Oral Abstract Program
Programme des résumés oraux

IMMUNIZATIONS IN SPECIFIC POPULATIONS – SESSION 1

Tuesday, December 6 **11:00 – 12:30** **Room 201**

CANVAS: Active Surveillance for Adverse Events following Immunization with Seasonal Influenza Vaccines, 2015 and 2016 – *Julie Bettinger*

Co-authors: *Louis Valiquette, Brenda Coleman, Karina Top, Otto Vanderkooi, Anne McCarthy, James Kellner, Jennifer Isenor, Gaston De Serres*

Introduction/Background: The Canadian National Vaccine Safety (CANVAS) network monitors the safety of seasonal influenza vaccines used in Canada each year. By estimating the frequency of adverse events of sufficient severity to cause medical visits or prevent daily activities in vaccinated and unvaccinated adults and children, the network is able to detect signals for adverse events following immunization.

Methods: In 2015 and 2016, adults and parents of children were invited to complete an online survey in October and early November for health events occurring in the first 7 days post-influenza vaccination for vaccines or in the prior week for controls. Health events preventing daily activities or requiring medical attention were defined as severe. Those requiring medical attention were followed up by a nurse to obtain additional details.

Results : In 2015, among the 22,197 adults and children that were recruited, 14,643 (66%) responded to the online survey. Most participants did not report any health events after the flu shot. A total of 3.4% of vaccinated participants reported a health problem severe enough to prevent their normal daily activities and/or cause them to seek medical care compared with 5.0% of unvaccinated controls. The severe event rate in adults was lower than the background rate (i.e. events occurring in unvaccinated adults), while the rate in children was similar to the background rate. No unexpected adverse events were observed in adults or children.

The most frequently reported events in adults were respiratory (1.4%) and gastrointestinal symptoms (0.9%) and headache (1.6%), while in children they were respiratory symptoms (4.1%) and fever (3.6%). Allergic-like reactions and severe injection site reactions were rarely reported (0.01%).

For medically attended events, at the time of telephone follow-up the reported problem had resolved for 30% of controls and 41% of vaccines, was improving for 60% of controls and 43% of vaccines and was unchanged or worsening for the remainder in both groups. Safety data for influenza vaccines used in the 2016 fall campaign will be presented at the conference.

Conclusions/Implications for immunization research and evaluation: No safety signals were detected for the 2015 influenza vaccines. The vaccines had good safety profiles with rates of adverse events in vaccines similar to, or lower than, the background event rates.

End-of-Season Estimates of 2015-16 Influenza Vaccine Effectiveness, Canada – *Danuta Skowronski*

Co-authors: *Catharine Chambers, Suzana Sabaiduc, Gaston de Serres, Anne-Luise Winter, James Dickinson, Jonathan Gubbay, Steven Drews, Hugues Charest, Christine Martineau, Mel Krajden, Nathalie Bastien, Yan Li*

Introduction/Background: The 2015-16 influenza season in Canada peaked later than usual and was characterized by mixed circulation of newly emerging H1N1pdm09 subclade 6B.1 viruses and influenza B viruses belonging predominantly to the B/Victoria lineage.

Methods: Vaccine effectiveness (VE) was derived using a test-negative design comparing self-reported vaccination status between influenza test-positive cases and test-negative controls. Nasal/nasopharyngeal specimens collected between January-April 2016 (week 1-17) from patients presenting within 7 days of influenza-like illness (ILI) onset to the Canadian Sentinel Practitioner Surveillance Network were tested for influenza by RT-PCR. Influenza viruses were further characterized by hemagglutination inhibition assay and hemagglutinin sequencing to assess antigenic and genetic relatedness to vaccine.

Results: Among 2007 included specimens, influenza was detected in 1081 (54%) specimens, including 663 (61%) influenza A (>90% H1N1pdm09) and 422 (39%) influenza B (~80% B/Victoria-lineage). Overall, 19% of cases and 33% of controls reported vaccine receipt ≥2 weeks before ILI onset. Adjusted VE against H1N1pdm09 was 43% (95%CI=25-57%) but decreased significantly from 64% (95%CI=46-77%) in January/February to 18% (95%CI=-21-44%) in March/April. The majority (96%) of sequenced H1N1pdm09 viruses belonged to subclade 6B.1 throughout the study period, with smaller proportions belonging to subclade 6B.2 (2%) and clade 6B (2%).

However, nearly 40% of H1N1pdm09 specimens could not be sequenced, particularly in late-season. Although dominant 6B.1 viruses included clade-defining antigenic site mutations S162N (potential gain of glycosylation) and adjacent K163Q (present in all 6B viruses), all but one characterized virus was antigenically similar to A/California/07/2009 vaccine. H1N1pdm09-specific VE was 64% (95%CI=29-81%) for participants vaccinated in the current season only and 41% (95%CI=20-57%) if also vaccinated the prior season compared to unvaccinated participants.

Adjusted VE against influenza B was 50% (95%CI=31-63%) overall, including significant cross-protection of 53% (95%CI=30-68%) against dominant B/Victoria (subclade 1A) viruses mismatched to the trivalent vaccine's B/Yamagata strain. Influenza B-specific VE was 56% (95%CI=11-78%) for participants vaccinated in the current season only and 48% (95%CI=24-64%) if also vaccinated the prior season.

Conclusions/Implications for immunization research and evaluation: The 2015-16 season in Canada was characterized by suboptimal VE against H1N1pdm09, notably in late-season analyses, and repeat vaccination effects that warrant further investigation. Substantial cross-lineage VE against influenza B was also observed.

Influenza Vaccine Effectiveness in the prevention of influenza-related hospitalization in Canadian adults over the 2011/12 through 2013/14 season: A pooled analysis from the Serious Outcomes Surveillance (SOS) Network of the Canadian Influenza Research Network (CIRN) – *Shelly McNeil*

Co-authors: *Todd Hatchette, Melissa Andrew, Ardith Ambrose, Guy Boivin, Francisco Diaz-Mitoma, William Bowie, Ayman Chit, Gael Dos Santos, May ElSherif, Karen Green, Francois Haguinet, Scott Halperin, Barbara Ibarguchi, Jennie Johnstone, Kevin Katz, Joanne Langley, Jason LeBlanc, Philippe Lagace-Wiens, Bruce Light, Mark Loeb, Donna Mackinnon-Cameron, Anne McCarthy, Janet McElhaney, Allison McGreer, Andre Poirier, Jeff Powis, David Richardson, Makeda Semret, Vivek Shinde, Stephanie Smith, Daniel Smyth, Grant Stiver, Geoffrey Taylor, Sylvie Trottier, Louis Valiquette, Duncan Webster, Lingyun Ye*

Introduction/Background: Ongoing assessment of influenza vaccine effectiveness (VE) is critical to inform public health decision making. The CIRN SOS Network provides annual estimates of influenza VE in the prevention of influenza-associated hospitalization in adults. Here we provide pooled VE estimates across three influenza seasons.

Methods: From 2011/12 – 2013/14, the SOS Network conducted active surveillance for influenza among hospitalized adults ~1Nov- 30April each season in up to 45 hospitals in 7 provinces. A nasopharyngeal swab for influenza polymerase chain reaction (PCR) was obtained from all patients admitted with any acute respiratory diagnosis or symptom. Cases were PCR-positive for influenza; test-negative controls were enrolled and matched for date, enrolment site and age of the case (≥65y versus <65y). VE was estimated as (1 minus odds ratio of influenza in vaccinated versus unvaccinated patients) x 100 for cases and controls enrolled over three seasons. VE estimates were adjusted using multivariable logistic regression with stepwise backward selection of covariates with p-value of <.1 in univariate analysis.

Results: 3394 cases and 4560 controls were enrolled; 2078 (61.2%) cases and 2939 (64.5%) controls were ≥65y. Over 3 seasons, overall matched, adjusted VE was 41.7% (95% Confidence Interval [CI]: 34.3, 48.3%); corresponding VE in adults ≥ 65y was 39.3% (95% CI: 29.4, 47.8%) and in adults 16-64y was 48.0% (95% CI: 37.5-56.7%). Including all age groups, VE against influenza A was 44.1% (95% CI: 35.1, 51.9%) and against influenza B was 35.3% (95% CI: 20.7, 47.3%). In adults ≥65y, VE against influenza A/H3N2 and A/H1N1 was 24.2% (95% CI:

3.6, 40.4) and 58.7% (95% CI: 39.4, 71.9%), respectively. Corresponding estimates in 16-64y were 44.4% (95% CI: 19.0, 61.8%) & 60.8% (95% CI: 45.1, 72%), respectively.

Conclusions/Implications for immunization research and evaluation: While effectiveness of influenza vaccines to prevent serious outcomes varies year to year due to factors such as virulence and match between circulating and vaccine strains, we demonstrate statistically and clinically important benefit of vaccination in adults spanning three seasons with average overall effectiveness of 42%. Individual and public health benefit of influenza vaccines should be highlighted and public messaging should address overall benefits over time while acknowledging year to year variability.

Impact of prior season vaccination on seasonal influenza vaccine effectiveness: A preliminary analysis over 4 seasons from the serious outcomes surveillance network of the Canadian Immunization Research Network – *Michaela Nichols-Evans*

Co-authors: *Lingyun Ye, Melissa Andrew, Todd Hatchette, Ardith Ambrose, Guy Boivin, William Bowie, Gael Dos Santos, May ElSherif, Karen Green, Francois Haguinet, Kevin Katz, Jason LeBlanc, Mark Loeb, Donna MacKinnon-Cameron, Anne McCarthy, Janet McElhaney, Allison McGreer, Jeff Powis, David Richardson, Makeda Semret, Rohita Sharma, Vivek Shinde, Daniel Smyth, Sylvie Trottier, Louis Valiquette, Duncan Webster, Shelly McNeil*

Introduction: Recent controversy has arisen from observational studies suggesting a negative association between prior influenza vaccination and subsequent influenza vaccine effectiveness (VE). As immunologic theories suggest that impact of prior season vaccination could vary season to season, we investigated this association over 4 influenza seasons in Canada.

Methods: The CIRN SOS Network prospectively identified laboratory-confirmed influenza cases and influenza-negative controls admitted to participating hospitals. Using a test-negative control design, matched conditional logistic regression modeling stratifying participants into 4 groups (not vaccinated current or prior season [referent], vaccinated prior season only, vaccinated current season only, and vaccinated both current and prior season) was used to calculate odds ratios (OR) to estimate the effect of vaccination status on influenza-related hospitalization (VE= 1-OR x100). We assessed VE for overall effect and effect stratified by age (<65y, ≥65y) for 4 influenza seasons in Canada: 2011/2012-2014/2015.

Results: Although impact of prior vaccination varied season to season, the largest effects were observed in H3N2 dominant seasons 2012/2013 and 2014/2015, seasons where the H3N2 vaccine component was matched, and mismatched, respectively, to the circulating strain. In 2012/13 this association was observed mainly in adults ≥65y; VE in patients ≥65y vaccinated in current season only was 64.9% (95% Confidence Interval [CI]: 36.5, 80.6%) compared to 20.2% (-7.3, 40.6%) among those vaccinated in both seasons. In 2014/2015 this trend was only observed in adults <65y; VE in patients vaccinated current season only was 9.2% (95% CI: -103.6, 59.5) versus -4.1% (95% CI: -78.8, 39.4%) in patients vaccinated both seasons. In these <65 patients in 2014/2015, influenza A VE (mostly H3N2) was 29.9% (95%CI: -111.2, 76.7%) in current season only vaccinees, compared to -47.8% (95% CI: -184.4, 33.2%) in both seasons vaccinees.

Conclusions/Implications for immunization research and evaluation: While our findings support a possible negative association between prior influenza vaccination and subsequent season VE, mainly non-statistically significant reductions in VE were observed. Additionally, across analyses, VE of patients vaccinated in prior season only was lower than VE of patients vaccinated in current season only or both seasons. Future prospective studies, using varying methodology to examine this association and to explore contributing biological/immunological mechanisms, are critical to inform immunization policy.

Burden of Vaccine-Preventable Pneumococcal Disease in Hospitalized Adults: A Canadian Immunization Research Network (CIRN) Serious Outcomes Surveillance (SOS) Network Study. – *Jason Leblanc*

Co-authors: *May ElSherif, Lingyun Ye, Donna Mackinnon-Cameron, Li Li, Ardith Ambrose, Todd Hatchette, Amanda Lang, Hayley Gillis, Irene Martin, Melissa Andrew, Guy Boivin, William Bowie, Karen Green, Jennie Johnstone, Mark Loeb, Anne McCarthy, Allison McGreer, Sanela Moraca, Makeda Semret, Grant Stiver, Sylvie Trottier, Louis Valiquette, Duncan Webster, Shelly McNeil*

Introduction: Pneumococcal community acquired pneumonia (CAP_{Spn}) and invasive pneumococcal disease (IPD) cause significant morbidity and mortality worldwide. Although childhood immunization programs have reduced the overall burden of pneumococcal disease, there is insufficient data in Canada to inform immunization policy in immunocompetent adults. This study aimed to describe clinical outcomes of pneumococcal disease in hospitalized Canadian adults, and to determine the proportion of cases caused by vaccine-preventable serotypes.

Methods: Active surveillance for CAP and IPD in hospitalized adults was performed in five Canadian provinces from December 2010 to 2013. CAP was identified by chest radiography, clinical symptoms, and laboratory testing. Sputum and blood cultures were performed, and *S. pneumoniae* isolates were serotyped using the Quellung reaction or PCR-based serotyping. Urine was tested using a multiplexed PCV13-serotype specific UAD (UAD_{PCV13}) or a commercial pan-pneumococcal UAD (UAD_{Spn}).

Results: Of 4769 all-cause CAP cases, a laboratory test for *S. pneumoniae* was performed in 3705. Of these, 14.8% were CAP_{Spn} and 6.4% bacteremic CAP_{Spn}. In addition, 81 cases of IPD (non-CAP) were identified. CAP_{Spn} cases and incidence increased with age, and the disease burden was evident in terms of requirement for mechanical ventilation, intensive care unit admission, and 30-day mortality. Of serotypeable CAP or IPD results, a predominance for serotypes 3, 7F, 19A, and 22F was observed, with 66.2% and 84.5% caused by 13-valent pneumococcal conjugate vaccine (PCV13) and 23-valent pneumococcal polysaccharide vaccine (PPV23) serotypes, respectively. The contribution of PCV13 and PPV23 serotypes to all-cause CAP were estimated at 15.3% and 19.6%, respectively.

Conclusions: Overall, this study has described the significant morbidity and mortality of pneumococcal CAP and IPD in hospitalized Canadian adults, particularly in the ≥65 and ≥50 cohorts. In the US, the Advisory Committee on Immunization Practices (ACIP) now recommends that PCV13 should be followed by PPV23 in adults ≥65 years, and recent systematic reviews demonstrated benefits of PPV23 in adults ≥50. While the added benefit of PPV23 immunization of immunocompetent Canadian adults requires further investigation, this data strongly supports a recommendation for the use of PCV13 in Canadian adults aged ≥50.

IMMUNIZATIONS IN SPECIFIC POPULATIONS – SESSION 2

Tuesday, December 6 **11:00 – 12:30** **Room 202**

Safety and Immunogenicity of Tetanus-Diphtheria-Acellular Pertussis Vaccine (Tdap) During Pregnancy – *Scott Halperin*

Co-authors: *Beth Halperin, Victoria Allen, Joanne Langley, Shelly McNeil, Li Li, Donna MacKinnon-Cameron, for the Canadian Tdap Pregnancy Investigator Group*

Background: Immunization of women during pregnancy with Tdap is recommended to provide protection against pertussis to the newborn infant; however, this intervention has not been well studied.

Methods: We undertook a randomized, controlled clinical trial to measure the safety, reactogenicity, and immunogenicity of Tdap given during pregnancy, the transplacental passage of antibody, and the effect of maternal immunization with Tdap on the infant's immune response to the primary immunization series with diphtheria-tetanus-acellular pertussis-inactivated-poliovirus-*Haemophilus influenzae*-b vaccine. A total of 273 women were enrolled in the study, randomly allocated to receive either Tdap or Td in the 3rd trimester,

delivered infants, and provided samples for the safety and immunogenicity analyses; 261 infants provide serum specimens for the immunogenicity analysis.

Results: Both Tdap and Td were well-tolerated during pregnancy; rates of adverse events were similar in both groups. There were 76 serious adverse events (29 for women, 47 for infants) uniformly distributed by group: 73 were unrelated; 2 were possibly related; 1 was probably related. Antibodies against pertussis toxin (PT), filamentous hemagglutinin (FHA), pertacin (PRN) and fimbriae (FIM) were elicited in the women and transferred across the placenta; infants of Tdap recipients had cord blood levels that were 21% higher than maternal levels for PT, 13% higher for FHA, 3% higher for PRN and 7% higher for FIM. Infants whose mothers received Tdap during pregnancy had significantly higher PT antibody levels at birth and 2 months of age (pre dose 1) and significantly higher FHA, PRN, and FIM antibodies at birth, 2, and 4 months of age (pre doses 1 and 2). Infants of Tdap immunized mothers had significantly lower PT and FHA antibody levels at 6 and 7 months of age and significantly lower PRN and FIM antibody levels 7 months of age. At 7 months, the Tdap/Td antibody ratio for infants was 0.74 for PT, 0.60 for FHA, 0.59 for PRN and 0.40 for FIM.

