plateaued in October 2021 at 74.1% 8 months after the beginning of the campaign, and coverage for the 1st additional dose plateaued at 44.9% after 4 months.

The attainment of these plateaus is even more concerning in older individuals (70+) who plateaued at 79.3% in February 2022 for the 1st additional dose, and at 53.9% in September 2022 for the 2nd additional dose, after they were strongly recommended at the end of October 2021 and in April 2022, respectively. As more doses were recommended, particularly for additional doses, coverage plateau levels decreased and greater differences in coverage are observed between age groups ranging from 19.4% (12-17 years) to 86.3% (70+ years).

Conclusions and implications for policy, practice or additional research: While the majority of the eligible Canadians received an additional dose, uptake of each recommended dose is lower than the previous one, indicating a decreasing adherence of the population to vaccination recommendation. The planning of future phases of COVID-19 vaccination will need to take this phenomenon into account.

---

96. The impact of provincial proof of vaccination policies on age-specific uptake of first doses of COVID-19 vaccines in Canada

Camillo C, Fitzpatrick T, Rowein S, Habbick M, Roerig M, Muhajarine N, Allin S

Introduction/background: In response to Canada's Delta-driven fourth COVID-19 pandemic wave, proof of vaccination (PoV) requirements were mandated for non-essential establishments by all provinces throughout fall 2021. We estimated the impact of provincial PoV mandates on age-specific uptake of COVID-19 vaccines.

Methods: We used event study regression to estimate the impact provincial PoV announcements had on the age-specific weekly number of first doses of COVID-19 vaccines administered, as reported by the Public Health Agency of Canada. Percentage point changes in uptake were estimated for each of the seven weeks following announcement relative to the week prior, and adjusted for weekly case and death counts. We further estimated the impact of PoV implementation and rescission on first dose uptake.

Results and analysis: Announcement of provincial PoV mandates was associated with a rapid, significant increase in first dose uptake, particularly in younger Canadians (<50 years). Compared to the week prior, first dose uptake increased by 39.7 percentage points (for 12-17-year-olds), 47.2 (18-29), 43.1 (30-39), 35.7 (40-49), 29.9 (50-59), 24.6 (60-69), 18.9 (70-79), and 17.7 (80+) following PoV announcement. However, these changes were short-lived, returning to pre-announcement levels or lower within six weeks post-announcement; this decline occurred earlier, and was more apparent, among 12-17-year-olds, whose uptake declined towards pre-announcement levels after two weeks. Nationally, we estimated a 22.1% increase in first dose uptake, equivalent to 423,226 additional doses, in the seven weeks post-announcement. Moreover, we observed a decline in first dose uptake immediately after PoV mandates were rescinded, further supporting a causal association. .

Conclusions and implications for policy, practice or additional research: This study provides novel age-specific evidence showing PoV mandates led to an immediate, significant increase in first dose uptake, particularly among younger groups. Future work should examine other impacts of mandates, such as viral transmission.

---

97. 2021 Immunization Communication Tool for Health Care Providers

Chilton K, Haines C

Introduction/program need and objectives: The Immunization Communication Tool (ICT) was first created in 2008 to support health care providers respond to concerns about vaccines. Following an evaluation in 2019, the 2021 edition of the ICT was revised based on the most recent literature recommendations for addressing vaccine hesitancy.

Program methods, activities and evaluation: The evaluation of the ICT included a survey of immunization providers in BC. The evaluation demonstrated a need for updated content and a revised format to support health care providers in responding to immunization questions and concerns.

Program results or outcomes: Based on the evaluation findings, the ICT was reformatted with new content and a new immunization communication framework which aligns with current evidence based literature for addressing vaccine hesitancy.

Recommendations and implications for practice or additional research: The evaluation of the ICT helped us better understand what improvements could be made to support immunization providers in BC address vaccine hesitancy. The updated ICT offers an evidence based resource for immunization providers to use in their every day practice. Ongoing evaluation of the tool is needed to ensure it meets the needs of its users and is reflective of the most recent literature.

