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Public Health Programs: Burden of Disease, Cost-Effectiveness Key Factors in Funding Decisions

Quebec City - Deciding on whether or not to publicly fund a vaccination program is a complex process and involves consultation with many different decision-makers. Here in Canada, the National Advisory Committee on Immunization (NACI) must first recommend a vaccine as being worthy of public funding. Even when a vaccine is recommended by NACI—as the rotavirus vaccines have been—the onus falls on the provinces and territories to pay for the program. Consequently, cost-effectiveness has become a major factor in the decision to publicly fund a vaccine. Examples of how this process functions as it relates to specific vaccines were discussed by experts here during at the CIC.

Funding a public health program requires economic assessment of that program and attempts must be made to quantify both the burden of illness and the impact that illness has on quality of life. In the case of rotavirus (RV) infection, it is also vital to quantify the impact that the illness has on parents, as they are very clearly involved in the care of children when they become sick with RV.

Burden of Disease

As reviewed by Dr. Nicole Le Saux, Children's Hospital of Eastern Ontario, London, the burden of RV infection in Canadian children is considerable. "This is not just a simple 2-day gastrointestinal infection, RV is a very significant infection that is also systemic in many cases," she emphasized. For example, Ford-Jones et al. (*Arch Pediatr Adolesc Med* 2000;154(6):586-93) followed approximately 400 children who were recruited from either child care centres or primary care physician (PCP) offices. Over an 8-month interval, 23% of the diarrheal illness seen in children was due to RV infection and much higher rates approaching 55% have been reported among children attending PCPs across Canada.

When RV testing is encouraged as it was in a 7-hospital study carried out in Quebec, RV was thought to cause approximately 71% of the diarrhea disease seen in hospitalized children. IMPACT (Immunization Monitoring Program, ACTIVE) data from 12 pediatric hospitals in which nurse monitors actively look for target diseases found that in 2005-2007, 1856 children had laboratory-confirmed RV infection, 1359 of them community-acquired, the rest hospital-acquired.

"These are mainly healthy children—they have no underlying illnesses—but are only admitted for their RV disease," Dr. Le Saux observed. Some 70% of those who were admitted in the IMPACT study had the "typical triad" of RV symptoms including diarrhea, vomiting and fever which typically last 6 to 8 days. RV is the most common hospital-acquired infection in most hospitals.

Given the burden of RV disease in Canadian children, Dr. Le Saux reviewed data from Brisson et al. who quantified quality-adjusted life-years (QALY) lost due to RV infection in infants and their parents. Overall, investigators estimated that there was a 6% reduction in quality of life when the child was sick with the RV infection or a QALY loss/1000 patients of 4.

"This QALY falls right in the middle of pneumonia where QALY lost is 4 to 6 and otitis media where the QALY lost is 5," Dr. Le Saux observed, "so this suggests that the impact of RV on quality of life is similar to pneumonia or otitis media."

Most of the health care costs for RV infection occur in the setting of the emergency department (ED) at a median direct cost to the hospital of \$179/child, or in the need for hospitalization at a median direct cost of \$1709.

Additionally, "most people have to take some time off to care for their child when they get sick," Dr. Le Saux noted. Out-of-pocket expenses plus the indirect cost of lost wages because parents have to stay home with the child significantly increase the total costs of treating 1 episode of RV infection to a median of \$2209 if a child needs to be hospitalized; \$675 for ED care; \$398 if a child requires a physician visit; and a similar amount even if a child does not receive any formal care.

"In our economic analysis, we conservatively assumed that most children required no medical care," Dr. Le Saux noted. "But based on a birth cohort of 354,000 children followed from birth to 5 years, 85% of whom we assumed would acquire RV infection by the age of 5, we estimated it would cost \$125 million over 5 years to treat RV infection," Dr. Le Saux told delegates. Their economic analysis also showed that the incremental cost/QALY gained with vaccination vs. no vaccination would be \$122,000 from a health care perspective for the 3-dose pentavalent vaccine and \$108,000 for the 2-dose monovalent vaccine. The use of cost/QALY allows the government, the primary

purchaser in a universal mass vaccination, to compare competing programs. In general, the lower the cost/QALY, the greater the likelihood of the program to be selected for implementation.

“If you are using either vaccine, it would be cost-saving from both a health care and a societal perspective to introduce universal vaccination against RV infection,” Dr. Le Saux concluded.

Experience Outside Canada

Certainly that has proven to be the case in the US where the pentavalent vaccine was approved in February 2006 for publicly funded programs and the monovalent vaccine in April 2008. By the fall of 2010, about 80% of infants had been vaccinated against RV. According to reports from 25 laboratories, the number of RV-positive tests dropped so precipitously between 2006 and 2010 that technically, the 2010 RV season did not exist, noted epidemiologist Daniel Payne, PhD, Centers for Disease Control and Prevention, Atlanta, Georgia.

“This is a disease that once plagued every ED and every hospital and it’s now virtually gone,” he informed listeners. Indeed, 9 independent US-based hospitals reported a reduction in RV cases between 84 and 95% in 2008 compared with the previous year. Importantly as well, there has been a significant herd immunity effect following the introduction of the RV vaccines.

Regarding the decline in RV acute gastroenteritis (GE) hospitalization rates in 2008 vs. 2006, Dr. Payne found that there was an 87% reduction in RV GE rates in infants between the ages of 6 and 12 months; a 96% reduction in infants and children between 1 and 2 years of age; and a 92% reduction in children between 2 and 3 years of age.

“We are also seeing that there are really significant cost savings as a result of this decline so the cost benefit from the vaccination program looks very solid as well,” Dr. Payne confirmed.

Success of Public Vaccine Programs

A very similar effect has been documented in Australia following its introduction of a publicly funded RV vaccination program in July 2007. Within 1 year, “we reached 85% coverage nationally,” stated Prof. Kristine Macartney, National Centre for Immunisation Research and Surveillance, Sydney, Australia. Compared to pre-vaccine years, hospitalizations due to RV GE have now dropped by 70 to 80% and more. “We’ve also had a reduction in nosocomial RV episodes,” she added, “and overall, these 2 vaccines have been incredibly well accepted by providers and parents.”

Dr. Paul Van Buynder, presently Deputy Chief Medical Officer, New Brunswick, was formerly director of communicable disease control for Western Australia when the country launched their RV vaccine campaign. He confirmed here at the CIC that the impact of the vaccines on the incidence of RV disease in the country has been “enormously impressive.” “We introduced both of the vaccines across Australia and the decrease in RV infection was much more dramatic than we expected from the clinical trials, so the RV vaccines are much more effective than we gave them credit for based on initial data,” he said in an interview.

The main distinguishing feature between the 2 vaccines is that the monovalent vaccine requires 2 doses and the pentavalent vaccine requires 3.

This feature may be important, as mentioned during the conference by Dr. Monika Naus, Associate Professor, School of Population & Public Health, University of British Columbia, Vancouver. Data on diphtheria, pertussis and tetanus (DPT) dose completion by 32 weeks of age—the same age as both RV vaccines must be completed—suggest that only about 75% of infants receive their third dose of the DPT vaccine. “This means if you have to give a 3-dose vaccine, you are going to reach a smaller proportion of children than you would if you were giving a 2-dose vaccine, so there is some advantage to the 2-dose vaccine schedule,” Dr. Naus noted. □

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