Conclusions: This study demonstrated that Tdap is well-tolerated during pregnancy and results in higher levels of antibodies early in infancy but lower levels after the primary series. The higher levels at birth may provide protection during the highest risk of severe pertussis in the immediate postnatal period but this may be at the expense of increased susceptibility during the second half of the first year of life.

Fecal shedding of rotavirus vaccine in premature babies in the neonatal unit – *Manish Sadarangani*

Co-authors: *Sheula Barlow, Mark Anthony, Andrew J Pollard*

Introduction/Background: Rotavirus (RV) is the commonest cause of severe gastroenteritis in young children worldwide. RV1 is a live, attenuated RV vaccine and is over 85% effective in preventing severe rotavirus gastroenteritis in high-income countries. Babies must receive the first dose of RV1 by 15 weeks of age. Premature babies are highly susceptible to RV infections so vaccination should not be unduly delayed. International guidelines vary regarding the vaccination of premature babies in the neonatal unit due to theoretical risk of transmission to other babies. The aim of this study was to establish the duration of fecal shedding of RV1 vaccine in premature babies in the neonatal unit, which has not been previously assessed.

Methods: Premature babies born at less than 37 weeks gestation receiving the first dose of RV1 vaccine during their admission in the neonatal unit were recruited between January 2015 and March 2016. Fecal samples were collected before and up to 21 days after vaccination. Samples were stored in RNAlater and viral RNA subsequently extracted using the QIAamp viral RNA Mini kit. RV1 vaccine in samples was detected by amplification of the *NSP3* gene using quantitative reverse-transcriptase polymerase chain reaction.

Results: A total of 17 babies were recruited, born at 24-30 weeks gestation. The first dose of RV1 was administered between 52 and 90 days of age (median 66 days). All babies were concomitantly immunized with diphtheria-tetanus-pertussis-polio-*Haemophilus influenzae* type b and pneumococcal conjugate vaccines, and 8 babies also received the 4CMenB vaccine. On average, 14 samples were collected from each baby. RV1 was detected in 57/234 (24%) samples overall, although no positive samples were obtained from 7 babies. RV1 was detected in at least one sample on each day post-vaccination from day 1 to day 20. Peak shedding rate occurred on day 15 post-vaccination (5/9 (56%) samples positive).

Conclusions/Implications for immunization research and evaluation: RV1 shedding occurs for at least 20 days post-vaccination and infection control measures to prevent vaccine virus transmission must be in place during this period. Future studies of nosocomial transmission of RV1 vaccine should consider that approximately 60% of premature babies have detectable fecal shedding and peak shedding is around 2 weeks post-vaccination.

Rotavirus Hospitalizations: A decade (2005 to 2015) of Surveillance Documenting Vaccine Success – *Nicole Le Saux*

Co-authors: *Scott Halperin, Wendy Vaudry, David Scheifele, Julie Bettinger*

Background: Since 2005, IMPACT has been doing surveillance for hospitalizations due to laboratory confirmed rotavirus infections. As of January 2012, 6 of 12 sites had initiated publically funded immunization programs with 5 further sites implementing programs later.

Methods: Active, surveillance of patients hospitalized for rotavirus infections was conducted by IMPACT from January 1 2005 to December 31, 2015 at 12 paediatric hospitals. Rotavirus hospitalization data was compared for periods pre (2005-2011) and post (2012-2015) implementation of publically funded immunization programs.

Results: The annual number of cases fell from a high of 730 cases in 2005 to a low of 136 cases in 2015. Initiation of rotavirus vaccine programs has resulted in an 81.4% annual reduction in hospitalizations for rotavirus infection in pediatric hospitals in Canada. From 2012, provinces with programs have shown a significant decrease in the number of hospitalized cases (190 to 69 $p<0.0001$) whereas the number in provinces without programs increased (135 to 156), although not significantly ($p=1.0$)

Overall, the average annual number of hospitalizations for children under the age of 2 years fell from 381 in 2005-2011 to 153 in 2012 to 2015 representing a 60% decrease in hospitalizations. However, this decrease has occurred only in provinces with programs. In provinces without programs the number of cases in children < 2 years of age has remained unchanged. Overall, the average yearly number of hospital acquired was 148 in 2005-2011. This decreased significantly ($p<0.0001$) to an annual average of 23 cases in 2012-2015 in provinces with programs and remained unchanged in provinces without programs. From 2005-2015, overall seasonal peaks have declined.

Conclusions: Publically funded rotavirus vaccine programs have resulted in important reductions in hospitalizations due to community and hospital acquired rotavirus infections in pediatric hospitals in Canada with the greatest decreases seen in provinces with programs that were established as of January 2012. Seasonal peaks have also decreased significantly, decreasing the burden on the healthcare system. Increasing uptake and public funding in the remaining provincial and territorial jurisdictions would further increase this impact of this vaccine nationally.

Understanding rotavirus coverage in Ontario: No easy task! – *Sarah Wilson*

Co-authors: *Hannah Chung, Kevin Schwartz, Astrid Guttmann, Shelley Deeks, Jeff Kwong, Natasha Crowcroft, Laura Wing, Karen Tu*

Introduction/Background: In August 2011, Ontario introduced a rotavirus immunization program. Assessment of vaccine coverage has been challenged by two issues: (1) the Ontario coverage monitoring system delays assessment until school-entry, and (2) the lack of an immunization delivery code for rotavirus vaccine within administrative data.

Methods: A rotavirus vaccine coverage evaluation was undertaken. Vaccine receipt was assessed using the Electronic Medical Record Administrative data Linked Database (EMRALD), a collection of family physician electronic medical record (EMR) data. Series initiation (1 dose) and series completion (2 doses) for the first three program years were evaluated among eligible cohorts (date of birth range: August 1, 2011 to July 31, 2014). Characteristics of the infant, mother and physician were derived from EMRALD and linked health administrative databases accessed at the Institute for Clinical Evaluative Sciences . Adjusted odds ratios (aOR) and 95% Confidence Intervals (95%CI) were calculated for covariates using logistic regression with general estimating equations to account for clustering at the physician practice level.

Results: A total of 7,486 children were included. Full series coverage increased each year of the program (73%, 78% and 84%, respectively). Series initiation (83% to 91%) and series completion among initiators (88% to 92%)

also increased over time. Factors significantly associated with the odds of series initiation included high continuity of care (>=50% of visits to the same physician) (aOR=2.08; 95%CI, 1.51-2.87), recent (<5 years) maternal immigration (aOR=1.49; 95%CI, 1.01-2.20), and maternal influenza vaccination in the year following delivery (aOR=1.62; 95%CI, 1.22-2.16). Among initiators, those with high continuity of care (aOR=1.47; 95%CI, 1.16-1.85), no siblings (aOR=1.59; 95%CI, 1.10-2.28) and maternal age >= 30 years (aOR=1.23; 95%CI, 1.02-1.48) were more likely to complete the series. Children receiving care from a foreign-trained physician were less like to complete the series (aOR=0.56; 95%CI, 0.37-0.83). There was no association with neighbourhood income quintile, rural residence, prematurity or low birth weight in either analysis.

Conclusions/Implications for immunization research and evaluation: Rotavirus vaccine uptake increased in the three years following the program's launch. Several maternal/family and physician characteristics were associated with initiation and completion. This assessment demonstrates the utility of EMR data for evaluations of vaccine coverage prior to school-entry in Ontario.

Vaccine effectiveness against laboratory-confirmed influenza hospitalizations among young children during the 2010-11 to 2013-14 influenza seasons in Ontario, Canada – *Sarah Buchan*

Co-authors: *Hannah Chung, Michael Campitelli, Jonathan Gubbay, Tim Karnauchow, Kevin Katz, Allison McGeer, Dayre McNally, David Richardson, Susan Richardson, Andrew Simor, Marek Smieja, George Zahariadis, Laura Rosella, Natasha Crowcroft, Dat Tran, Jeffrey Kwong*

Introduction/Background: Uncertainty remains regarding the effectiveness of influenza vaccines for preventing serious outcomes, especially among young children. The objective of this study was to estimate vaccine effectiveness (VE) against laboratory-confirmed influenza hospitalizations among children aged 6-59 months.

Methods: We used the test-negative design in children admitted to an acute care hospital and tested for influenza using immunoassay or nucleic acid amplification techniques in Ontario during 2010-11 to 2013-14. Cases were defined as children who tested positive for influenza and controls as those who tested negative for influenza. Receipt of seasonal influenza vaccines was determined from physician billing claims. We used logistic regression models adjusted for age, season, month of specimen collection, and asthma diagnosis to calculate VE estimates by immunization status (full vs. partial), age group, and influenza season. We also assessed VE incorporating prior history of influenza immunization.

Results: In preliminary analyses, we included 6141 children over 4 seasons, of which 961 (15.6%) tested positive for influenza and 11.7% were classified as either fully or partially immunized. We observed variation in VE by immunization status, age group, and influenza season. In children aged 24-59 months, VE was 72% (95%CI 51%-84%) for those fully immunized and 62% (95%CI 20%-82%) for those partially immunized. VE estimates were lower for children aged 6-23 months. VE estimates for any immunization were 55% (95%CI 44%-66%) for the 4 seasons combined, 74% (95%CI 50%-86%) for 2010-11, 66% (95%CI 27%-84%) for 2011-12, 23% (95%CI –25%-52%) for 2012-13, and 54% (95%CI 23%-73%) for 2013-14. Over the seasons combined, VE in children aged 24-59 months appeared similar between those immunized during both the current and previous season and those who had been immunized during the current season only; there was no residual protection from those who had been immunized during the past season only. However, the VE estimate for the 2011-12 season seemed markedly lower for those immunized during both the current and previous season compared to those who had been immunized during the current season only.

Conclusions/Implications for immunization research and evaluation: Influenza VE was higher for fully immunized children and those aged 24-59 months, with some variation by season and past history of influenza immunization.

MAKING AND IMPLEMENTING POLICY – SESSION 1

Tuesday, December 6 **14:30 – 16:00** **Room 201**

Physician Immunization Decision-Making Support Tools – *Sarah Loseth*

Introduction/Problem identification: Physicians and other health care providers face complex immunization decisions, especially when dealing with multiple vaccines, varying eligibility criteria and expert recommendations. Research has shown that providing physicians with decision support systems improves clinical decision-making. Peel has developed two immunization tools to support the optimal provision of Pneumococcal and Meningococcal vaccines.

Purpose: The purpose of the tools is to assist with immunization decision-making by combining information from the Canadian Immunization Guide, the National Advisory Committee on Immunization, product monographs, and Ontario's publicly funded immunization schedule. Physician feedback received through a variety of avenues consistently indicates that immunization decision-making is complex and challenging, especially pertaining to pneumococcal and meningococcal vaccines. The tools were developed to address this need. The Pneumococcal tool was designed for high-risk patients. The Meningococcal tool provides information on the meningococcal vaccines available in Canada, and their use and indications for both healthy and high-risk patients.

Methods/Evidence: The tools were created using the most current Canadian guidelines and recommendations for the vaccines. Focus testing of the Meningococcal tool with family physicians and pediatricians in Peel provided valuable usability feedback, which was also applied to the Pneumococcal tool. The tools have been distributed to physicians through the available communication channels in Peel, including: the Region of Peel's Health Professionals webpage, Family Practice Rounds, by fax/e-mail through Peel's physician information management system, and at a national physician conference held in Mississauga in May 2016. In addition, the Meningococcal tool was mailed directly to the focus group physicians and to those that attended a meningococcal-focused Continuing Medical Education event hosted by Peel in April 2015. The tools have received very positive feedback, and have been shared with the Ministry of Health and Long Term Care and other health units in Ontario. The tools are being evaluated to determine recognition and usability at two to four months after distribution.

Significance of Findings/Outcomes for immunization research and evaluation: The evaluation of the tools is in progress and outcomes will be available November 2016.

Adult immunization by pharmacists – A national scan of current policy and practice – *Cathy Mcdermott*

Co-authors: *Jean Pagnucco, Stacy Johnson*

Introduction: NACI has recently recommended many vaccines for adults, and more adult immunization recommendations are expected in the future. However, adults continue to be under-immunized. Across Canada, pharmacists are playing an increasingly important role in Adult immunization, although there are large variations in policy and practice between jurisdictions.

Purpose: To examine current policy and practice, across Canadian jurisdictions, related to pharmacy immunizers.

Methods/Evidence: Information will be collected and synthesized from provincial ministries, pharmacy professional colleges and associations and other key informants by a team consisting of public health professionals, a pharmacy immunization educator and the senior manager of a national pharmacy chain. The current state and key differences will be reviewed for the following factors:

- Pharmacist scope of practice
- Provincial policy and practice guidelines, including access to and distribution of publicly funded vaccine
- Pharmacy uptake and practice

- Record keeping and communication
- Reporting requirements

Significance of Findings/Outcomes for immunization research and evaluation: This review will identify common differences and gaps that may assist decision makers to create policies and action plans to integrate newer pharmacist immunizers and to improve access to, and levels of, adult immunization.

Evaluating the impact of a universal policy with or without pharmacists as immunizers on influenza vaccine coverage in Nova Scotia – *Jennifer Isenor*

Co-authors: *Beth O'Reilly, Angela Fitzgerald, Beverly Billard, Susan Bowles*

Introduction/Background: The influenza vaccine is considered to be safe and effective at preventing disease, however, recommended Canadian coverage goals are not being met. Following the 2009 H1N1 epidemic, a publicly funded universal influenza program was introduced in Nova Scotia to improve vaccination coverage. In 2013, pharmacists with appropriate training began administering influenza vaccines to those 5 years of age and older within the publicly funded program in further attempts to improve access and coverage. The impact of the two policies (universal funding and pharmacists immunizing) have not previously been compared.

Method: Influenza vaccine administration data will be obtained through the Nova Scotia Department of Health and Wellness (DHW) from 2006-07 to 2015-16. Comparisons will be made between three distinct time frames with respect to influenza immunization policies in Nova Scotia: 1) pre-universal funding (2006-07 to 2009-10); 2) universal funding policy prior to pharmacist immunizing policy (2010-11 to 2012-13); and 3) pharmacist immunizing policy (2013-14 to 2015-16). Coverage data during the 2009/10 season were unique due to the H1N1 pandemic and as such, will be described, but not included in the policy comparisons. To determine the impact of the policies on vaccination coverage, census data will be used to calculate vaccination coverage for each influenza season and compared between years and policy periods. Although not available for all years or providers, when available, the demographics of vaccine recipients and timing of vaccine receipt, will be described and compared between policy periods and providers to determine if either has had an effect on who receives the influenza vaccine and when (early or late).

Results: Pending, results expected in fall 2016.

Conclusions/Implications for immunization research and evaluation: The data from this research are expected to provide insight into the impact that the universal influenza vaccine policy and the addition of pharmacists as immunizers are having on influenza vaccine coverage in Nova Scotia.

Public opinion of pharmacist administered flu vaccines in Canada: A media analysis – *Michelle Simeoni*

Co-authors: *Samantha Meyer, Richard Violette, Nancy Waite, Reenika Aggarwal, Heather MacDougall*

Introduction/Background: In recent years, legislated changes to the scope of practice of pharmacists in 9 Canadian provinces have granted immunization authority to trained and certified pharmacists. Along with the impressive uptake in influenza immunization service delivery, immunizing pharmacists are increasingly faced with individuals who are hesitant to receive some or all vaccines. Current evidence indicates that vaccine hesitancy involves a large number of vaccine--- and provider--- specific factors, yet there is limited research exploring pharmacy---specific factors such as perceived pharmaceutical industry ties, privacy concerns, issues of trust, the emerging roles of pharmacists as primary health care providers and the retail nature of the community pharmacy space.

Objectives: To identify Web 2.0 consumer perspectives regarding the administration of vaccination by pharmacists.

Methods: Comments from online CBC articles regarding pharmacist administration of vaccination during the 2013/2014 to 2015/2016 flu seasons were 'scraped' for thematic analysis from two online media platforms (CBC and reposts of the same articles on Facebook). Scraping software linked reader demographic information to individual comments allowing for an analysis of how individual demographics shape perspectives on the administration of vaccination by community pharmacists. Data were analysed using inductive thematic analysis.

Results: Early themes that have emerged from consumer comments suggest general public support for expanded scope of practice for pharmacists, public trust in pharmacists to administer vaccines, and support for pharmacists as immunizers due in part to increased access and convenience of receiving vaccines at a pharmacy. Themes related to hesitancy include skepticism around vaccination more generally, misgivings about pharmacists' training and competency in administering the vaccine and concerns about remuneration for service provision. Analysis is ongoing.