---

98. Healthcare provider awareness, attitudes, beliefs, and behaviors regarding the administration of vaccines by pharmacists

Di Castri A, Halperin D, Isenor J, Kouokam Lowe W, Ye L, Halperin S

Introduction/background: Despite national recommendations and widened scope of pharmacists' practice to include immunization, vaccine coverage among adults in Canada remains suboptimal. We surveyed immunization providers (pharmacists, nurses, and physicians) in Nova Scotia and New Brunswick to determine their perceptions about the administration of vaccines by pharmacist immunizers.

Methods: We developed a cross-sectional online survey and assessed it for validity and test-retest reliability. Invitations to participate were circulated by professional associations, health authorities, and in social media posts. The survey was open from October 2020 until July 2021.

Results and analysis: Of the 223 participants, 41.3% were pharmacists, 24.7% nurses and 34.1% physicians who administer vaccines. There was agreement across health professions that vaccines are safe (86.1%) and effective in preventing disease (85.6%). Pharmacists felt under professional pressure to give vaccines (62.0%) compared to their nursing (27.9%) and physician (9.1%) colleagues ($p<0.001$). Unique barriers for pharmacists as immunizers included working in a solo practice setting (58.9%) and having no method of identifying unvaccinated adults (76%) compared to nurses (20%, 51.7%) and physicians (26.6%, 25%) ($p<0.001$). Support of pharmacists as immunizers for adults, children and adolescents, and children younger than five varied by profession, with pharmacists most supportive (88%, 88%, and 62.7%), nurses in the middle (71.4%, 57.1%, and 46.9%), and physicians least (60%, 47.1%, and 28.6%) ($p \leq 0.001$). Open-ended survey responses indicated concerns over pharmacists administering vaccines to children younger than five as pharmacists have comparatively little opportunity to complete the comprehensive assessments, screening and anticipatory guidance that primary care providers do.

Conclusions and implications for policy, practice or additional research: Pharmacists have been authorized to vaccinate for several years and there is mounting professional pressure for them to do so. Logistical barriers persist for pharmacist immunizers, as does resistance to their widening scope of practice to include children younger than five.

---

99. An intervention using narratives to address vaccine hesitancy online

Dubé E, Trottier M, Gagnon D, Bettinger J, Greyson D, Graham J, MacDonald N, MacDonald S, Meyer S, Witteman H, Driedger M

Introduction: Negative information about vaccines on the internet can contribute to parental vaccine hesitancy or refusal. Misleading information based on emotional narratives results in more positive media engagement (likes and comments) than evidence-based public health recommendations. This study aimed to evaluate an online intervention using positive narratives to promote childhood vaccination.

Method: Three videos representing different narrative scenarios (~4 mins) promoting childhood vaccination were evaluated: 1) parent's decision making in a context of an abundance of online information, 2) a paediatrician's anecdote about vaccine preventable diseases, and 3) a mother's experience of a vaccine preventable disease. In phase 1, three online focus groups (n=15) were held to explore parents' perception about three specific narratives about childhood vaccination. In phase 2, an experimental study was conducted among an online sample of 2000 parents to measure the impact of those narratives on vaccine intentions and hesitancy (pre-post with a control group, 500 participants randomly assigned to each condition).

Results: In phase 1, Participants trusted health care professionals but identified most with the parents' narratives. In addition, participants said they did not typically watch vaccine narrative videos online. At baseline survey in phase 2, participants reported a high intention to vaccinate their child with routine vaccines in the future. At post-survey, only the video about the mother's experience of a vaccine preventable disease showed an increase in participant's intention to vaccinate, but this effect was not significant.

Conclusions: Currently, there are few studies on how to reduce the negative effects of online vaccine misinformation. A narrative online intervention to promote childhood vaccination was found to be more persuasive especially for narratives featuring parents. A larger scale of this type of intervention may positively impact parents' vaccine acceptability, but more research is needed.

---

100. Vaccine confidence during an infodemic: Insights for action

Edwards M, Chojnacki A, Simeon R, Fadiejew G, Howarth A

Introduction/background: Given the pervasive use of social media, misinformation and disinformation (MIDI) have become a serious risk to public health, labelled by the World Health Organization as an "infodemic". Research has shown that vaccine confidence and uptake can be diminished by MIDI. The Public Health Agency of Canada's (PHAC) exploration of the effects of MIDI on vaccine confidence has identified insights on how to support vaccination and public health measures.