Conclusions/Implications: It is important that pharmacists be aware of consumer concerns, know how to address these factors of vaccine hesitancy in the pharmacy and ultimately foster positive vaccine conversations. To support them, pharmacist-targeted vaccine hesitancy interventions should be developed and tailored to address these unique pharmacy-specific hesitancy findings.

Economic analysis of community pharmacists providing influenza vaccination in Ontario – *Sherilyn Houle*

Co-authors: *Nancy Waite, Jeff Mehltretter, Sheri Burns, Natasha Burke, Gord Blackhouse, Daria O'Reilly*

Introduction/Problem identification: In 2012, Ontario pharmacists were authorized to administer influenza vaccines to those 5 years of age and older under the Universal Influenza Immunization Program. Increasing the number of individuals vaccinated leads to cost savings through reduced healthcare service use related to influenza infection and indirect costs including work absenteeism.

Purpose: As a recently introduced service, little is known about the economic impact, such as resource use and cost consequences, of pharmacist administered influenza vaccinations.

Methods/Evidence: An economic analysis was performed, comprised of a pre-post comparison of the healthcare resource use and an assessment of the indirect costs associated with vaccination in community pharmacies, physician offices, and public health clinics. The primary analysis was conducted from a Ministry of Health perspective, while a societal perspective was applied for the analysis of indirect costs associated with productivity gains and losses. Changes in vaccination rates from the 2011/12 to 2013/14 flu seasons were determined from available pharmacy and physician administrative billing data, and provincial vaccine distribution numbers. Efficacy of the vaccine, rates of complications, hospitalizations, and lost productivity due to illness or obtaining the vaccine in different settings were obtained from the literature. Program costs considered both vaccine costs and professional fees for administration.

Two findings were factored into the analysis: a net increase of 480,000 vaccinations realized after pharmacies were able to participate in influenza immunization, and that individuals vaccinated in community pharmacies were generally of lower age and healthier than individuals vaccinated in physicians' offices. As a result, $763,000 in direct health care savings was estimated in the 2013/14 season versus 2011/12, with an estimated $4.5 million in lost productivity saved due to the accessibility of pharmacy vaccinations outside of typical work hours, and an additional $3.4 million saved from reduced absenteeism due to influenza illness.

Significance of Findings/Outcomes for immunization research and evaluation: Since implementing pharmacy-based influenza immunization, the number of Ontarians being vaccinated has increased, with younger, healthier individuals accessing this new service. While the rates of major complications in this population are lower than among higher-risk patients, the accessibility and convenience of pharmacist-administered vaccination translates to significant savings related to decreased workplace absenteeism.

MAKING AND IMPLEMENTING POLICY – SESSION 2

Tuesday, December 6 **14:30 – 16:00** **Room 202**

Resource utilization and cost of influenza requiring hospitalization in Canadian adults: A study from the Serious Outcomes Surveillance (SOS) Network of the Canadian Immunization Research Network (CIRN) – *Shelly McNeil*

Co-authors: *Carita Ng, Lingyun Ye, Stephen Noorduyn, Margaret Hux, Edward Thommes, Ron Goeree, Ardith Ambrose, Melissa Andrew, Todd Hatchette, Guy Boivin, William Bowie, May ElSherif, Karen Green, Jennie Johnstone, Kevin Katz, Jason LeBlanc, Mark Loeb, Donna MacKinnon-Cameron, Anne McCarthy, Janet McElhaney, Allison McGreer, Andre Poirier, Jeff Powis, David Richardson, Makeda Semret, Rohita Sharma, Stephanie Smith, Daniel Smyth, Grant Stiver, Sylvie Trottier, Louis Valiquette, Duncan Webster*

Introduction/Background: Influenza causes considerable morbidity, mortality, and strain on limited Canadian healthcare resources. Hospitalization is the largest component of influenza cost. We estimated average total cost of laboratory-confirmed influenza in adults requiring hospitalization in Canada using costs for resource utilization collected before, during, and 30 days following hospitalization. Effects of patient and disease characteristics, treatment, and outcomes on cost and variation in costs across geographic regions were explored.

Methods: This study used clinical characteristics, resource use, and outcomes data collected prospectively for patients with laboratory-confirmed influenza admitted to participating CIRN SOS Network hospitals from 2010/11 – 2012/13. Resource use was linked to a single set of unit price weights for each influenza case, regardless of the hospital where treatment was received. For in-hospital resources, price weights from a corporate hospital costing model included hospital overheads. Multiple imputation was used to estimate cost components which were missing in order to preserve variation in cost. All costs were measured in $2015 CAN.

Results: The surveillance dataset used included 2,943 adult admissions to 17 SOS Network hospitals and 24 associated TIBDN hospitals. Average length of stay (LOS) was 10.8 days (d) (95% Confidence Interval [CI]: 10.3, 11.3) and comprised 9.4d (95% CI: 9.0, 9.8) on a general ward and 1.4d (95% CI: 1.2, 1.6) in an intensive care unit (ICU). Average cost per case was $14,612 (95% CI: $13,852, $15,372) including $133 (95% CI: $116, $150) for care before admission, $14,031 (95% CI: $13,295, $14,768) during the initial hospital stay, and $447 (95% CI: $271, $624) after discharge, including readmissions within 30d. Across Canada, cost ranged from $13,711 (95% CI: $12,797, $14,625) in Ontario to $20,808 (95% CI: $15,798, $25,818) in Western Canada. The higher cost in Western Canada was largely driven by longer LOS; mean LOS in Western Canada was 12.7d, compared to 10.4d in Ontario and 6.0d in Quebec.

Conclusions/Implications for immunization research and evaluation: This retrospective study makes use of national surveillance data and a micro-costing approach to validate the costs associated with hospitalization due to laboratory-confirmed influenza in Canada. These costs were found to be substantially different from previous estimates, driven mostly by differences in LOS. Consequently, the burden of influenza hospitalization has been underestimated and prevention programs should be evaluated in this context.

Obstacles and opportunities for including males in Canadian human papillomavirus vaccination programs – *Gilla Shapiro*

Co-authors: *Samara Perez, Zeev Rosberger*

Introduction/Problem identification: The human papillomavirus (HPV) is associated with multiple cancers. The Canadian National Advisory Committee on Immunization (NACI) recommends human papillomavirus (HPV) vaccination for females and males aged 9–26 years. All Canadian provinces and territories have instituted school-based publicly funded quadrivalent HPV vaccination programs for females, albeit at different ages and dosing schedules. To date, only Prince Edward Island, Alberta and Nova Scotia have included boys in their

school-based quadrivalent HPV vaccination programs. Recently, Manitoba, Ontario, and Quebec have committed to expand their school-based HPV vaccination programs to include boys beginning in September 2016. As other provinces (and countries) are evaluating whether to include boys in public programs, it is essential to understand the underpinnings of this policy decision.

Purpose: The objective of this research was to analyze the obstacles to, and opportunities for, change in HPV vaccination policy in Canada.

Methods/Evidence: We reviewed the academic and grey literature to identify the key factors that have influenced some provinces' decisions to incorporate boys into their programs.

Significance of Findings/Outcomes for immunization research and evaluation: Canada has been an international leader in initiating public HPV vaccination programs for males in some jurisdictions, alongside Australia, Austria, Israel, and Italy. A number of obstacles to uptake of the HPV vaccine in boys include not receiving a recommendation from a doctor or health care provider, lack of information about the HPV vaccine, negative attitudes toward the HPV vaccine or other vaccines, HPV being overidentified as a woman's disease, cost, and logistical challenges. Nevertheless, provinces have decided to fund the HPV vaccine for boys following clearer evaluation of cost-effectiveness models, reduction of vaccine costs, consideration of principles of equity, and public advocacy efforts.

Mapping the gap between immunization program evaluation/research and decision-making in Canada: The case of the Human Papillomavirus (HPV) vaccine program – *Maria Eugenia Espinoza*

Introduction: Evidence-based decision-making relies on high quality information from program evaluation and research; however, the path between these two interdependent processes is not well understood. Taking the HPV vaccine program as an instrumental case, we utilized citation patterns as a surrogate of information dissemination and uptake to systematically map information production intensity and direction flow, and formally evaluate utilization of Canadian immunization research/evaluation studies for decision-making in this field.

Methods: Systematic literature review and Citation network analysis (CNA) of pre- and post-implementation empirical studies conducted in Canada, and National/P/T immunization guidelines on HPV vaccine program published in either English or French before December 2015. CNA was used to produce network graphs and statistics to examine the contribution of different research groups and specific publications for the entire network, and separately for the research-to-research (RtR), research-to-guideline (RtG), and guideline-to-guideline (GtG) networks.

Results: Canada's HPV vaccine program research and decision-making network included 54 pre-, 31 post-implementation studies, and 28 guidelines published between 2006 and 2015, interconnected by 306 citation links. After NACI/CIC guidelines, pre-implementation studies were the most cited (average out-degree=2.72). Among all networks, the RtG had the smallest density (d=0.004), with only CIC and Quebec's CIQ guidelines showing high uptake of empirical studies available (average in-degree=9.26); yet, higher density of RtR and GtG networks denote that research and guidelines are utilized within each niche.

Conclusion: The flow of information between immunization research/evaluation and decision-making remains quite limited in this field. Potential barriers and facilitators are examined using the 3I's or "Ideas, Interests, and Institutions" framework from the political sciences field. Having a better understanding of those factors might allow scientists and policy-makers to be strategic in their collaborations, facilitating timely and effective knowledge translation.

Effect of human papillomavirus vaccination on cervical cancer screening in Alberta – *Jong Kim*

Co-authors: *Christopher Bell, Maggie Sun, Gordon Kliewer, Linan Xu, Maria McInerney, Lawrence Svenson, Huiming Yang*

Introduction/Background: A school-based program with quadrivalent human papillomavirus (HPV) vaccination was implemented in Alberta in 2008. We assessed the impact of this program on Pap test cytology results using databases of province-wide vaccination and cervical cancer screening.

Methods: We conducted a nested case–control study involving a cohort of women in Alberta born between 1994 and 1997 who had at least 1 Pap test between 2012 and 2015. Women with negative cytology results were controls. Women with low-grade (atypical squamous cells of undetermined significance or low-grade squamous intraepithelial lesion) and high-grade (atypical squamous cells, cannot rule out a high-grade lesion; or high-grade squamous intraepithelial lesion) cervical abnormalities were cases. Exposure status was assigned according to records of HPV vaccination. Odds ratios (ORs) for abnormal cytology results by vaccination status were adjusted for neighbourhood income, laboratory service, rural versus urban residency, and age.

Results: The total study population was 10,204. Adjusting for age, vaccinated women had a higher screening rate than unvaccinated women (13.0% v. 11.4%, $p < 0.001$). Among women who received full vaccination (≥ 3 doses), the adjusted OR for cervical abnormalities was 0.72 (95% confidence interval [CI] 0.63–0.82). For high-grade lesions, the adjusted OR was 0.50 (95% CI 0.30–0.85).

Conclusions/Implications for immunization research and evaluation: Quadrivalent HPV vaccination significantly reduced high-grade cervical abnormalities in females completing 3-dose schedule. Vaccination against HPV was associated with screening uptake. Population-based vaccination and screening programs should work together to optimize cervical cancer prevention.

Evaluation of new vaccines that have therapeutic indications and lack traditional public health prevention indications: An emerging gap in the vaccine evaluation framework – *Robert Van Exan*

Introduction/Problem identification: A review of the vaccine pipeline reveals that there are a number of new vaccines currently in development which are therapeutic in nature. Vaccines to treat a host of chronic diseases such as cancer, neurological disorders, autoimmune diseases and to address a number of lifestyle issues such as obesity, addictions and contraception have broad public health implications but do not fit the current model for vaccine evaluation in the context of public health immunization programs. These new tools will undergo the traditional Health Canada evaluation for Notice of Compliance (NOC) and will be classified as vaccines but the indications and use of these tools may be focussed on the health of the individual rather than the health of the population.

Purpose: The purpose of this paper is to consider and identify potential policy gaps in the current processes of evaluation, funding, procurement, distribution and administration of traditional public health vaccines as applied to these new therapeutic vaccines and to stimulate discussion before these new products receive regulatory approval.

Methods/Evidence: A review was undertaken of vaccines in development in order to identify vaccines that do not fit the traditional population based, public health disease prevention paradigm. An evaluation was undertaken to see how these vaccines might fit into the current processes involved in the introduction of vaccines in Canada and what challenges might develop.

Significance of Findings/Outcomes for immunization research and evaluation: These new vaccines do not necessarily fit well into either the CADTH review process for drugs or the current NACI review process for vaccines. Challenges and potential policy gaps were identified in several areas of the road to public access including not only the criteria for scientific and program evaluation but also price regulation, economic analysis, funding, procurement, distribution and administration. As the first of these new generation vaccines are in phase three trials, we can anticipate that they will start to appear on the doorstep of the regulatory authorities within the next 3 to 5 years. Now is the time to start a serious dialogue about how these products will make their way through all of the review stages so that the health care system and the public may have access to them.

ELECTRONIC REGISTRIES

Tuesday December 6 **14:30 – 16:00** **Room 213**

An End to End Model for Electronic Registration, Recording and Reporting in Mass Immunization Clinics: The University of Alberta Experience – *Beth Woytas*

Co-author: *Cathy McDermott*

Introduction: The University of Alberta (UofA) provides an annual mass influenza immunization clinic on campus for students, faculty and staff members. Over 3000 people are immunized during a 4-day mass clinic annually. Historically, all processes were paper-based, including maintaining records for professional students who required proof of immunization and manual collation of data for aggregate reporting to public health. None of the records were entered into the provincial immunization registry.

Purpose: The session will present a new registration, recording, and reporting model for mass clinics developed and piloted during the 2014 and 2015 influenza clinics. Key benefits and learnings will be summarized.

Evidence: The session will describe the logistics, human resources, technology and work flow for the first end to end electronic mass influenza clinic in Canada. It will draw on information synthesized from post-clinic key stakeholder evaluations conducted both years. While the first year delivered some key benefits, including near real-time electronic record capture and reporting, it was not until the second year that a sustainable model was achieved.

Significance of Findings/Outcomes for immunization research and evaluation: The pilot showed that significant improvements are possible in any mass clinic setting, with the addition of simple electronic processes well-integrated into traditional workflow, which can remove the barriers for complete electronic record capture.

Transformation by tool: Working together to build immunization registries and the impact on immunization coverage in Canada – *Rosalie Tuchscherer*

Co-authors: *Maureen Perrin, Jill Reedijk, Elizabeth Lee, Karen Hay, Josée Dubuque, Carol Kurbis*

Introduction/Problem identification: Improving immunization coverage is a priority of the Canadian government, as announced in the 2016 Federal Budget. Setting coverage targets at a national level faces some well-defined challenges, including variations in jurisdictional immunization schedules. Drivers of schedule differences include epidemiological characteristics and financial considerations in the provinces/territories. Standardizing immunization coverage methodologies (e.g., using the same definition, like number of doses of an antigen by a certain age) is desirable.

The ongoing implementation of Provincial/Territorial immunization registries provide accurate data to support immunization coverage assessments, thereby positioning public health leaders to set immunization goals and targets. The Panorama Immunization Forecaster, implemented in six Canadian jurisdictions, is a rules-based decision support tool to assist clinicians with assessing historical and administered immunizations, and planning future immunizations. The Forecaster assesses immunizations recorded for a client in Panorama as valid or invalid, and forecasts when the client is eligible and due (based on predetermined requirements) for future immunizations.

Purpose:

1. To illustrate how the implementation of the Panorama Immunization Forecaster supports distinct jurisdictional schedules while making progress towards semantic interoperability of immunization records
2. To propose future work that drives greater convergence of national immunization coverage measures.

Methods/Evidence: Each jurisdiction implementing Panorama has coded their unique provincial/territorial immunization schedule into the Forecaster. Each jurisdiction ran their Forecaster on the same set of sample data

with clients of varying degrees of complex immunization histories to compare similarities and differences across antigens and agents, and to draw conclusions on the impact for coverage assessment results across jurisdictions.

Significance of Findings/Outcomes for immunization research and evaluation: Examination of the Forecaster results between jurisdictions informs comparison of coverage rates at the national level and progress towards common goals. Electronic immunization registries support the production of real-time information that can be used to calculate immunization coverage rate reports and reminder/recall notifications, creating an advantage for those jurisdictions in improving immunization coverage rates and managing vaccine preventable diseases. Public health can operationalize programs to identify sub-populations at risk of under-immunization and offer subsequent services. The sharing of a common tool promotes comparable data across participating jurisdictions, and a practical forum to evaluate results.

Tracking immigrant immunizations using an mHealth app – *Michelle Paradis*

Co-authors: *Charles Hui, Douglas Manuel, David Ponka, Katherine Atkinson, Kumanan Wilson*

Introduction/Background: In 2014, we released ImmunizeCA as a vaccine-tracking mobile app for the general Canadian public. The concept of ImmunizeCA was simple, to provide a mobile alternative to yellow immunization cards. The app was made freely available in both official languages to every province and territory.

Since its official release, ImmunizeCA has been downloaded over 140,000 times. As user feedback and media attention around the app grew, interest from the public health community sought its use for special populations, such as newcomers to Canada. In 2016, the Public Health Agency of Canada awarded additional funding to ImmunizeCA. One of the objectives was to explore use in special populations.

Methods: Our primary objective is to evaluate the potential for ImmunizeCA to be customized for newcomers. Our findings have been informed by field research whereby we received feedback from users, public health practitioners and policymakers. Specifically, we have received feedback and been in consultation with a newcomer clinic in Ottawa and refugee programs, regarding the need for an adapted version of ImmunizeCA for these populations.

Results: Feedback from stakeholders expressed interest in the use of ImmunizeCA to assist newcomers. Specifically, there was interest in ImmunizeCA incorporating the following functionalities to be of benefit to newcomers: (1) A translated portal within ImmunizeCA, (2) Provincial and Territorial vaccination catch-up schedules, (3) Curated information and tools on immunizations for newcomers and their children. The current information gaps in the healthcare system which could be addressed by ImmunizeCA include completeness of overseas vaccination records and tracking of vaccination status in Canada. Some of the potential barriers for newcomers using ImmunizeCA include: language, availability of smartphones usage and literacy levels.

Conclusion: There is potential for ImmunizeCA to be of value to newcomers. A needs assessment is required to assess the feasibility and acceptability of the ImmunizeCA platform for newcomers.

Using mobile apps to facilitate reporting of vaccination status: Results of a pilot study with ImmunizeCA and Ottawa Public Health – *Katherine Atkinson*

Co-authors: *Geoffery Barnum, Cameron Bell, Alicia St Hill Nassir, Marie Claude Turcotte, Mari Teitlebaum, Pranesh Chakraborty, Kumanan Wilson*

Introduction/Background: An augmented version of the ImmunizeCA mobile app was released on April 27, 2015 which permitted mobile reporting of immunization status.

This project was a partnership between The Ottawa Hospital, the Better Outcomes Registry and Network(BORN) and Ottawa Public Health(OPH). The scope was restricted to individuals in Ottawa, reporting immunizations for children aged 15 and under, via iOS devices.

All data submitted as a part of this pilot was disclosed to BORN by OPH and entered into the BORN information system(BIS). All data collected via the app was encoded using the SNOMED CT Pan-Canadian extension reference sets.

Methods: The objective of this study was to characterize participant use of mobile immunization reporting as a proxy for feature acceptability by parents and usability by public health. Pilot data was extracted from the BIS on June 22nd, 2016. Final unique records were identified by determining each child's last transmission. All data from this transmission was retained as "number of doses". The remaining were classified as "duplicate doses". Children's age was calculated based on the date they received their most recent immunization.

Results: A total of 4117 users were in the Ottawa area and had iOS devices. 41,125 immunization doses (21,066 duplicate) were transmitted between April 27th, 2016 and June 22nd, 2016, representing 1,596 individual children. 818(51.3%) were male and 778(48.7%) were female. 70% of children were aged 0-5 years old, 17% were aged 6-10 and the remaining 13% were 11-15 years old. 49% of records were submitted on time, with no subsequent updates.

The average number of vaccination doses submitted per child was 12.5(SD 4.21). Thirty different SNOMED codes were reported, the most frequent representing the DTaP-IPV-Hib vaccine followed by the Pneumococcal vaccine Pneu-C-13.

Conclusions/Implications for immunization research and evaluation: Our findings suggest that parental reporting of immunizations to public health via mobile devices may be acceptable. The potential to collect data on children aged 0-5 suggests that this data could enable more accurate assessments of vaccine coverage. However, several considerations should be made regarding user interface design, use of data standards and public communication in order to maximize the potential of mobile reporting.

Moving to Panorama: Immunization coverage assessment in British Columbia (BC) – *Samara David*

Co-authors: *Chi Kin Ho, Nadia Lesnikova, Penelope Nica, Jannie Leung, Tina Yang, Monika Naus*

Introduction/Problem identification: BC assesses immunization coverage at the 2nd and 7th birthdays using data extracted from the provincial immunization registry (Panorama) for four of the five BC health regions. Analyses using SAS® 9.3 statistical software ("external analyses") count doses that meet minimum age/interval criteria to determine whether children are up-to-date for age (UTDFA).

Coverage reports were created within Panorama to assess receipt of the recommended number of doses, counting doses validated by the Panorama forecaster's programmed logic.

Purpose: To compare results from Panorama's coverage reports to external analyses in order to determine the reliability of the Panorama coverage reports for immunization coverage surveillance.

Methods/Evidence: Panorama coverage reports and external analyses were run for a 2nd birthday cohort (born April 1-June 30, 2013) and a 7th birthday cohort (born January 1-December 31, 2007). UTDFA status was compared for antigens/agents and for all recommended vaccines. Initial comparisons identified validation logic discrepancies that required updating in the external analysis, Panorama reports and Panorama forecaster. Following these changes, data were reanalyzed using both methods, and results compared.

Compared to external analyses, Panorama results at the 2nd birthday were 0.18% higher for the overall percent UTDFA and ranged from 0.04% lower (polio) to 0.22% higher (hepatitis B) for antigen/agent-specific estimates. Panorama results at the 7th birthday were 0.03% higher for the overall percent UTDFA and ranged from 0.02% lower (meningococcal-C) to 0.07% higher (varicella) for antigen/agent-specific estimates.

Panorama analyses count manually validated doses (doses invalidated by the Panorama forecaster but determined to be valid based on clinical judgement) and revised dose numbers (used to indicate that previous doses were received but not recorded in Panorama), while the external analyses count only doses with complete day, month and year of receipt, and that meet validation criteria.

Significance of Findings/Outcomes for immunization research and evaluation: The two methods produced similar results. Panorama's acceptance of manually validated doses and revised dose numbers does not meet provincial standards for coverage assessment, despite being permitted as an occasional practice to avoid giving children extra vaccine doses. BC will continue to use the external analyses for coverage surveillance; however, Panorama reports provide health regions with the ability to reliably monitor coverage trends.

NEW DEVELOPMENTS IN VACCINES AND THEIR USE – SESSION 1

Wednesday, December 7 **11:00 – 12:30** **Room 201**

Impact of frailty on influenza vaccine effectiveness and clinical outcomes: Experience from the Canadian Immunization Research Network (CIRN) Serious Outcomes Surveillance (SOS) Network 2011/12 Season – *Melissa Andrew*

Co-authors: *Sarah MacDonald, Lingyun Ye, Ardith Ambrose, Guy Boivin, Francisco Diaz-Mitoma, William Bowie, Ayman Chit, Gael Dos Santos, May ElSherif, Karen Green, Todd Hatchette, Francois Haguinet, Scott Halperin, Barbara Ibarguchi, Jennie Johnstone, Kevin Katz, Joanne Langley, Jason LeBlanc, Philippe Lagace-Wiens, Bruce Light, Mark Loeb, Donna Mackinnon-Cameron, Anne McCarthy, Janet McElhaney, Allison McGreer, Andre Poirier, Jeff Powis, David Richardson, Makeda Semret, Vivek Shinde, Stephanie Smith, Daniel Smyth, Grant Stiver, Sylvie Trottier, Louis Valiquette, Duncan Webster, Shelly McNeil*

Introduction/Background: The health impact of influenza is traditionally considered only in acute terms. There is increasing evidence that influenza may have lasting health implications, particularly for frail older adults. We studied vaccine effectiveness (VE) and outcomes of influenza-related hospitalization in relation to frailty and functional status.

Methods: The SOS Network conducted active surveillance for influenza in Canadian hospitals for the 2011/12 influenza season. VE for prevention of influenza-hospitalization was assessed using a matched test-negative case-control analysis. Special attention was paid to frailty and functional status of patients ≥65y at baseline (2 weeks prior to onset of symptoms) and follow up (30d post-discharge). Admission swabs were tested by Polymerase Chain Reaction to identify influenza cases (positive) and controls (negative). VE was calculated as 1 minus the odds ratio of vaccination in cases versus controls x 100. VE estimates were adjusted using conditional multivariate logistic regression with age, antiviral use, frailty and a stepwise backward selection of covariates with p-values of <0.1 by univariate analysis. Frailty was assessed using a validated 39-item frailty index (FI) and functional status was assessed using the Barthel Index (BI).

Results: The SOS Network enrolled 320 cases and 564 controls. Unadjusted VE for patients ≥65y against influenza-hospitalization due to any strain was 45.0% (95% Confidence Interval (CI): 25.7, 59.3); adjusted VE was 58.0% (95% CI: 34.2, 73.2). Adjusting only for baseline FI very closely approximated the final fully adjusted model (VE 58.7%; 95% CI; 36.2, 73.2). On average, all adults ≥65y experienced functional loss during hospitalization. 13.2% experienced persistent catastrophic disability (≥20 point decline on the BI between baseline & follow up); older patients with influenza were more likely to experience this decline than controls in the same age segment (p=0.047).

Conclusions/Implications for immunization research and evaluation: VE was moderate for prevention of influenza-related hospitalization in elderly people. Not accounting for frailty may underestimate VE due to a frailty bias; frailty is the most important confounder to take into account in adults ≥65y. Persistent functional decline is an important adverse outcome of influenza-related hospitalization and reducing this burden represents an important public health goal.

Comparison of the epidemiology of vaccine preventable and non-vaccine preventable invasive *Haemophilus influenza* disease in Canada, 2011 to 2015 – *Jenny Rotondo*

Co-authors: *Susan Squires, Raymond Tsang, Shalini Desai*

Introduction/Background: The pan-Canadian implementation of routine childhood vaccination programs against Haemophilus influenzae type b (Hib) in 1988 has resulted in a 95% decrease in the incidence of invasive disease due to Hib. A review of national Hi epidemiology has not been done since invasive disease due to non-b H. influenzae serotypes (Hi non-b) became nationally notifiable.

Methods: This study compares the epidemiology of Hib and Hi non-b in Canada. Data sources include the Canadian Notifiable Disease Surveillance System, the International Circumpolar Surveillance Invasive Bacterial Disease Network, and provinces and territories. Death data were obtained from the Statistics Canada Death Database. Descriptive analyses were conducted for the time period of 2011 to 2015 for case data and 2008 to 2012 for death data. Incidence rates (IRs) were calculated per 100,000 population.

Results: The average annual IR for Hi non-b was 16.7 times higher compared to the IR for Hib (1.42 and 0.09, respectively). Hib IRs were stable during this time, while Hi non-b IRs showed an increasing trend. The highest average annual IRs for both Hib and Hi non-b were in infants less than 1 year old (1.34 and 10.27) followed by those 60 years of age and greater (0.11 and 3.60) and one to four year olds (0.21 and 2.29). On average, 10 deaths occurred annually; 44% in adults 60 years of age and greater and 12.5% in infants less than one year old. In Northern Canada, the most common serotypes identified were a (69.5%), b (7.1%), and f (5.7%). Non-typeable isolates accounted for 11.5% of cases.

Conclusions/Implications for immunization research and evaluation: While Hib incidence remains low, Hi non-b appears to be an important cause of morbidity in Canada. In particular, Hi type a appears to be an important cause of invasive disease in Northern Canada. National information on isolate characteristics, antibiotic susceptibility, disease manifestation, immunization history, and disease outcome would enhance our understanding of Hi epidemiology in Canada and support vaccine development.

Variable effects of repeat vaccination against Influenza A(H3N2) illness by season: 2010-11 to 2014-15 – *Danuta Skowronski*

Co-authors: *Catharine Chambers, Gaston de Serres, Anne-Luise Winter, James Dickinson, Suzana Sabaiduc, Naveed Janjua, Jonathan Gubbay, Kevin Fonseca, Steven Drews, Christine Martineau, Alireza Eshaghi, Mel Krajden, Martin Petric, Nathalie Bastien, Yan Li*

Introduction/Background: Recent studies suggest that protection from seasonal influenza vaccine may be modified by vaccination in prior seasons. Theoretical modeling predicts that negative interference will be greatest during seasons when serial vaccine components are antigenically similar but circulating viruses are mismatched to vaccine.

Methods: Repeat vaccination effects were assessed in data collected from the Canadian Sentinel Practitioner Surveillance Network (SPSN) using a test-negative case-control design for four separate seasons (2010-11 to 2014-15, excluding 2013-14). Using logistic regression, the odds of medically attended, laboratory-confirmed influenza A(H3N2) illness was compared across self-reported vaccination categories for the current and/or prior seasons relative to those unvaccinated in all evaluated seasons. Vaccine effectiveness (VE) was derived as (1–odds ratio)*100%.

Results: Significant protection against A(H3N2) illness was observed in all four seasons, except 2014-15 when VE was negligible. Among patients vaccinated in the current season, 84% on average had been vaccinated in the prior season, while 79% had been vaccinated in two consecutive prior seasons. Significant effect modification by season was observed for current and/or prior season's vaccination in pooled four-year analysis. During seasons when the A(H3N2) vaccine component was changed to an antigenically unrelated strain (i.e. 2010-11 and 2012-13), prior season's vaccination had little effect on current season's VE, with some blunting of protection seen in

2012-13. In 2011-12 when vaccine components were unchanged and circulating viruses were vaccine-matched, prior season's vaccination had a boosting effect, with the highest VE observed in those who received both current and prior season's vaccines. During the 2014-15 season when A/Texas/50/2012 vaccine was unchanged and ~90% of circulating viruses were antigenically mismatched, substantial negative interference from prior season's vaccination was observed. A similar pattern was found when vaccination over two consecutive prior seasons was considered, particularly in 2014-15 when greater negative interference was found with antigenically similar vaccine across two prior seasons.

Conclusions/Implications for immunization research and evaluation: The effect of prior season vaccination on current season's protection varied with the antigenic relatedness of serial vaccine components and circulating A(H3N2) viruses. Given annual vaccine reformulation and heterogeneity in vaccine-virus relatedness across seasons, analyses should be stratified by season to understand possible mechanisms and implications of repeat vaccination.

Non-influenza Respiratory Virus (NIRV) detections in a Sentinel Surveillance Platform, Canada, 2010 -11 to 2014-15 – *Catharine Chambers*

Co-authors: *Danuta Skowronski, Mark McCabe, Gaston de Serres, Anne-Luise Winter, James Dickinson, Naveed Janjua, Suzana Sabaiduc, Jonathan Gubbay, Kevin Fonseca, Steve Drews, Christine Martineau, Mel Krajden, Martin Petric, Nathalie Bastien, Yan Li*

Introduction/Background: Non-influenza respiratory viruses (NIRVs) contribute to influenza-like illness (ILI) during the influenza season, but systematic NIRV surveillance is not routinely conducted in the outpatient setting. This study assessed influenza and NIRV detections in respiratory specimens from the Canadian Sentinel Practitioner Surveillance Network (SPSN) from 2010-11 to 2014-15.

Methods: Patients presenting to sentinel community-based practitioners in Alberta, British Columbia, Ontario and Quebec within seven days of influenza-like illness (ILI) onset were enrolled. ILI was defined for influenza specificity as fever and cough and ≥1 of sore throat, arthralgia, myalgia or prostration. Nasal/nasopharyngeal swabs were tested for influenza and NIRVs using multiplex reverse-transcription polymerase chain reaction (RT-PCR) assays. Analyses were restricted to the typical influenza season (November-April).

Results: Across five seasons, nearly 40% of specimens were influenza-positive and about one-quarter were NIRV-positive, including entero/rhinoviruses (6%), respiratory syncytial viruses (RSV, 5%), coronaviruses (5%), human metapneumovirus (hMPV, 4%), or other NIRV (4%). Co-infections were detected in 3% of specimens. The proportion of respiratory specimens that tested NIRV-positive was highest at 56% in young children 0-4 years old (23% RSV, 13% entero/rhinoviruses, 8% hMPV, 6% coronaviruses, and 6% other), nearly double that of influenza at 30%; this age group also accounted for about one-third of all co-infections.

Conversely, in school-age children 5-19 years old, NIRV positivity was 24%, about half that of influenza at 47%. NIRV positivity rates in adults 20-64 years and ≥65 years old were 22% and 28%. The corresponding influenza positivity rates for these adult age groups were 39% and 34%, respectively. In most seasons, peak RSV and coronavirus detection followed peak influenza A activity, whereas entero/rhinovirus detection more often occurred at the tail ends of the season in November and April. The overall proportion of patients vaccinated against influenza was comparable (~30%) between those who had no virus detected and those who tested positive for NIRVs, but was lower (~20%) for patients who tested positive for influenza.

Conclusions/Implications for immunization research and evaluation: NIRVs contribute substantially to medically-attended outpatient ILI during influenza seasons, particularly among young children. Evaluation across more seasons, settings, case definitions, and illness severity may support development of prevention and control measures to mitigate their impact.