Methods: A multi-faceted research approach was used to synthesize and inform time-sensitive evidence needs for COVID-19 vaccination initiatives. Key sources and inputs for dynamic analysis anchored by a vaccine confidence framework included social media listening), social network analysis, news aggregation via the Global Public Health Intelligence Network (GPHIN); ARCGIS to map vaccine uptake; and public opinion research/national surveys. This evidence was analyzed to identify public discourse trends, characterize the basis and sources of MIDI, and counter discourses to support vaccine confidence.

Results and analysis: Findings indicate that over the course of the pandemic many people in Canada encountered MIDI, most commonly on social media. While many report an ability to identify misinformation related to COVID-19, some misclassify false statements as being true when tested. The analysis helped to identify groups more susceptible to MIDI, key factors contributing to decreased vaccine confidence and a relationship between increased belief in MIDI and decreased protective behaviours, including vaccination. By identifying the claims and tactics highlighted in vaccine MIDI, and rapid emerging trends, key messages, communications, program initiatives and partnerships were mobilized and informed on areas to counter MIDI.

Conclusions and implications for policy, practice or additional research: While the COVID-19 pandemic has challenged the core of public trust and confidence in measures such as vaccination, new understanding of MIDI gained from diverse tools and evidence has helped to unpack the complexity of vaccine confidence. These insights regarding MIDI trends can inform practice strategies and point to areas for research to inform future vaccination and public health challenges in Canada.

---

101. Using local public opinion data to inform targeted COVID-19 vaccination strategies in Toronto

Gray N, Dubey V, **Buzek S**, Corson L

Introduction/background: In 2021, Toronto Public Health embarked on the largest mass-vaccination campaign in its history to combat the COVID-19 pandemic. Due to the unprecedented nature of the pandemic, little information was known about Toronto residents' opinions of COVID-19 vaccination. Timely, local data was needed in order to better understand the public's views and tailor vaccination strategies to promote uptake.

Methods: Toronto Public Health engaged Ipsos to conduct two public opinion surveys about COVID-19 vaccination attitudes and beliefs. The initial survey was administered online in April 2021, with a follow-up in August 2021. Quota targets were set to obtain a representative sample of residents by gender, age, region, education, and recency of immigration. The data were weighted to correct for minor deviations on age and gender. Results were compared over time and stratified by sociodemographic factors where possible.

Results and analysis: Approximately 1,200 Toronto residents responded to each survey. Results showed that there was a high level of vaccine acceptance among Toronto residents that increased between surveys. Survey participants expressed a need for more information about the COVID-19 vaccine and concerns about side effects. Barriers to vaccination included inability to get time off work and discomfort with booking appointments online. The survey results were used to inform public messaging about vaccination, identify vaccine hesitant groups, and reduce barriers.

Conclusions and implications for policy, practice or additional research: Using public opinion polling during a pandemic is a useful way to get real time data to inform rapidly evolving vaccine campaigns. Repeated surveying is important to track progress. However, results from online polls may not be fully representative of the population of Toronto. Although these survey methods allow for rapid collection of local data, they may miss the opinions of hard-to-reach populations, who are also at high risk of being missed from population-based vaccination strategies.

---

102. Vaccine Hesitancy Guide: A patient-centric resource for better conversations in primary care

Leslie S, Fadaak R, Pinto N

Introduction/background: The COVID-19 (C-19) pandemic highlighted vaccine hesitancy (VH) as a barrier to achieving public health goals. Approaches often focus on authoritative public health messaging to educate, but research shows this can entrench people in hesitancy and limit vaccine uptake. Motivational Interviewing (MI) however, leverages trusting relationships to draw out fears and encourages a focus on positive outcomes. We applied MI principles to create a web-based guide for primary care (PC) teams to improve conversations with VH patients. We outline our approach to developing www.vhguide.ca (the Guide), drawing out lessons for creating future VH resources.

Methods: We co-developed the Guide with PC teams across Canada. MI-informed assumptions guiding this work included: 1) long-term trusting relationships between patients and PC are critical in VH counselling; 2) Guide uptake depends on identifying VH types and counselling strategies experienced in PC; and 3) cognitive load on clinicians is reduced by sharing strategies successfully used by colleagues elsewhere.