Adjuvants: Understanding their Role in Vaccines – *Leonard Friedland*

Co-authors: *Christopher Gunst, Tyler Middegaal, Shehzad Iqbal, David Willer, Shireen Khaliq*

Introduction/Background: Vaccine development currently faces many unique challenges. In general, such challenges include the need for booster vaccinations, lack of longevity or persistence of protective immune responses, and the use of antigens that are poorly immunogenic or require complex immune responses. Special consideration is also required in generating adequate immune responses in patients with impaired immune systems or immunosenescence, as well as in reducing the amount of antigen used per dose in the face of supply issues resulting from outbreak situations. In all these instances, novel adjuvant technology is being employed to augment and/or direct the immune system in vaccines to overcome these obstacles. We sought to provide an overview of the interaction between innate and adaptive immunity in mounting a response against pathogens. Specifically, we discuss the role of adjuvants in different vaccine approaches and provide examples of how adjuvants can be used to enhance immune responses against vaccine antigens.

Methods: Each combination of vaccine adjuvant and antigen must be evaluated individually as each possesses a unique safety and efficacy profile. As an example of evaluating different adjuvant systems, we discuss the development of malaria vaccine candidate RTS,S. Antigen RTS,S was formulated with AS02, AS03, and AS04 to make three separate vaccines. Subjects were scheduled to receive one formulation followed by malaria challenge. The vaccine with the highest efficacy was then evaluated against the RTS,S/AS01 vaccine in a similar Phase II trial.

Results: RST,S/AS02 had higher efficacy as compared to RTS,S/AS03 and RTS,S/AS04 and was subsequently evaluated against RTS,S/AS01. The AS01-adjuvanted vaccine had higher efficacy when compared against RTS,S/AS02 and was ultimately chosen for Phase III trials.

Conclusions/Implications for immunization research and evaluation: Some of the most prominent global infectious diseases still don't have a suitable vaccine, and due to the complicated nature of these pathogens and their targets, the future success of vaccines is contingent on the use of current adjuvants, as well as the development of novel ones. Adjuvants will continue to play an integral role in the successful development of novel preventative measures and they allow us the potential to improve currently existing vaccines such as the investigational malaria vaccine.

NEW DEVELOPMENTS IN VACCINES AND THEIR USE – SESSION 2

Wednesday, December **11:00 – 12:30** **Room 202**

Timeliness and completeness of routine childhood immunizations in Alberta – *Sarah Edwards*

Co-authors: *Vineet Saini, Shannon MacDonald, Deborah McNeil, Sheila McDonald, James Kellner, Victoria Stagg, Suzanne Tough*

Introduction/Background: Assessing timeliness, in addition to completeness of vaccine administration, is important for evaluating the effectiveness of immunization programs. The objective of this study was to examine timeliness and completeness of receipt of vaccination for each recommended routine childhood vaccine by 24 months of age among children in a community-based pregnancy cohort in Calgary, Alberta.

Methods: Vaccination records from May 2008 to December 2012 of two year old children (n=2763) were retrieved from the Public Health database in Calgary. The following vaccines were included for analysis: Diphtheria, acellular pertussis, tetanus, polio, and *haemophilus influenzae* type b (DTaP-IPV-Hib, available May 2008-Dec 2012); Pneumococcal conjugate 7 (PCV7, available May 2008-Jun 2010); Pneumococcal conjugate 13 (PCV13, available Jul 2010–Dec 2012); Meningococcal conjugate Group C (MenC, available May 2008-Dec 2012); Varicella (Var, available May 2008-Aug 2010); Measles, mumps and rubella (MMR, available May 2008-Aug 2010) and Measles, mumps, rubella and varicella (MMVR, available Sep 2010–Dec 2012). The proportion of children receiving timely vaccination and series completion rates were calculated.

Results: A majority of mothers included in this study were aged 25 to 34 years (71%), married (95%), born in Canada (78%), and had a household income greater than $80,000 (70%). For multi-dose vaccines (DTaP-IPV-Hib and MenC), over 80% of the children had timely doses at 2, 4 and 6 months of age. Only 65%, 61% and 64% of the children had timely dose of MenC, measles antigen containing vaccines (MMR/MMRV) and varicella antigen containing vaccines (Var/MMRV) at 12 months, respectively. At 18 months, 55% of the children had a timely 4th dose of DTaP-IPV-Hib vaccine. Overall, 77.0% of the children had all the recommended doses of all the routine childhood vaccinations by age two.

Conclusions/Implications for immunization research and evaluation: The proportion of children with timely doses decreased as children got older. The timeliness and completeness of vaccine administration to pre-school children in this cohort is suboptimal, putting children at risk of potentially severe but preventable diseases. Data on timeliness of vaccination can inform further work to examine barriers and enablers to ensure adequate immunization coverage.

What is the impact of combination vaccines on uptake? Immunization coverage before and after introduction of the MMRV vaccine – *Shannon Macdonald*

Co-authors: *Xiaoyan Guo, James Kellner, Suzanne Tough*

Background: Combination vaccines decrease the number of needles needed at an immunization visit, addressing a common concern of parents. However, some parents are hesitant about combination vaccines and/or want to opt out of certain vaccine components. We examined whether introduction of the combination measles-mumps-rubella-varicella (MMRV) vaccine to Alberta in 2010 influenced coverage for measles- and varicella-containing vaccines, and whether children continued to receive separate MMR and varicella vaccines after introduction of MMRV.

Methods: For the 2006-2012 Alberta birth cohorts, we linked vital statistics, provincial immunization, and health insurance plan databases. We measured coverage at age 24 months for measles- and varicella-containing vaccines, and compared coverage in children born before and after 2010 using logistic regression analysis. Among immunized children born from 2010 onward, we calculated the proportion of children receiving separate versus combination vaccines.

Results: Of 307,704 children, 269,095 were immunized against measles and/or varicella by age 24 months. For measles vaccine, coverage was 88% in the 2006-2007 birth cohorts, decreased to 86% (2008-2011 birth cohorts), then returned to 88% in the 2012 cohort. The difference in measles vaccine coverage for children born before and after 2010 was not significant ($p=0.07$). For varicella, vaccine coverage was 86% in the 2006-2007 birth cohorts, decreased to 85% (2008-2009 birth cohorts), started increasing again (2010-2011 birth cohorts), and reached 87% in the 2012 birth cohort. There was a significant difference in varicella vaccine coverage for children born before and after 2010 ($p<.0001$). Of the 119,697 immunized children born from 2010 onward, most received MMRV (95.9%), while fewer received MMR only (1.4%), varicella only (0.2%), MMR and varicella on the same day (1.3%), MMR and varicella on different days (0.3%), or MMRV and MMR on different days due to travel to a measles endemic region (0.9%).

Conclusions: Coverage for both vaccines increased from the 2010 birth cohort onward (after introduction of MMRV), reaching 88% for measles (below national target of 97%) and 87% for varicella (exceeding national target of 85%). A small number of children received separate vaccines after introduction of the combination MMRV vaccine. MMRV vaccine appears to be acceptable to most parents and may increase coverage.

Evaluation of meningococcal C conjugate vaccine programs in Canadian children: Duration of protection – *Julie Bettinger*

Co-authors: *David Scheifele, Scott Halperin, James Kellner, Otto Vanderkooi, Anthony Schryvers, Gaston De Serres, Joenel Alcantara*

Introduction/Background: The diversity of universal infant meningococcal C conjugate (MenC) immunization programs in Canada is unique among countries providing MenC vaccines and offers a rare opportunity to determine the optimal immunization program. Alberta (AB) offers a 3-dose program (2, 4 and 12 months); British Columbia (BC) provides 2 doses (2 and 12 months) and Nova Scotia (NS) offers 1 dose at 12 months. This analysis of 4 years of follow-up data from a 4-year cohort study presents data to assess differences in protection in provinces providing early priming doses in infancy.

Methods: In this prospective comparative cohort study, three similar cohorts of healthy children from 1, 2 and 3 dose programs were enrolled prior to the 12 month MenC dose and vaccinated with MenC-tetanus-toxoid conjugate. All sera were assayed for serogroup C serum bactericidal activity using standardized procedures (serum bactericidal assay (SBA)) with rabbit as the exogenous complement source. SBA was measured at baseline (12 months of age) and 1 month after the 12 month MenC dose (13 months of age), 2 years later (36 months of age) and 4 years later (5 years of age). SBA titers >= 1:8 were considered protective.

Results: A total of 356 participants completed the last study visit at 5 years of age (n=124, 124 and 108 from 1, 2 and 3 dose sites, respectively). The 2-dose program had a significantly higher proportion of children protected at 5 years of age: 74.1% (95% CI 65.1%-81.4%) (p=0.0003) compared to 54.8% (46.1%-63.3%) in the 3-dose program and 49.2% (40.6%-57.9%) in the 1-dose program.

Geometric mean titers were also significantly higher in the 2-dose program: 50.9 (95% CI 41.6-60.2) (p<0.0001) 2-dose program vs. 17.7 (12-25.4) 3-dose program and 14.5(9.4-21.8) 1-dose program.

Conclusions/Implications for immunization research and evaluation: Our data indicate 2-dose MenC infant immunization programs provide the highest proportion of children with protective SBA titers at 5 years of age. While one-dose programs still provide protective SBA titers 4 years after the initial vaccine for almost 50% of vaccinated children, the vulnerability to IMD of vaccinees with lower or non-detectable titers remains unclear. Further validation of the results through repeat testing is underway.

Impact of an immunization campaign to control an increased incidence of Serogroup B meningococcal disease in one region of Quebec, Canada – *Genevieve Deceuninck*

Co-authors: *Philippe De Wals, Brigitte Lefebvre, Raymond Tsang, Dennis Law, Gaston De Serres, Vladimir Gilca, Rodica Gilca, Nicole Boulianne*

Introduction/Background: An increase in the incidence of invasive meningococcal disease (IMD) started in Quebec in 2003 and was caused by the emergence of a Serogroup B Sequence-Type 269 clone. The Saguenay-Lac-Saint-Jean (SLSJ) region was particularly affected with an average annual incidence rate of 3.4 per 100,000 person-years in 2006-2013. In May 2014, an immunization campaign was launched in SLSJ, using a newly licensed four-component protein-based meningococcal vaccine (MenB-4C).

Methods: Immunization registry data and B-IMD cases notified to public health authorities and confirmed by culture or PCR from July 1st 2000 to April 30th 2016 were analyzed to evaluate the impact of the campaign two years after its initiation.

Results: By the end of the campaign, 82% of the 59,000 targeted SLSJ residents between 2 months and 20 years of age had been immunized. Following the initiation of the campaign, no B-IMD case occurred among vaccinees, whereas 2 cases were reported among unvaccinated adult SLSJ residents, and a third case in an unvaccinated child who had stayed in the region during the week prior to disease onset, in 2015. In SLSJ, B-IMD incidence was 3.4/100,000 person-years in the period July 2006 to June 2014 and 0.4/100,000 person-years in the post

immunization period July 2014 to April 2015. In the other regions, the corresponding figures were 0.6/100,000 and 0.3/100,000.

Conclusions/Implications for immunization research and evaluation: Results suggest a high level of protection provided by MenB-4C following mass vaccination at regional level. This, along with reassuring safety data, supports the current recommendations for MenB-4C use for controlling outbreaks caused by clones covered by the vaccine.

Anaphylaxie post-vaccination et retrait national d'un lot de vaccin contre le méningocoque C: L'évaluation risque/bénéfice au quotidien, sommes-nous prêts? – *Eveline Toth*

Co-authors: *Danielle Auger, Monique Landry, Nadine Sicard*

Introduction/Définition du problème : En février 2016, le ministère de la Santé et des Services sociaux (MSSS) du Québec reçoit 2 signalements d'anaphylaxie liés à un même lot de vaccin. Un registre recense depuis 1990 les manifestations cliniques inhabituelles (MCI) survenant à la suite de la vaccination au Québec. Le volet de gestion des produits immunisants (GPI) de Panorama a été déployé en 2013 dans cette province et le volet immunisation, en 2016. Ces outils sont-ils adéquats pour détecter précocément des agrégats de MCI et soutenir l'intervention judicieuse et en temps opportun lors d'une problématique émergente?

But :

- Décrire les interventions provinciales utilisées pour confirmer l'agrégat puis gérer la situation de MCI ayant mené au retrait national du lot;
- Explorer les bénéfices et les limites des différents systèmes d'information dont ceux de Panorama pour les MCI.

Méthode/Données probantes : Les processus de vigie, mécanismes décisionnels et outils informatiques ont fait l'objet d'une évaluation qualitative.

Pour confirmer l'agrégat de MCI, le registre provincial a pu être consulté immédiatement. Le volet GPI de Panorama a permis de vérifier la distribution des doses du lot associé à l'agrégat. Nous avons pu ensuite déterminer le nombre de personnes vaccinées avec le lot problématique à partir du volet immunisation de Panorama, cependant le délai de saisie était un enjeu. Afin d'avoir un portrait réaliste en temps réel, une mobilisation des ressources régionales en vaccination et MCI a été réalisée.

Les activités mises de l'avant afin de cesser rapidement l'administration de ce vaccin dans la population, les modalités de collaboration entre les partenaires ainsi que les stratégies de surveillance active de la survenue des nouveaux cas seront décrites pendant la présentation.

Importance des constatations/résultats pour la recherche et l'évaluation en immunisation : Le retrait d'un lot de vaccin est un événement exceptionnel au Canada. Un problème de lot de vaccin peut avoir des conséquences sérieuses et la santé publique doit pouvoir détecter les événements et agir rapidement pour protéger la population. Le partage d'informations rapide entre les différents partenaires et la combinaison d'un réseau humain consacré à la vigie des MCI et des outils technologiques utilisés lors de cette intervention sont des stratégies efficaces pour atteindre ces objectifs.

OPTIMAL PRACTICE – SESSION 1

Wednesday, December 7 **14:30 – 16:00** **Room 201**

The risk of seizure after immunization in children with epilepsy – *Karina Top*

Co-authors: *Paula Brna, Bruce Smith*

Introduction/Background: In children with epilepsy, fever and infection can trigger seizures. Immunization can also induce inflammation and fever, which could trigger a seizure. Few studies have examined the risk of seizure after immunization in children with pre-existing epilepsy. Our objective was to estimate the risk of medically attended seizure after immunization in children with epilepsy <7 years of age.

Methods: We conducted a retrospective study of children <7 years of age with a neurologist diagnosis of epilepsy who were followed at the IWK Health Centre between 2010 and 2014. Hospitalizations, emergency visits, unscheduled clinic visits, and telephone calls for seizures were extracted from medical records. Immunization records were obtained from family physicians and public health with informed consent. The relative risk (RR) of seizure during the putative risk period for vaccine-triggered seizure 0-14 days post-immunization versus the control period 21-83 days post-immunization was estimated using Poisson regression analysis.

Results: In total, 302 children with epilepsy were eligible, of whom 166 (55%) consented to release immunization records. Ninety-six (58%) children had ≥1 immunization between epilepsy diagnosis and age 7 years, 49 (30%) received no immunizations after epilepsy diagnosis, and in 21 (13%) cases, records were unavailable. Children with immunization events between diagnosis and age 7 were younger at diagnosis than those without immunization records (1.6 years versus 3.0 years; P<0.001) and had more seizure events (0.6 vs. 0.4 events per person, P<0.001). There were 7 medically attended seizure events during the 0 to 14-day risk period and 27 during the 21 to 83-day control period after immunization (RR= 1.1, 95% confidence interval: 0.5–2.5). Further analyses of the RR after live and inactivated vaccines and assessment of confounders are ongoing.

Conclusions/Implications for immunization research and evaluation: The preliminary results suggest that children with epilepsy are not at increased risk of medically attended seizure following immunization. Children with recorded immunization events were diagnosed earlier and had more frequent seizure events; they may represent a subgroup that raises particular concern among parents and clinicians about the risk of vaccination-triggered seizure. Confirmation of these results will reassure parents and clinicians that vaccination is safe in children with epilepsy.

A longitudinal randomized trial of the relative effectiveness of additive pain mitigation interventions during vaccination in infants – *Anna Taddio*

Co-authors: *Rebecca Pillai Riddell, Moshe Ipp, Steven Moss, Stephen Baker, Jonathan Tolkin, Malini Dave, Sharmeen Feerasta, Preeya Govan, Emma Fletcher, Horace Wong, Caitlin McNair, Pri Mithal, Derek Stephens*

Introduction/Background: Vaccine injections frequently cause severe distress in infants. There is a gap in primary research regarding the pain intervention regimen(s) that achieve maximal infant analgesia. The objective was to compare the effectiveness of additive pain interventions administered consistently during vaccine injections over the first year of life.

Methods: Multicentre, longitudinal, double-blind, double-dummy, add-on, randomized controlled trial including healthy infants randomized to four levels of pain management during routine 2, 4, 6, and 12 month vaccinations: 1) placebo control; 2) parent-directed education about infant soothing using a video (video); 3) video + oral sucrose solution (sucrose), 4) video + sucrose + liposomal lidocaine cream (lidocaine). Infant distress was assessed during three phases: pre-injection (baseline), vaccine injection (needle), and one minute post-injection (recovery) using a validated scale, the Modified Behavioural Pain Scale (MBPS) (range, 0-10). Scores during each phase were compared over time using repeated measures analysis of variance.

Results: Three-hundred and fifty-two infants participated from January 17, 2012 to February 2, 2016. Demographics and pre-injection MBPS scores did not differ among groups at any time point ($p>0.05$ for all analyses). MBPS needle scores differed over time ($p<0.001$) and among groups ($p=0.003$). Scores were lower in the video + sucrose + lidocaine group compared to placebo ($p<0.001$), video ($p=0.003$), and video + sucrose ($p=0.005$) groups; there were no other between-group differences. There were no differences among groups during the recovery phase.

Conclusions/Implications for immunization research and evaluation: Over time, only liposomal lidocaine provided consistent analgesia within an additive pain intervention regimen during infant vaccinations. Efforts should be made to promote its routine use.

Improving pediatric experience of pain during vaccinations at the North Bay Nurse practitioner-led clinic – *Terri MacDougall*

Introduction/Problem identification: Quality improvement is based in real world analysis of clinical practice data "the noise of practice" with patients centred in the flow of care. It is well known fact that it takes 15 to 17 years for research to permeate into practice. There are very good clinical practice guidelines that address assessment and mitigation of vaccination pain in the pediatric population. Most clinicians will acknowledge they implement some best practices to mitigate pain during vaccinations when they see their pediatric patients.

Purpose: What this session will do is describe how the North Bay Nurse Practitioner-Led Clinic analyzed assessment of pain in the pediatric population and how they deliberately planned improvements according to best practice to optimize use of strategies to mitigate pain during vaccinations.

Methods/Evidence: Quality improvement tools and adaptive leadership skills that were learned at Health Quality Ontario IDEAS (Improving and Driving Excellence across Sectors) will be presented in the context of improving pediatric experience of pain during vaccinations. Cost analysis of some strategies will be presented in the context of low income families' ability to access topical anesthetic cream prior to their appointments.

Significance of Findings/Outcomes for immunization research and evaluation: An exploration of the value of pain prevention in the pediatric population will be touched on in the context of our cultural expectations of pain. Experience of pain may relate to vaccine hesitancy. Addressing pain in the vaccine hesitant population is an important strategy. Quality improvement tools, lessons learned and suggestions for clinicians to take back to their practices will be outlined.

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10 practical tips to increase early childhood immunization coverage rates – *Karen Dickenson-Smith*

Co-authors: *Rachel Douglas, Shovita Padhi, Anup Samra*

Introduction/Problem identification: Early childhood immunizations are a valuable opportunity to protect some of the most vulnerable members of the population while striving for herd immunity. Many jurisdictions, however, struggle to increase coverage rates due to a variety of factors including resource constraints, challenges with information systems, barriers to client access, and conflicting client beliefs. Hear how Fraser Health, the largest health authority in BC, increased their regional 2-year old immunization coverage rate by 5% in less than one year, achieving 76.6% in Q4 of 2015/16.

Purpose: To increase immunization coverage rates in young children through implementation of a focused quality improvement strategy.

Methods/Evidence: Guided by LEAN management principles, during 2015/16 a multi-pronged regional strategy was implemented that included the following components: (i) operational improvements across 17 local public health units such as weekly monitoring of clinic access and activity data, establishment of targeted clinics and client reminders, and monthly monitoring of coverage rates; (ii) immunization promotion such as revamping the immunizations website to be more client-centred, and effective use of social media; (iii) physician engagement

to increase immunization education; (iv) business process improvements such as quantifying adequate capacity required to meet immunization appointment needs in different communities, and standardizing clinics and data entry timelines, and (v) technological enhancements such as trialing remote access to the public health information system to enable offsite charting by nurses, and advocating provincially for system improvements such as self-serve client appointment booking and automatic reminders. From the above quality improvement activities we have distilled 10 practical tips. An interim evaluation was conducted in April 2016. The percentage of 2-year olds in Fraser Health who were up-to-date for their immunizations increased by 5% during 2015/16, from 68.4% year to date (YTD) to 73.5% YTD. The regional rate in Q4 of 2015/16 reached 76.6%, exceeding the health authority's key performance indicator of 76%.

Significance of Findings/Outcomes for immunization practice, research and evaluation: Using LEAN management principles, Fraser Health has succeeded in increasing coverage rates in a context where other jurisdictions are stable or declining. The upward trend continues in Fraser Health, demonstrating that focused, practical quality improvement efforts can lead to increases despite multiple organizational and system barriers.

Socioeconomic status differences in parental vaccination attitudes and child vaccinations: Findings from the 2013 Childhood National Immunization Coverage Survey – *Richard Carpiano*

Co-authors: *Andrea Polonijo, Nicolas Gilbert, Martine Dubuc, Lyne Cantin, Eve Dube*

Introduction/Background: Promoting and maintaining adequate population levels of vaccination coverage remains a continued challenge in Canada. In recent years, vaccination efforts have been negatively impacted by increased public and activist concerns with safety, side effects, and effectiveness. Less understood is how parent's vaccination attitudes and child's up-to-date status may be patterned by parental socioeconomic status (SES). Our study examines the extent to which (a) family SES (parent education, household income) is linked to parents' vaccination attitudes (general safety, effectiveness, and side effects concerns; and vaccination-specific importance and safety concerns) and vaccination-specific up-to-date status, and (b) whether these attitudes mediate SES inequalities in vaccination status.

Methods: Analyzing 2013 Childhood National Immunization Coverage Survey data, we estimated linear and binary and multinomial logistic multivariable models for parental attitudes and vaccination-specific up-to-date status—for MMR at age two (n=3524), DPT at age 7 (n=3384), HPV at ages 12-14 (n=4616 females), and Hepatitis B (HepB) at age 17 (n=5649).

Results: Across the four age group and vaccine-stratified analyses, SES was an inconsistent predictor of attitudes and vaccination up-to-date status. However, a pattern of significant differences for lower education (versus bachelor's degree or higher) and lower income brackets (versus $120,000 or more) centered around (a) strong (versus mixed) concern for potential side effects of vaccinations in general and (b) greater concern for the safety of specific vaccines. Few significant SES disparities were observed in up-to-date status for any of the four vaccinations. Positive general attitudes about vaccine effectiveness and side effects were most commonly associated with vaccination-specific up-to-date status, but perceived importance of MMR and Hepatitis B immunization were respectively associated with higher odds of being up-to-date for these vaccinations. Mediation was limited to general concerns about side effects—for only MMR and HPV vaccination up-to-date statuses.

Conclusions/Implications for immunization research and evaluation: Our study identified SES differences in vaccine safety perceptions, yet few of these concerns are associated with up-to-date status. These findings have implications for public health education strategies. Future research in Canada needs to consider more detailed measurement and geographic clustering (and sampling) of vaccination attitudes and up-to-date status.

OPTIMAL PRACTICE – SESSION 2

Wednesday, December 7 **14:30 – 16:00** **Room 202**

Forecasting the potential public health impact of introducing a new herpes zoster vaccine to the Canadian population – *Ruben Tavares*

Co-authors: *Desiree van Oorschot, Robyn Widenmaier, Lijoy Varghese, Desmond Curran*

Introduction/Background: With a lifetime risk of up to 30%, Herpes Zoster (HZ) infections pose a significant health concern. Independently the incidence of infection and severity of illness can increase with age. The objective of this study was to estimate the impact of introducing a 2-dose Herpes Zoster (HZ) subunit candidate vaccine (HZ/su) in the Canadian population ≥50 years compared to no vaccination.

Methods: The analysis was performed using a multi-cohort static Markov model developed in MS Excel that uses an annual cycle length and models the progression of HZ. The model tracks a cohort ≥50 years over its lifetime and compares the outcomes against no vaccination, including health states for susceptible lives, deaths, HZ, Postherpetic Neuralgia (PHN) and other complications related to HZ, where recurrence of the disease is taken into account. Canadian-specific population parameter inputs were derived from published literature and Statistics Canada. Age-specific vaccine efficacy data were derived from Phase III randomized controlled trial data (NCT01165177), with exponential waning explored at 2% and 4% per year. A conservative estimate of first-dose coverage of 60% was inferred from influenza public health vaccination statistics. Compliance of the second dose was assumed to be 100%.

Results: Depending on the waning scenario, vaccinating 60% of the 11.4 million individuals ≥50 years with the HZ/su vaccine was projected to avert between 634,000 – 838,000 HZ cases, 138,000 – 190,000 PHN cases and between 80,000 – 108,000 cases related to other complications. The table below provides a more detailed overview of the HZ and PHN cases avoided compared to no vaccination.

Conclusions/Implications for immunization research and evaluation: Introduction of the HZ/su candidate vaccine in the age group ≥50 years of age may significantly reduce the burden of HZ in Canada.

Table

		Herpes Zoster Cases Avoided		**Postherpetic Neuralgia Cases Avoided**	
Age Cohort	Population Vaccinated	2%	4%	2%	4%
50-59 years old	2,873,891	390,080	270,897	75,232	47,583
60-64 years old	1,132,660	152,402	117,176	33,113	23,799
65-69 years old	844,126	106,651	85,844	25,642	19,684
70-79 years old	1,193,792	129,999	107,802	37,292	30,533
>80 years old	775,621	59,234	52,440	19,073	16,886
Total	**6,820,090**	**838,366**	**634,159**	**190,352**	**138,485**

The effectiveness of the shingles vaccine in Alberta – *Bruce McDonald*

Co-authors: *Douglas Dover, Kimberley Simmonds, Christopher Bell, Larry Svenson, Margaret Russell*

Introduction/Background: Using administrative data, we assessed the effectiveness of the shingles vaccine in the Alberta population against an incident episode of shingles among those aged 50 years and older. Currently, the shingles vaccine (Zostavax II®) is not publicly funded in Alberta.

Methods: A historical cohort was created using the mid-year 2009 Alberta population file. People who received the shingles vaccine were identified from the provincial pharmaceutical information network, and shingles incident records were identified through physician claims, inpatient, and ambulatory care data. Incident shingles

was defined as the earliest record of ICD 9-CM 053 or ICD-10-CA B02. Starting on November 1, 2009, unique individuals aged 50+, who were Alberta residents and had no history of shingles or shingles vaccination were followed for 6 years, or until shingles incidence, death, or Alberta Health Care Insurance cancellation. Shingles incident rates were compared during time at risk for incident shingles while controlling for vaccination status, age, sex, income quintile, and immune compromising conditions (identified from physician claims, inpatient, and cancer registry data). We determined vaccine effectiveness (VE) by taking the inverse of the relative risk of developing incident shingles in each year following vaccination compared to time at risk without vaccination.

Results: Out of 1,058,325 individuals in the cohort, there were 54,166 incident shingles cases, and 82,496 vaccinated individuals. The shingles incidence rate across the cohort was 10.29 [95% CI: 10.21, 10.38] cases per 1,000 person years. VE in the first year following immunization was 40% [95% CI: 34%, 45%] against incident shingles, decreasing to no effect by the fifth year (VE = 4% [95% CI: -32%, 30%]).

Conclusions/Implications for immunization research and evaluation: Our findings on the effectiveness of the shingles vaccine are consistent with observations from other population based studies and provide Alberta specific data for policy-makers to review when making decisions related to public funding of shingles vaccines. Similar studies should be conducted for newly licensed shingles vaccines and for assessing vaccine effectiveness against recurrent episodes of shingles.

Epidemiology of Invasive Pneumococcal Disease (IPD) among adults 65 years and older in New Brunswick 2012-2015: an enhanced surveillance lens. – *Rita R. Gad*

Co-authors: *Sophie Wertz, Suzanne Savoie, Louis-Alexandre Jalbert, Shinthuja Wijayasri, Laurence Caron-Poulin, Irene Martin, Walter Demczuk*

Introduction/Background: In April 2011, New Brunswick (NB) implemented the enhanced Invasive Pneumococcal Disease Surveillance System (eIPDSS) in collaboration with the Public Health Agency of Canada and the National Microbiology Laboratory. The eIPDSS captures epidemiological and laboratory-linked data on all confirmed IPD cases in NB. The Polysaccharide 23-Valent Pneumococcal Vaccine (Pneumo-P-23) is publicly funded for adults 65 years and older in NB. The objectives of this analysis were to describe the epidemiology of confirmed cases of IPD among adults 65 years and older in NB as captured by the eIPDSS between January 2012 and December 2015; to determine trends of IPD including severity and AMR; and to highlight the distribution of IPD serotypes in relation to immunization status.

Methods: A descriptive analysis was performed using IBM SPSS Statistics 22. Only data on adults aged 65 years and older were included in the analysis. The chi-square test was used to assess the differences in frequencies ($p < 0.05$).

Results: During this period, 125 IPD cases were reported among adults 65 years and older, representing 48% of the total reported IPD cases (n=261). Of these cases, 70.4% had one or two comorbid conditions, 94.4% were hospitalized, and death was reported in 21.5% of cases. Males represented 54% of cases. Immunization history was available for 68% of the cases. Among those, 25 cases (29%) were immunized, of which 18 (72%) presented with serotypes currently covered by the Pneumo-P-23 vaccine, with serotypes 3, 19A and 22F being the most prevalent. Of those unvaccinated, 78% had serotypes covered by the Pneumo-P-23. There was no statistically significant difference between proportions of Pneumo-P-23 covered serotypes in vaccinated and unvaccinated cases (p=0.531). AMR data was available for 81 isolates, of which 6% were resistant to cefuroxime (parenteral), 10% to clindamycin and trimethoprim-sulfamethoxazole, 12% to doxycycline and 15% to penicillin using meningitis breakpoints.

Conclusions/Implications for immunization research and evaluation: The high incidence of Pneumo-P-23 covered serotypes in vaccinated adults 65 years and older is particularly concerning. Further analysis and continued monitoring of IPD serotypes in relation to case outcome and immunization information are imperative to thoroughly assess the effectiveness of current vaccines and inform vaccination programs in the province.

Clinical validation of PCR-Based detection and serotype deduction of Streptococcus pneumoniae from nasopharyngeal swabs collected for viral studies – *Hayley Gillis*

Co-authors: *Amanda Lang, May ElSherif, Irene Martin, Lingyun Ye, Donna MacKinnon-Cameron, Li Li, Ardith Ambrose, Todd Hatchette, Shelly McNeil, Jason LeBlanc*

Introduction/Background: *Streptococcus pneumoniae* is a bacterium that colonizes oro- and nasopharynx of humans, and can cause life-threatening disease like community acquired pneumonia (CAP). While vaccines have reduced the burden of disease caused by some *S. pneumoniae* serotypes, ongoing surveillance is important to monitor epidemiology and serotype distribution. Our laboratory previously demonstrated the feasibility of PCR-based detection and serotyping of *S. pneumoniae* from nasopharyngeal (NP) swabs routinely collected for viral studies. This study assessed the clinical performance of these methods in patients meeting clinical case definition of CAP and laboratory-confirmed pneumococcal CAP (CAP_{Spn}).

Methods: Active surveillance for CAP in hospitalized adults was performed from December 2010 to 2013. CAP was identified by chest radiography and clinical symptoms, and detection of CAP_{Spn} was performed by urine antigen detection (UAD) or identification of *S. pneumoniae* in sputum or blood cultures. Serotyping was performed using the Quellung reaction, PCR-based serotyping, and a serotype-specific UAD. For NP swabs, *S. pneumoniae* was detected using *lytA* and *cpsA* real-time PCR and conventional and real-time PCR-based serotyping.

Results: NP swab results were compared against 434 CAP cases where paired UAD and specimen cultures were performed. Of these, 96 were identified as CAP_{Spn}, with 68 non-bacteremic CAP_{Spn} and 28 bacteremic CAP_{Spn}. For Np swabs, the sensitivity for *S. pneumoniae* detection was poor: 35.4% for CAP_{Spn}, 32.4% for non-bacteremic CAP_{Spn}, and 42.9% for bacteremic CAP_{Spn}. However, in *lytA*/*cpsA*-positive NP swabs where a serotype was identified, the specificity was 100% in all disease categories. For all-cause CAP cases not attributed to *S. pneumoniae*, NP *lytA*/*cpsA* real-time PCR detected two additional positive results, which could represent colonization or disease not identified by the other detection methods.

Conclusions/Implications for immunization research and evaluation: While there was low sensitivity of PCR-based detection and serotyping of *S. pneumoniae* from viral swabs, the high specificity in CAP_{Spn} cases suggests it may be used to monitor *S. pneumoniae* colonization and deduce serotype in CAP cases with paired specimens that are non-available, non-viable, or non-typeable by other methods. As such, PCR-based detection and serotyping adds to the repertoire of surveillance tools for *S. pneumoniae*.

Increasing the diagnostic yield of pneumococcal community acquired pneumonia surveillance in hospitalized adults using combinative laboratory testing – *Jason Leblanc*

Co-authors: *May ElSherif, Lingyun Ye, Donna Mackinnon-Cameron, Li Li, Ardith Ambrose, Irene Martin, Todd Hatchette, Shelly McNeil*

Introduction/Background: The Serious Outcomes Surveillance (SOS) Network of the Canadian Immunization Research Network (CIRN) has been performing active surveillance for pneumococcal community acquired pneumonia (CAP_{Spn}) in hospitalized adults since December 2010. This study evaluated the diagnostic yield for CAP_{Spn} of laboratory detection methods for *Streptococcus pneumoniae*, alone or in combination.