Co-development used a four step approach: 1) leveraging existing theory about VH origins in the general population; 2) developing and validating a VH typology as PC teams experienced them; 3) role playing and debriefing with teams to identify successful strategies; and 4) creating and updating the Guide to deliver strategies in a meaningful, patient-centric way.

Results and analysis: The Guide identifies 32 hesitancy types, offers strategies for each, and presents clinician-to-clinician advice. Since launch in July 2021, it has had more than 21,000 users and received endorsements from PC organizations, providers, and Canadian medical associations. An evaluation to assess uptake and user experiences is underway.

Conclusions and implications for policy, practice or additional research: We present a patient-centric resource created with stakeholders from the ground-up that is applicable in PC across Canada. Our work shows the importance of engaging with target audiences and stakeholders to develop resources during a health crisis, with broader lessons applicable under 'normal' conditions.

---

103. The associations between precautionary or health-seeking behaviours and COVID-19 vaccine uptake or vaccination intent: Results from the Canadian Community Health Survey (CCHS)

Maquiling A, Guay M, Chen R, Lavergne V, Baysac D

Introduction/Background: While the majority of Canadians have already received at least one dose of a COVID-19 vaccine, continued research surrounding the barriers of vaccination remain relevant in order to maintain adequate and up to date protection against COVID-19. Many studies have investigated the sociodemographic determinants of non-vaccination and vaccination hesitancy in the Canadian context. However, data to examine the associations between vaccine uptake or vaccination intent and health behaviours are limited despite their value in understanding populations who may be targeted for vaccination promotion efforts.

Methods: Data from the 2021 Canadian Community Health Survey (CCHS) survey were used to determine whether certain precautionary behaviours, such as handwashing, mask wearing, or physical distancing were associated with the following outcomes; increased uptake or intent to get vaccinated. In a separate analysis, we examined whether abstaining from cigarette, e-cigarette, cannabis, or alcohol were associated with the same outcomes. In both analyses, multiple logistic regression models were performed to adjust for time and potential confounders (region, age, gender, education, income, visible minority status, and community size).

Results: Most precautionary behaviours were associated with increased uptake and intent. However, those who avoided leaving the house for non-essential reasons were at a *greater* risk of being unvaccinated. Smokers were at greater risks of being unvaccinated and of being unlikely to get vaccinated compared to non-smokers, however alcohol drinkers were at *lower* risks of both outcomes compared to non-drinkers. Use of cannabis or e-cigarettes were not associated with either outcomes.

Conclusions and implications for policy, practice or additional research: This study suggests that precautionary behaviours and abstinence from substance use were associated with COVID-19 vaccine uptake and vaccination intent in varying directions. Understanding these associations is crucial in identifying populations facing barriers of vaccination. In turn, education and promotion efforts can be directed accordingly to enhance vaccination efforts and ensure continued protection against COVID-19 in the Canadian population.

---

104. The effect of vaccine mandate announcements on vaccine uptake in Canada: an interrupted Time series analysis

Maquiling A, Jeevakanthan A, Ho Mi Fane B, Rotondo J

Introduction/background: In 2021, most provinces and territories enacted vaccine mandates that restricted access to non-essential businesses and services to those that could provide proof of full vaccination to decrease the risk of transmission and provide an incentive for vaccination. This analysis aimed to examine the effects of a vaccine mandate announcement on vaccine uptake over time by age group and province.

Methods: Data from the Canadian COVID-19 Vaccination Coverage Surveillance System (CCVCSS) were used to measure change in vaccine uptake (defined as the weekly increase in vaccination coverage) among those 12 years and older following the announcement of vaccination requirements. We performed an interrupted time series analysis using a quasi-binomial autoregressive model adjusted for the weekly number of new COVID-19 cases and modelled the effect of mandate announcements on vaccine uptake. Additionally, counterfactuals were produced for each province to estimate vaccine uptake without mandate implementation. The analysis was limited to nine provinces with available information on both vaccination coverage and COVID-19 cases.

Results: The times series models demonstrated significant increases in vaccine uptake following mandate announcement in BC, AB, SK, MB, NS, and NL. No trends in the effect of mandate announcements were observed by age group. In AB and SK, counterfactual analysis showed that the announcement was followed by a 7% (271,658 and 75,257 people, respectively) increase in vaccination coverage over the following 10 weeks. In MB, NS, and NL, there was at least a 5% (66,346, 44,621, and 25,724 people, respectively) increase in coverage. Lastly, BC announcements were followed by a 3% (150,271 people) increase in coverage.