Methods: CAP was identified by chest radiography, clinical symptoms, and laboratory testing. Sputum and blood cultures were performed as standard practice, and *S. pneumoniae* isolates were serotyped using the Quellung reaction or PCR-based serotyping. Urine was tested using a multiplexed PCV13-serotype specific urinary antigen detection assay (UAD_{PCV13}) or a commercial pan-pneumococcal UAD (UAD_{Spn}). Proportions for each test result (or test combinations) were then divided into two categories: serotypeable and non-serotypeable. The serotypeable results were further subdivided to evaluate the proportion of 7- or 13-valent pneumococcal conjugate vaccine serotypes (PCV7 and PCV13, respectively), 23-valent pneumococcal polysaccharide vaccine serotypes (PPV23), or non-vaccine types (NVT). Non-serotypeable results represented isolates identified as *S. pneumoniae* but were

not available (NA) for serotyping or not viable (NV) following re-culture, or were detected solely by UAD_{Spn} or could not be typed (NT) by Quellung or PCR.

Results: Of the 4769 all-cause CAP cases, 3110 (65.2%) had blood cultures, 1941 (40.7%) had a UAD_{Spn}, 1917 (40.2%) were tested using UAD_{PCV13}, and 1640 (34.3%) had a sputum culture. The proportion of *S. pneumoniae*-positive results for each individual test ranged from 7.1% to 10.3%; however, using a combination testing, the diagnostic yield increased. Of the patients having received any of the detection tests for *S. pneumoniae* (n = 3705), 549 (14.8%) were identified as CAP_{Spn}. Of the patients with paired blood culture and urine specimens for UAD_{PCV13} and UAD_{Spn}, 18.5% (263/1420) were identified as CAP_{Spn}. For CAP cases who received all tests for pneumococci (blood and sputum culture, UAD_{PCV13}, and UAD_{Spn}), *S. pneumoniae* was identified in 23.2% (144/621). Similar trends were observed for serotypeable results (PCV7, PCV13, PPV23, and NVTs) and non-serotypeable results (NA, NV, and NT).

Conclusions/Implications for immunization research and evaluation: Overall, the contribution of *S. pneumoniae* to all-cause CAP in hospitalized adults was better defined using combination testing, as each tests increased the diagnostic yield.

INDIGENOUS PEOPLES' HEALTH

Thursday, December 8 **11:00 – 12:30** **Room 213**

Community health aides (CHA): Augmenting the scope of nursing practice in northern Inuit communities – *Tina Buckle*

Co-author: *Sylvia Doody*

Introduction/Problem identification: Historically there have been challenges meeting the provincial public health mandate in the Labrador Inuit communities of Nunatsiavut. These challenges include the turnover of nurses, cultural understanding and knowledge, community trust, language barriers, and the difficulties associated with living in northern remote isolated communities. All of these challenges are multilayered and thus result in difficulties in providing a high standard of care across the continuum.

Purpose: In response to these unique challenges a new service delivery model was explored to respond to our needs. The model that was chosen, which was adapted from the Alaska Community Health Aide Practitioner program, looked at the realities of nursing recruitment and retention in northern remote isolated communities. We also took into consideration the resources that currently existed in the communities and built on those strengths to enhance capacity. The CHA positions were introduced into our community health nursing programs to support and bridge some of the gaps and barriers in service delivery across community programs.

Methods/Evidence: Our community health aides are residents of the community, Inuit, and have a strong knowledge and understanding of Inuktitutt. In addition, the CHA's possess an innate cultural understanding which is specific to their home community. These qualities are the foundation for giving the programs longevity and continuity to respond to the transiency in nursing staff. The CHA's engage families and support the nurses in program service delivery such as in the immunization program, provide health care services and facilitate linkages within the community.

Significance of Findings/Outcomes for immunization research and evaluation: The CHA program was implemented in the Nunatsiavut region in January of 2008. Since this time, feedback has been positive from various partner organizations, community health nurses and residents of the community. In addition, immunization coverage rates in all of the communities are greater than 95% and have been consecutively at that rate and higher for many years. Furthermore, the CHA's have become such an integral part of our programs that even during periods when there is no nurse the community health programs continue.

Partnering to improve Influenza vaccine uptake in the Labrador Inuit communities of Nunatsiavut – *Sylvia Doody*

Co-author: *Tina Buckle*

Introduction/Problem identification: Within the Nunatsiavut region health care delivery falls under the jurisdiction of two separate service providers. The mandate for public health and home care rests with the Nunatsiavut Government Department of Health and Social Development (DHSD) and primary care is provided by the province of Newfoundland and Labrador through Labrador Grenfell Regional Health Authority (LGH). To ensure seamless healthcare services for residents throughout the region strong partnerships across providers is essential. A huge undertaking each fall is the Influenza vaccination clinics which require continuous commitment and partnership between both organizations. Given the remoteness and limited resources within these isolated communities the need for prevention through immunization is even more critical because of the social determinants of health present in these communities and the potential for disease to become widespread.

Purpose: Each year within the province of Newfoundland and Labrador there are deaths associated with Influenza. The Labrador Inuit communities of Nunatsiavut are situated in the remote and isolated area of Northern Labrador. Due to geography, availability of acute care services in these communities are limited and residents have to be flown out of their community to access tertiary care. Given that clients with suspected or confirmed Influenza are generally very ill and require acute respiratory services the goal is to focus on prevention and health promotion within the communities through vaccination and promotion of handwashing.

Methods/Evidence: The partnership starts from planning right through to implementation and after the clinics have been completed. During the planning phase both partners are engaged to ensure the necessary planning and preparation is in place to roll out the Influenza clinic. During the implementation phase, again staff are engaged and actively involved in the community Influenza clinics. Finally, even after community Influenza clinics have been completed, staff continue to be vigilant in health promotion and vaccine administration for those who may have missed this scheduled clinics.

Significance of Findings/Outcomes for immunization research and evaluation: Through our partnership with LGH, Influenza coverage rates throughout Nunatsiavut have remained comparable to the regional average and in some communities rates have been higher.

Up-to-date immunization coverage rates among 2-year olds in the Saskatchewan First Nations communities – *Michelle Allard-Johnson*

Co-authors: *Nolan Claude, Ryan Leadbetter, Mustafa Andkhoie, Germain Bukassa Kazadi, Deborah Kupchanko, Ibrahim Khan*

Introduction/Problem identification: There are 70 First Nations bands in Saskatchewan (SK) residing approximately 7% of the overall population. Routine immunization of infants, children and adolescents are tracked by community-based health care providers in First Nations bands and shared with the First Nation and Inuit Health branch of Health Canada in Saskatchewan. The Canadian Immunization Registry Network has national standards (including the "up-to-date" coverage) to measure a population's protection against vaccine-preventable-diseases.

Purpose: The purpose of this study is to present the up-to-date (UTD) vaccine coverage rates of children aged 2 year- old residing in the Saskatchewan First Nation (FN) communities between 2006 and 2015. The study also estimates the change in the UTD vaccine coverage rates in this population during the 10-year period.

Methods/Evidence: The up-to-date (UTD) coverage encompasses vaccine antigens including diphtheria, pertussis, tetanus, poliomyelitis, *Haemophilus influenzae* type b, measles, mumps, rubella, pneumococcal conjugate, meningococcal conjugate and varicella. We also included hepatitis-A in the UTD coverage measure. The number of doses administered were recorded and collected in the individual communities (majority collected in paper-based format). The denominators for the analysis were estimated by the community-based

health workers based on their "expert knowledge". Descriptive statistics and linear regression analysis were conducted in SAS EG 5.1 to estimate the change in the up-to-date vaccine coverage rates among 2 year-olds in the SK FN communities between 2006 and 2015.

Significance of Findings/Outcomes for immunization research and evaluation: In 2006, 67% (95% CI: 41% to 93%) of the children had received all the valid and required doses by their 2nd birthday. In 2015, their UTD coverage among two-year olds had increased to 86% (95% CI: 80% to 91%). Between 2006 and 2015, the up-to-date vaccine coverage among 2-year olds in the SK FN communities increased (on average) by 1.7% per year (95% CI: 1.2% to 2.2%; p-value < 0.001). The immunization coverage rates in the SK FN communities have significantly improved in the last 10 years. This study provides standard estimates of UTD coverage among 2-year olds, which would be essential for future evaluation and policy making regionally and federally, as well as to compare with other regions and jurisdictions.

The epidemiology of invasive diseases caused by *Haemophilus influenzae* type a (Hia): A report from the Canadian Immunization Monitoring Program ACTive (IMPACT) – *Ben Tan*

Co-authors: *Athena McConnell, Julie Bettinger, David Scheifele, Joanne Embree, Laura Sauve, Natalie Bridger, Wendy Vaudry, Scott Halperin, Shalini Desai, Raymond Tsang*

Introduction: *Haemophilus influenzae* type a (Hia) is an important pathogen in the Hib vaccine era. The Canadian Immunization Monitoring Program ACTive (IMPACT) conducts active surveillance for invasive *H. influenzae* infections in 12 pediatric tertiary care centres. The study was to determine the proportion, severity and outcome of Hia cases from 2007-15.

Methods: Demographic and clinical data of invasive *H. influenzae* cases from the 12 IMPACT centers were analysed. Serotyping of isolates was performed at the National Microbiology Laboratory in Winnipeg.

Results: Of 356 *H. influenzae* cases, Hia accounted for 112 (32%); the remainder were due to non-typeable (149), Hib (47), Hic (4), Hie (5), Hif (38), and unknown (1) serotypes. Results herein concerns the Hia cases only. A median of 12 cases was reported per year, and 59% of cases were male. Age distribution was: 21 (19%) 0-5 mos, 37 (33%) 6-11 mos, 32 (29%) 12-23 mos, 13 (12%) 2-4 years, 4 (4%) 5-9 years, and 5 (4%) 10-16 years-of-age. Sixty-one (55%) were previously healthy, 8 (7%) had immunodeficiency disorders, 42 (38%) had other medical diseases, 1 had unknown health status. Forty (36%) cases were from Nunavut, Northwest Territories or northern Quebec (38 of aboriginal descent). The remaining cases from other Canadian regions affected 42 aboriginal, 7 caucasian and 1 asian children, but ethnicity was unknown in 22 cases. Meningitis, pneumonia and septic arthritis were present in 49%, 26% & 20% of cases, respectively. Forty-five (41%) required PICU care, for a range of 1-25 days. Case fatality rate was 8% (9 cases – all aboriginal children, and 8 were < 12 mos-of-age).

Conclusions/Implications for immunization research and evaluation: The severity of Hia cases was comparable to Hib in the pre-vaccine era. Aboriginal children in all (especially northern) regions were disproportionately affected, with all nine deaths in this group. The infant age-group is an important risk factor. Due consideration should be given to develop a Hia vaccine effective in infants, and/or provide herd immunity.

Haemophilus influenza type a invasive infections at the Montreal Children Hospital and infection rates in Quebec – *Andrée-Anne Boisvert*

Co-authors: *Dororthy Moore, Brigitte Lefebvre*

Introduction/Background: In recent years, increasing numbers of invasive infections due to H. influenza type a (iHia) have been reported in the Canadian north.

In Nunavik, Quebec, iHia infection was first reported in 2010, with numbers peaking in 2013. In November 2013, the Institut national de santé publique du Québec (INSPQ) made interim recommendations for Nunavik to provide chemoprophylaxis to household and other close contacts (Flash Vigie Dec. 2013).

The objectives of this study are to describe epidemiologic and clinical features of patients with iHia infection admitted to the Montreal Children's Hospital, and to determine iHia infection rates in Quebec.

Methods: We conducted a retrospective observational study of cases of iHia infection admitted between 2006 and 2015. Children who had Hia isolated from a normally sterile site (blood, cerebrospinal fluid, joint fluid) were identified from laboratory records. Data on iHia infections in Quebec were obtained from the INSPQ. Population data were obtained from Statistics Canada and the Institut de la statistique du Québec.

Results: Between January 2009 and December 2015, 19 children with invasive Hia infection were admitted. All were aboriginal children from Northern Quebec.

Median duration of hospitalization was 7 days. Five patients were transferred to the pediatric intensive care unit (PICU), for a median duration of 4 days The median age at admission was 14 months and for those transferred to the PICU was 9 months. There were 9 cases of meningitis, 9 of osteoarticular infection and one of bacteremic pneumonia. Two patients with meningitis died.

For 2013, rates of iHia infection per 100 000 persons were 82.7, 21.2 and 0.05 for Nunavik, James Bay Cree territory and the whole province, respectively. For the same year, Nunavik and James Bay Cree territory rates were 364. 5 for children less than one year of age and 235.2 for those aged 1 to 4 years.

Conclusions/Implications for immunization research and evaluation: Invasive Hia infection is a significant health threat to aboriginal children living in Northern Quebec, with infection rates similar to those reported for Haemophilus influenza b in the pre-vaccine era. A vaccine is needed. Meanwhile, information about carriage and secondary infection rates could help inform recommendations for antibiotic prophylaxis.

VACCINE UPTAKE AND ACCEPTANCE – SESSION 1

Thursday December 8 | **11:00 – 12:30** | **Room 201**

What causes changes in mothers' vaccine hesitancy over time? – *Devon Greyson*

Co-authors: *Julie Bettinger, Gina Ogilvie, Simon Dobson*

Introduction/Background: Some parents experience changes in vaccine hesitancy over time, leading to shifts in vaccination behaviour. A family may vaccinate previously unvaccinated children or, alternatively, cease vaccinating after previously following immunization recommendations. In order to effectively intervene to improve vaccine uptake, we must understand what causes these changes in parental vaccine hesitancy. This qualitative study retrospectively explored shifts in vaccine hesitancy over time among a group of mothers of school-aged children in Greater Vancouver, British Columbia.

Methods: Parents whose attitudes toward vaccination had changed since their school-aged (6-12 years) children were infants were recruited via primary schools in Greater Vancouver and via Facebook. Data was collected via semi-structured individual interviews in community settings, and analyzed using constructivist grounded theory.

Results: We interviewed 23 mothers, of whom 9 had become less vaccine hesitant over time, 9 had become more hesitant, and 5 had experienced multiple changes in vaccine attitudes since their children were born.

Mothers who were initially hesitant described feeling fear, anxiety, and confusion when deciding about infant immunization. Key factors in decreasing hesitancy over time included positive immunization experiences, positive trust relationships with healthcare providers, and consistent and verifiable vaccine safety and effectiveness information that was possible to triangulate among trusted sources. Key events occasionally caused a rapid change in attitudes, for example outbreaks of vaccine preventable disease.

Mothers who were initially accepting yet became hesitant over time commonly experienced a lack of healthcare provider support or clear guidance following a child's AEFI and/or diagnosis of a chronic health condition of unknown etiology (e.g., autism, autoimmune diseases). Peer group attitudes (online and offline) and media

narratives sometimes encouraged hesitancy, and this was most salient for mothers who already felt that their concerns had not been adequately addressed by healthcare providers.

Conclusions/Implications for immunization research and evaluation: New mothers who are or might be vaccine hesitant need additional support and verifiable information regarding vaccination. Early identification and supportive intervention by healthcare providers may ameliorate hesitancy. In addition, adequate attention and time to address mother's concerns regarding an AEFI or chronic health condition may be key to minimizing vaccine hesitancy in time for children to be fully vaccinated before adolescence.

Maternal perceptions of childhood vaccination: Reasons for and against – *Melissa Mueller*

Co-authors: *Deborah A. McNeil, Shannon MacDonald, Sheila McDonald, Vineet Saini, James D. Kellner, Suzanne Tough*

Introduction/Background: Understanding reasons for and against vaccination from the parental perspective is a critical component for designing vaccination campaigns and informing other interventions to increase vaccination uptake. The objective of this study was to understand maternal vaccination decision making for children.

Methods: Mothers participating in the longitudinal community-based pregnancy cohort study, the All Our Babies study in Calgary, Alberta, completed open-ended survey questions on reasons for vaccinating or delaying/not vaccinating their child by 24 months postpartum. One team member, using content analysis, identified codes and categories and the remaining team developed sub-themes and themes. Qualitative responses were also linked to administrative vaccination records to examine survey responses and recorded vaccination status (none, partial, complete, missing).

Results: Open-ended responses were available from 1560 women at 24 months postpartum; 89% (n=1391) provided reasons for vaccinating, 5% (n=79) provided reasons for not vaccinating/delaying, and 6% (n=90) provided reasons for both. All three major themes and most sub-themes were the same regardless of a mother's vaccination decision, however; interpretation was different depending upon a mother's decision. Three broad themes were: 1) Influencers on decision making which included personal, family, and external experiences. 2) Reasons common to both perspectives were risk, research, effectiveness, and balancing risks and benefits. Responsibility was a reason for those vaccinating; while choice, instrumental/practical, and health issues were the reasons for those not vaccinating or delaying. 3) Context of decision making encompassed a mother's level of conviction and motivation. External or internal motivation was evident in 40% of respondents while a strong level of conviction either for or against vaccination was evident in approximately 50% of respondents. Of those who provided reasons for vaccinating (n=1391), the majority (81%) were completely vaccinated.

Conclusions/Implications for immunization research and evaluation: Immunization decision making is complex and can be impacted by interplay of many factors that are similar but contribute to different decisions depending on mothers' perspectives. The results of this study can help inform nuanced strategies to target interventions or strategies. Examples include: addressing maternal knowledge gaps related to risks and benefits; enhancing paradigms of collective responsibility; and addressing instrumental barriers through vaccine delivery systems or approaches.

Is the pre-natal period an underutilized opportunity for initiating communication with parents about pediatric vaccinations? – *Clara Rubincam*

Co-authors: *Julie Bettinger, Constance Haselden, Devon Greyson, Robin Saunders*

Introduction/Background: Vaccines are the most effective way to prevent many communicable diseases, yet immunization rates in British Columbia are below the level required to mitigate outbreaks of some infectious diseases. This can be partly explained by some parents' doubts and concerns about pediatric vaccinations,

termed 'vaccine hesitancy'. Numerous interventions have attempted to address these concerns by focusing on communication between physicians and parents when the child is several months old. Yet there is evidence that some parents make decisions about their child's vaccinations prior to the first mention of vaccines in their family doctors' offices or public health clinics, raising the question: Is the pre-natal period an underutilized opportunity for initiating communication with parents about pediatric vaccinations?

Methods: This longitudinal qualitative study employed a sequence of in-depth interviews with pregnant women (n=19) from the Greater Victoria, B.C. area at two distinct time periods: first, in their last trimester of pregnancy and second, when their babies were 3-4 months old to explore when and how mothers form their intentions to vaccinate their children. Interviews were digitally recorded and transcribed before being coded using both the inductive principles of modified grounded theory and deductive principles based on existing literature on the role of trust in shaping health care decisions.

Results: The majority of women in the study reported forming their intentions regarding vaccination prior to or during the pre-natal period. Women reported a strong, trusting relationship with their maternity care providers and described being receptive to health care provider recommendations about vaccinations going forward. Yet few of their maternity care providers had initiated any communication about vaccination during the pre-natal period, meaning that many women formed their intentions without the advice or consultation of a health care professional.

Conclusions/Implications for immunization research and evaluation: Results suggest that the pre-natal phase constitutes a potential missed opportunity for maternity care providers to provide pertinent information to women about pediatric vaccinations and address any pre-existing concerns or questions before the child is born. Further research on key barriers and facilitators of communicating about vaccination for maternity care providers should be undertaken.

Who and what do vaccine rejecting parents' trust when making vaccination decisions? A qualitative study in WA and SA, Australia – *Samantha Meyer*

Co-authors: *Katie Atwell, Julie Leask, Pippa Rokkas, Paul Ward*

Introduction/Background: Although from a public health point of view, childhood immunization appears to be win-win in attempting to provide protection to individuals and communities, some parents decide not to immunize their children with some or all vaccines for reasons including lack of trust in government, health professionals and vaccine manufacturers. We explored in-depth the reasons underpinning individual perceptions of trust in vaccinations, healthcare professionals and the variety of social systems that influence the structure and function of immunization programs.

Methods: We interviewed 21 parents in urban parts of Fremantle, Western Australia (September 2013-April 2014) and Adelaide, South Australia (October-December 2015), who had chosen not to vaccinate, or to partially vaccinate their children. In our analysis, we applied deductive social theoretical reasoning on how people engage with expert systems in late modernity. We focused on participants' interactions with the allopathic healthcare system and other systems, and notions of (dis)trust. This analysis involved developing a visual representation of expert systems as encountered and/or constructed by participants.

Results: Parental distrust of childhood vaccinations was framed through distrust of pharmaceutical companies and the profit motive. Parents believed "pharma" influenced most of the systems that make vaccination policy happen: research, health professionals and government. This has direct implications for trust, with participants seeing vaccine recommendations in conflict with the interests of their child, and 'the system' underscored by malign intent, even if individual representatives of this system were not equally tainted.

Conclusions/Implications for immunization research and evaluation: Vaccine rejecting parents in our dataset convey a perception of vaccination expert systems as tainted by the profit motive of pharmaceutical companies. It is not possible to say whether this finding dominated the interview discussions because it formed a genuine

basis for decision-making, or whether it instead served as a salient rationale for this decision in a context in which non-vaccination is framed (in mainstream Australian society) as 'deviant.' This context provides shaky ground for experts seeking to (re)build trust, but avenues such as a no-fault compensation scheme and publicising policy development processes may prove fruitful in Australia.

A geography-based equity approach to increasing childhood immunizations in the Winnipeg Health Region – *Bunmi Fatoye*

Co-authors: *Shelley Marshall, Marjolyn Caton, Kristie Hastie, Carol Kurbis, Souradet Shaw, Chris Green*

Introduction/Problem identification: Childhood immunization rates for school entry (at 7 years) in the Winnipeg Health Region are lower than the provincial average. Lower immunization rates are seen in areas with low socio-economic status. There is a 24% gap in rates between neighborhoods with higher and lower rates. Winnipeg has recently experienced vaccine- preventable disease outbreaks in its school age population.

Purpose: To reduce the inequity gap by (1) Using geographic analysis to identify areas of greatest socio-economic disadvantage and lower immunization rates. (2) Conducting a qualitative analysis to increase understanding of the barriers to and facilitators of childhood immunization, (3) Pilot an immunization intervention using the knowledge from (1) and (2) above.

Methods/Evidence: Eleven neighborhood-level target areas were identified by mapping of seven- year- olds residing in areas with lowest immunization coverage rates and greatest socio-economic disadvantage. Semi-structured interviews of 17 parents / legal guardians and two child protection agents were undertaken; as well a focused conversation with child protection stakeholders (n=15) on the barriers and facilitators to immunization. Immunization clinics at 15 sites took place with the complementary use of an outreach worker. Evaluation of the clinic sites with intervention will be compared to sites with no clinic intervention.

Significance of Findings/Outcomes for immunization research and evaluation: Factors facilitating immunization include immunization awareness, and confidence in the health care provider, in particular physicians.

Barriers to immunization include lack of knowledge on when to get immunized, language/communication difficulties, safety concerns with vaccines, lack of proximity to a primary care physician, presence of other family priorities such as financial and food stability as well as challenges with accessing primary care for children in care.

Opportunities identified for increasing immunization coverage include using non- healthcare related settings such as churches and grocery stores as settings to promote immunization, offering immunizations to grade 1 students in schools, and shared responsibility between health and child protection agencies to redress low childhood immunization rates.

VACCINE UPTAKE AND ACCEPTANCE – SESSION 2

Thursday, December 8 **11:00 – 12:30** **Room 202**

Mapping vaccine history: Establishing a positive web presence for the Canadian context – *Heather MacDougall*

Co-authors: *Monica Brown, Laurence Monnais*

Introduction/Background: Although Canada has maintained reasonably high levels of childhood vaccination, the need to address the problem of waning public confidence in vaccination remains a priority. Scholarly and public debates have typically focused on the negative influence of anti-vaccination activity online. The more recent shift toward thinking about the current context in terms of vaccine hesitancy, however, has been accompanied by an interest in increasing the profile of vaccine acceptance online. In the United States, for example, the College of Surgeons and Physicians of Philadelphia has created the award-winning *History of Vaccines* website.

An educational resource, the site uses the methods of historical research to increase public knowledge about the positive impact of immunization on human health.

Methods: This presentation discusses the development of *Vaccine History: Canada and Beyond*, an educational website that documents the introduction of modern vaccines across Canada. The website emerges out of a broader, cross-Canada study of the introduction of measles and MMR vaccines in multiple Canadian provinces. Drawing on multiple historical sources, including archival records, news sources, journal articles, books, and educational and promotional materials, this qualitative study uses the methods of rhetorical and discourse analysis to identify key events in the history of immunization in Canada.

Results: This presentation describes the translation of historical and archival research findings for expert and lay audiences, as part of the broader effort to transform the culture of online debates about immunization. It also demonstrates an innovative use of the web to enrich both expert and lay understandings of the history of immunization, and to reinforce knowledge and beliefs about the value of modern vaccines. Finally, the presentation demonstrates the potential for humanities research to transform the culture of immunization, both in Canada and beyond.

Conclusions/Implications for immunization research and evaluation: While anti-vaccination activity online has certainly had an impact on public attitudes and beliefs about immunization, many commentators also see the growing problem of vaccine hesitancy as tied to the public's increasing lack of familiarity with vaccine-preventable diseases. This presentation identifies an opportunity to remedy this situation and, in doing so, to potentially improve vaccine acceptance and uptake across Canada.

Vaccine Hesitancy in the Web 2.0 Era – *Maryline Vivion*

Introduction/Background: Vaccination is considered to be one of the greatest achievements of public health. In Quebec, vaccination is not mandatory and relies on parent's acceptance. Studies have shown an increase of negative attitude toward vaccination for parents and some of them are categorized as being ***hesitant*** regarding vaccination. Vaccine-hesitant parents may refuse some vaccines, but agree to others; they may delay vaccines or accept vaccines according to the recommended schedule, but be unsure in doing so. In Quebec, while less than 5% of parents have refused all vaccines for their children, one third could be categorized as being ***hesitant*** regarding vaccination. It is often argued that the omnipresence of anti-vaccination content on the Internet has contributed to the increase of vaccine hesitancy among parents. The aim of this doctoral project is to explore the link between Internet and vaccine hesitancy.

Methods: An online ethnography based on non-participant and participant observation has been conducted in 2015 on social media groups where discussion on vaccination occurred. (Facebook groups and Forums in websites for parents). In order to complete these observations, 18 interviews have been conducted with mothers from Quebec. Discussion threads from social media were downloaded and interviews were recorded and fully transcribed. Data collection has ended December 31st 2015. A content analysis is conducted with N'vivo 10 software.

Results: The Internet is now part of everyday life of every parent and the most common tool used by parents who want information about health. It is increasingly apparent that the Internet contributes to vaccine hesitancy. Moreover, with social media, parents can now be exposed to information on vaccination without having looked for it. On Internet groups, vaccination is a recurrent topic that can be sensitive. However, if some mothers take into consideration this information other mention that they cannot trust it.

Conclusions/Implications for immunization research and evaluation: This project will allow the development of appropriate communication strategies about vaccination that will correspond to Canadian parents' needs and interests. The efficacy of vaccination promotion interventions online is based on our understanding of how parents use the Internet and its role in their decision.

HPV vaccination uptake in Canada: A systematic review and meta-analysis – *Olatunji Obidiya*

Co-authors: *Yelena Bird, Razi Mahmood, Chijioke Nwankwo, John Moraros*

Background: Human papillomavirus (HPV) is the most common reproductive tract infection worldwide. HPV is a known risk factor for cervical and other cancers. Canada introduced a publicly funded HPV vaccination in 2006. However, HPV vaccination uptake is variable across Canada with some provinces not even having reportable data.

Objectives: The objectives of this study were to determine the HPV vaccine uptake in Canada and determine if disparities exist amongst different subpopulations by conducting a systematic review and meta-analysis. To the best of our knowledge, no such study has been conducted in the Canadian population.

Methods: A systematic literature search was conducted in Medline, PubMed, Cochrane Library, EMBASE, Global Health, Proquest Public Health, and JSTOR. Searches used keywords and Medical Subject Headings (MeSH) in four domains: HPV, Viral Vaccines, Uptake and Canada/Provinces. Articles had to satisfy the following criteria for inclusion: published in English, peer reviewed, publically available, included human Canadian population, involved HPV vaccination as an intervention, provided quantitative data regarding HPV vaccination uptake, and published from 2006 onwards. Articles' were step-wisely screened based on tittle, abstract and full text. Methodological quality was checked using a modified Newcastle Ottawa Scale and then data were extracted. For the meta-analysis, pooled and subgroup analysis were conducted using age, sex, type of vaccination program, risk for HPV infection, method of payment, study design, and study risk of bias as key variables.

Results: A total of 718 peer reviewed articles were initially identified but only 13 remained after screening and methodological quality check review. Of the included studies, 9 were longitudinal and 4 were cross-sectional. Overall, the risk of bias was determined to be low. Articles extracted had vaccination uptake rates ranging from 12% to 88%. Pooled random effects model showed an HPV vaccination uptake of 55.92% (95% CI: 44.874 to 66.653). Individuals who were young (< 18 years old), females, with a lower risk for HPV infection, in school based programs, that were publically funded were more likely to have been vaccinated against HPV.

Conclusion: Currently, a targeted HPV vaccination campaign for populations with higher burden of HPV infection and cervical cancer in Canada is lacking but very much needed. Such information can prove very useful to policy makers, practitioners, and other stakeholders and facilitate an increased uptake of forthcoming HPV immunization programs among vulnerable populations in Canada.

A Canadian approach to the community health worker: Improving equity in immunization coverage rates in Saskatoon – *Simon Kapaj*

Co-authors: *Risa Ledray, Terry Dunlop*

Background: Since 2006, concerted efforts have been made in Saskatoon Health Region (SHR) to increase preschool immunization rates and reduce neighborhood level disparities. The role of Community Program Builder (CPB) was implemented in 2010. SHR strives to apply representative workforce principles, hiring CPB's from the community who: are trusted role models, can have positive influences in the health-care field, and increase uptake of services. CPB's work collaboratively with diverse and marginalized populations and community partners in the least advantaged neighborhoods of SHR to facilitate transition from program supports to independence and community connections. Working with the Immunization and Building Health Equity Departments, CPB's follow children behind in routine childhood immunization. Immunization coverage rates comparing areas of most and least advantage are used as a proxy to measure population health, the Disparity Ratio, and health care service delivery.

Methods: Information Technology Analyst receives Panorama (provincial electronic immunization system) data extracts weekly to update the 'Done by 2' database, a Population and Public Health developed database which identifies children < 24 months who are behind > 1 month. CPB or PHN's in rural use the database to prioritize and identify 20-24 month olds requiring reminders/interventions, followed by < 20 month olds. Interventions

tracked include: phone calls, texts, personalized door knockers, home visits, discussion of barriers, provision of bus coupon or taxi vouchers, direct electronic booking option, letters, or joint home visit with PHN to immunize in the home. Updated personal information such as phone #, address, and immigration information is saved in Panorama.

Results: Data collected tracked the immunization disparity ratio between neighborhoods of most and least advantage, along with overall immunization coverage rates. In 2015, the Disparity ratio reached 1.1, the lowest reported in 10 years, indicating near equity. Between 2007 and 2015, an absolute average increase in coverage rates of 21% was achieved in the 14 least advantaged of 70 neighborhoods in SHR. One neighborhood, which was the least advantaged in both 2007 and 2015, has seen an average increase in immunization coverage rates of 30%. In 2007, there were 14 neighborhoods (with > 10 children behind) in SHR with coverage rates < 60%; in 2015, there were four. In 2007 there were seven neighborhoods with < 50% coverage; in 2015 there was one.

Conclusions/Implications for Immunization research and evaluation: The institution of CPB's to implement and track interventions using 'Done by 2' has demonstrated significant success in improving equity in immunization coverage rates. Refinements to the database, corrective actions, and new activities are monitored monthly. Overall targets for immunization coverage are also trending upwards.

Influenza immunization in Canadian healthcare personnel – *Sarah Buchan*

Co-author: *Jeff Kwong*

Introduction/Background: Influenza immunization coverage among Canadian healthcare personnel remains below national targets. Targeting this group is of particular importance given their elevated risk of influenza infection, role in transmission, and influence on patients' immunization status. We examined influenza immunization coverage in healthcare personnel in Canada, reasons for not being immunized, and the impact of "vaccinate-or-mask" influenza prevention policies.

Methods: In this national cross-sectional study, we pooled data from the 2007 to 2014 cycles of the Canadian Community Health Survey and restricted to respondents reporting a healthcare occupation (n=18,446). Using bootstrapped survey weights, we examined immunization coverage by occupation and by presence of vaccinate-or-mask policies, and reasons for not being immunized. We used modified Poisson regression to estimate the prevalence ratio (PR) of influenza immunization for healthcare occupations compared to the general working population.

Results: Across all survey cycles combined, 50% of healthcare personnel reported receiving seasonal influenza immunization during the past twelve months, although this varied by occupation (range: 4% to 72%). Compared to the general working population, family physicians and general practitioners were most likely to be immunized (PR=3.15; 95%CI, 2.76-3.59), while chiropractors, midwives, and practitioners of natural healing were least likely (PR=0.17; 95%CI, 0.10-0.30). Amongst those not immunized, the most frequently cited reason was the belief that influenza immunization is unnecessary. Introduction of vaccinate-or-mask policies was associated with increased healthcare personnel influenza immunization.

Conclusions/Implications for immunization research and evaluation: Healthcare personnel are more likely to be immunized against influenza than the general working population, but coverage remains suboptimal overall and we observed wide variation by occupation type. More efforts are needed to target specific healthcare occupations with very low coverage.