Conclusion: Vaccine mandate announcements could have increased vaccine uptake. However, it is difficult to interpret this effect within the larger epidemiological context. Effectiveness of the mandates can be affected by pre-existing levels of uptake, hesitancy, timing of announcements and local COVID-19 activity.

---

105. Are public health prebunking messages countering COVID vaccine misinformation effective in increasing older adults' intent to accept vaccine?

Vivion M, Anassour Laouan Sidi E, Dionne M, Driedger S, Dubé E, Gagnon D, Graham J, Greyson D, MacDonald N, **Malo B**, Meyer S, Steenbeek A

Introduction/background: COVID-19 vaccination is an important measure to prevent death and severe outcomes of the disease, especially for those at high risk. COVID-19 misinformation has the potential to fuel vaccine hesitancy and jeopardize vaccine uptake. Prebunking is a promising strategy to combat misinformation. Prebunking, based on inoculation theory, involves "forewarning people [of] and refuting information that challenges their existing belief or behaviour."This study assessed the effectiveness of prebunking in countering misinformation about COVID-19 vaccines among Canadians aged 50 years and older, as measured by their COVID-19 vaccine intentions

Methods: We applied an online experiment with a mixed pre-post design. During March 2021,we conducted a national randomized survey among 2,500 English and French-speaking Canadians aged 50 years and older. Participants were randomized in 3 groups: Group D (disinformation group), Group I (inoculation group), Group C (control group) [message about flowers]. We evaluated participants' responses to two specific misinformation messages: one about safety of mRNA vaccines and one about vaccines' rapid approval by health authorities.Our outcome was the participants' intention to receive a COVID-19 vaccine. The McNemar test and multivariate logistic regression analysis on paired data were conducted when the outcome was dichotomized. Wilcoxon sign rank test and Kruskal-Wallis were used to test difference scores between pre- and post-tests by condition.

Results and analysis: Comparisons between Group D and Group I showed that prebunking messages may safeguard the intention to get vaccinated and have a protective effect against misinformation [OR = 0.63 [0.50–0.80] for group D, and OR = 0.80 [0.65–0.99] for Group I.]. Of note, the prebunking message targeting mRNA vaccine safety was more effective than the message on rapid approval.

Conclusions and implications for policy, practice or additional research: Prebunking messages should be considered a public health communication strategy to combat misinformation. To increase effectiveness, prebunking message must target misinformation negatively impacting vaccine intention. Social listening can provide information on negative messages about vaccines that should be countered by public health .

---

106. Examining vaccine hesitancy among a diverse sample of Canadian adults

Burns K, Dubé E, Nascimento M, **Meyer S**

Introduction/background: Given concerns regarding COVID-19 vaccine hesitancy and booster uptake, the aim of this study was to explore the sociodemographic and individual-level factors associated with vaccine hesitancy, including political affiliation and beliefs in vaccine conspiracy theories, in a diverse group of Canadian adults.

Methods: 641 responses were included in the analysis, with those self-identifying as Indigenous, Black Canadian, and low-income (household income <$40,000) being oversampled to yield data from historically marginalized

populations. Demographic variables and responses to questions on vaccine hesitancy, and beliefs in vaccine conspiracy theories were used to explore predictors of vaccine hesitancy. General linear regression models were fit using the method of least squares via PROC GLM and used to examine sociodemographic and individual predictors of vaccine hesitancy.

Results and analysis: Age, ethnicity, political affiliation, and beliefs in vaccine conspiracies were associated with vaccine hesitancy. Younger individuals, those identifying as Black or Indigenous, those supporting Conservative, those unsure/would not vote, those supporting other federal political parties, and those with higher scores on vaccine conspiracy beliefs, had higher average scores on vaccine hesitancy. Findings are discussed in relation to the critical role of distrust and misinformation in hesitancy.

Conclusions and implications for policy, practice or additional research: Our data provide insight into how Canadian provincial governments may promote uptake in ways that target diverse groups, in anticipation of future COVID-19 waves and vaccines in general.

---

107. Improving equitable access to adult vaccines in Canada

Hu J, Beduz E

Introduction/problem definition that demonstrates the need for a policy change: Currently, there is no obligation for Canadian provinces, territories, nor the federal government, to allocate funding for adult vaccines that have been recommended by Canada's National Advisory Committee on Immunization. Consequently, the availability of publicly-funded immunizations across Canada is patchy and inconsistent for certain diseases, limiting access to those in certain locations, and those who are aware of the vaccine and have the ability to pay.

Research methods: This research is based on insights from stakeholder interviews and information from publicly-available sources. Interviews were conducted with more than 20 leaders in public health, research, and public policy across the country, who have experience in infectious disease research and care, vaccine program implementation and decision-making, and more.

Results and analysis: For the majority of adult vaccines in Canada, funding for vaccine purchasing and program implementation has been the responsibility of each province and territory. But for some cases, alternative funding models have been used to promote access and uptake including: federally-funded and procured programs, and federal transfers to provinces and territories to implement programs. Each model has advantages and challenges to consider related to access, jurisdictional priorities, and implementation. But without change to the existing patchwork system, current inequities in access may persist and widen for adult vaccines.

Recommendations and implications for policy, practice or additional research: As more new and improved vaccines become available, there will be an increasing need for thoughtful and deliberate consideration into federal and provincial/territorial approaches to vaccination coverage. Above all, there will be increasing opportunities to improve equity in vaccination access to reduce suffering and death while alleviating burden on our healthcare systems – and governments have a primary responsibility for exploiting these opportunities.

---

108. Knowledge, attitudes, beliefs, and behaviours (KABB) of the general public regarding the administration of vaccines for adults by pharmacists

Selig B, Di Castri A, Halperin D, Isenor J, Kouokam Lowe W, Ye L, Halperin S

Introduction/background: Adult vaccination rates consistently fall below the desired levels in Canada. One solution to combat this is offering vaccines in pharmacies by pharmacists. We aimed to explore the knowledge, attitudes, beliefs, and behaviours of the general public in selected communities in Nova Scotia (NS) and New Brunswick (NB) regarding the administration of vaccines for adults by pharmacists.

Methods: Adult members of the public were invited to complete an online survey. Participants were recruited by distributing posters in local establishments, via social media, and through email lists at local universities. This survey took place between October 23, 2020 and July 5, 2021.

Results and analysis: Of 992 respondents, 72.4% lived in NS and 27.6% lived in NB. Less than half (45.7%) of respondents reported receiving all vaccines recommended for adults, while 38.2% did not know if they had received all recommended vaccines. The majority of respondents indicated they would get a vaccine if recommended by a physician, nurse, or pharmacist (91.9%, 87.9%, 82.4%, respectively), and 60.5% of respondents had received a vaccination by a pharmacist in a pharmacy. Most respondents thought pharmacists have enough training to administer vaccines (87.1%), thought it was convenient for them to receive their vaccines from their pharmacist (80.2%), and felt comfortable doing so (86.2%), while only 13.6% of respondents felt it was much easier to get a vaccine from their physician than from their pharmacist. Roughly half of respondents reported getting information about vaccination from a family physician (58.3%), the internet (52.4%), and the media (48.0%), while 38.1% got their information from a pharmacist and 23.5% from a nurse.

Conclusions and implications for policy, practice or additional research: This study demonstrates that pharmacists are convenient, accessible, and well-positioned to improve adult vaccine uptake and communicate recommendations and other vaccine-related information to their patients.

---

109. Knowledge, Perceptions, Behaviours, and Information: A Canadian National Influenza Survey

Shin T, Hu J, Tang T, **Lee J**

Introduction/background: Influenza is a viral seasonal respiratory illness disproportionately affecting young children, older adults, and those with chronic conditions. In Canada, an estimated 12,200 hospitalizations and 3,500 deaths are attributed to influenza annually. Current vaccine-related sentiments and behaviours are complex and constantly evolving, and a comprehensive national survey may help provide insights into the Canadian vaccine landscape.

Methods: Six thousand respondents were surveyed from Atlantic, Quebec, Ontario, and Western Canada, ranging from 18-34, 35-54, and >54 (median = 47). Influenza-related categories of analysis included: influenza knowledge and concern; vaccine uptake; vaccine information sources; vaccine knowledge, and perceptions. Pairwise comparisons were analyzed for those ≥65 and <65 across sub-categories to determine the likelihood of vaccine receipt. The relative risk for vaccine hesitancy was assessed by demographic variables, psychographic characteristics, and influenza-related beliefs.

Results and analysis: 70% perceived influenza as severe, and over 60% were aware of influenza's seasonality and the availability of annual vaccination. Regarding death (5%-25%), hospitalization (10%-26%), and pneumonia (17%-30%), respondents were somewhat to very aware of influenza's role. 37% were somewhat, and 18% were very concerned about influenza's return post-COVID-19. 51% were sure to vaccinate for the 2022/23 season; 15% were unsure. The top reason for vaccinating and failing to vaccinate was self-protection and the perceived lack of disease severity. News media (29%) and physicians (36%) were the top sources for vaccine education, while family physicians (73%), and local pharmacists (69%) were the most trusted information sources. 67% believed influenza vaccines were safe, with approximately 50% indicating comfort with the co-administration of influenza and other vaccines (e.g. COVID-19). Approximately 60% of respondents were unaware of the different types of influenza vaccines.

Conclusions and implications for policy, practice or additional research: Several demographic, psychographic, and influenza-related variables, characteristics, and beliefs highlighted gaps in public knowledge, perceptions, and behaviours. Additional research may help stakeholders formulate strategies and tactics to reduce vaccine hesitancy.

---

110. Shifting epidemiology of pneumococcal vaccine serotypes among various age groups in Canada from 2011 to 2021

Yuen A, Golden A, Griffith A, Demczuk W, Lefebvre B, McGreer A, Tyrrell G, Zhanel G, Kus J, Hoang L, Minion J, VanCaeseele P, Smadi H, Haldane D, Yu Y, Mead K, Steven L, McFadzen J, Mulvey M, Martin I

Background: The 13-valent pneumococcal conjugate vaccine (PCV13) was introduced in Canada during 2010-2011; newer formulations (PCV15 and PCV20) were approved for use in 2021/2022. The PPSV23 vaccine has been used for routine prevention of adult invasive pneumococcal disease in Canada since 1989. This study examined shifts in serotype distributions from 2011–2021 in Canada.

Methods: 30,838 invasive *Streptococcus pneumoniae* isolates collected from 2011-2021 were serotyped by Quellung reaction using commercial antisera (SSI Diagnostica).

Results: There was an overall decline of PCV13 serotypes from 2011 to 2021 (49.9%-35.8%). Prevalence of PCV13 serotype 3 in children <5 years was 3.4% in 2021, the lowest value recorded over the study period which ranged from 5.2% in 2014 to a high of 10.0% in 2018. For those ≥5 years, the prevalence of serotype 3 fluctuated between 8.1% and 12.2% of isolates tested (2012 and 2018, respectively). PCV13 serotype 4 has increased from 2011 to 2021, particularly in those ≥5 years (3.5%-13.4%). The greatest decreases among cases <5 and ≥5 years were seen in PCV13 serotypes 19A (33.5%-11.5% and 14.2%-4.4%, respectively); and 7F (9.3%-0% and 15.7%-2.7%, respectively). Increases in the prevalence of other vaccine serotypes for children <5 years include 15B/C (5.8%-17.3%; PCV20/PPSV23), 19F (1.5%-4.8%; PCV13/15/20/PPSV23), and 22F (7.3%-11.5%; PCV15/20/PPSV23), while increases in serotypes 9N (3.7%-7.5%; PPSV23), 9V (0.8%-4.7%; PCV13/15/20/PPSV23), 12F (3.0%-6.8%; PCV20/PPSV23) and 20 (1.2%-5.9%; PPSV23) were seen in patients ≥5 years of age. The most common non-vaccine serotypes for all ages were 15A (4.0%), 23A (3.6%), 23B (3.0%), 16F (2.6%), 6C (2.5%) and 35B (2.1%), accounting for almost 18% of all isolates collected from 2011 to 2021. The prevalence of non-vaccine serotypes was lowest in 2011 (22.4%) and highest in 2014 (30.7%).

Conclusions: Continued surveillance of serotypes is imperative to evaluate vaccine effectiveness and identify emergent replacement serotypes to inform future vaccine development.