

ECONOMIC EVALUATION OF UNIVERSAL ROTAVIRUS VACCINATION OF INFANTS IN IRELAND

Background

- Rotavirus (RV) is the most common cause of acute gastroenteritis in Irish paediatric patients. The incidence of RV infections is highest in children between 6 and 24 months of age. Deaths in previously healthy infants due to RV infection are rare. However, RV causes a significant disease burden and the availability of a vaccine presents an opportunity to reduce the burden of illness associated with RV infection, such as reduced hospitalisations, A&E attendances and GP visits. A further benefit that would result from prevention of RV infection is improved health related quality of life (HRQoL) of infected children and their parents and the societal benefit of increased productivity due to less time off work to care for sick children. In April 2009, the World Health Organisation (WHO) announced a global recommendation that RV vaccines be included in national immunisation programmes. In June 2009, the National Immunisation Advisory Committee (NIAC) requested that the National Centre for Pharmacoeconomics (NCPE) conduct an evaluation of the cost-effectiveness of introducing a universal rotavirus vaccination programme of infants in Ireland.
- The purpose of this evaluation was to estimate the burden of illness due to RV infection in Ireland and to evaluate the cost-effectiveness of universal infant rotavirus vaccination compared to the current standard of care in Ireland of “no vaccination”.
- Two live oral vaccines which protect against RVGE were approved by the European Medicines Agency in 2006: Rotarix (GSK) and Rotateq (Sanofi Pasteur MSD). Rotarix is a monovalent live attenuated human vaccine which is given in two doses at 2 and 4 months. Rotateq is a pentavalent reassortant vaccine developed from live human and bovine parent rotavirus strains. It is given in three doses at 2, 4 and 6 months. Rotarix is included in the base case analysis of this evaluation. No recommendation was made as part of this evaluation as to which of the two licensed vaccines should be offered.

Method

- An independently developed cohort model, which was developed by the Health Protection Agency (HPA) in the UK, was adapted to the Irish setting by incorporating Irish epidemiological, resource utilisation and cost data. The model was also updated incorporating recent clinical trial data from the literature. In the Irish model we only consider the impact on health related quality of life (HRQoL) of the infected child in the base case analysis, whereas the UK model considers the impact of infection on HRQoL of the child and one parent in the base case. The parameters incorporated in the economic model were agreed with NIAC and, for the base case analysis, included:
 - HSE perspective
 - Impact on HRQoL of infected child only
 - Vaccine coverage 90%
 - Cost of vaccine (Rotarix) €40 per dose
 - Cost of administration €10 per dose
 - Vaccine efficacy: 100% in reducing hospitalisations and A&E attendances, 91.8% in reducing cases treated in primary care.
 - Outcome measure: Quality Adjusted Life Year (QALY)
 - Discount rate 4% for costs and benefits
 - Time horizon from birth to five years.

Results

- Under the base case assumptions, the model predicts that universal infant RV vaccination would prevent around 2,038 GP visits, 3,271 A&E attendances and 2,499 hospitalisations per year in children from birth to 5 years of age.
- RV is estimated to cost the HSE approximately € 5.52 million per year; with 84.0% of these costs due to hospitalisations, 15.6% due to A&E attendances and the remainder due to GP visits. Under the base case model assumptions, a vaccination programme would cost €6.54 million per year. However, €4.65 million would be offset by reducing healthcare resource use in managing RV infection.
- The results of this cost-effectiveness analysis suggest that, under the base case assumptions, introduction of universal RV vaccination to the National Childhood Immunisation programme would not be cost-effective from the perspective of the Irish healthcare payer. However, the evaluation highlights that universal RV vaccination could be cost-effective if a lower vaccine price and/or vaccine

administration fee was negotiated. The results of the evaluation are summarised as follows:

1. Healthcare payer perspective

- The ICER for Rotarix in the base case analysis, assuming HRQoL benefits for the infected child only, was estimated at **€111,076/QALY**.
- The cost per LYG was €11,100,166, reflecting the small number of deaths associated with RV. The main benefit to the HSE of introducing RV vaccination would be to reduce hospitalisations. The cost per hospitalisation avoided was estimated at €759.
- The inclusion of the impact on HRQoL of one and two parents resulted in vaccination becoming more cost-effective with ICERs of **€68,224/QALY** and **€49,232/QALY** respectively. However, even if the HRQoL benefits for two parents is included in the analysis, vaccination would still not be considered cost-effective compared to other technologies which are currently funded.
- When the impact of vaccination on those cases which do not seek medical attention is considered the vaccination programme becomes more cost-effective because the ICER estimate includes the improvement in HRQoL for all cases of RV infection. The ICER when all RV cases are considered (only including the HRQoL benefit for the child) is **€30,485/QALY**. Inclusion of the HRQoL benefit for the child and one parent results in an ICER of **€20,641/QALY** which would be considered cost-effective.
- The impact of the vaccine price on cost-effectiveness was explored in a sensitivity analysis. The vaccine would need to be priced below approximately **€28 per dose** for the ICER to fall below a threshold value of €20,000/QALY.

2. Societal Perspective

- Under the base case assumptions, assuming HRQoL benefits for the infected child only and including indirect costs associated with lost productivity due to time off work to care for a sick child, the ICER for Rotarix was estimated at **€71,499/QALY**.
- The inclusion of the impact on HRQoL of one and two parents resulted in vaccination becoming more cost-effective with ICERs of **€43,916/QALY** and **€31,690/QALY** respectively.
- Universal rotavirus vaccination would be cost saving (dominant) from the societal perspective, if we include those cases that do not seek medical attention in the analysis.

Sensitivity analysis

- A key hurdle for evaluating the cost-effectiveness of RV vaccines is the absence of knowledge about the local burden of disease. Our estimates of disease burden and costs combine input data from several sources and include multiple assumptions. Furthermore, there are other uncertainties in the data inputs, such as the utility values for the infected child and parents and vaccine effectiveness in the real world setting. Therefore the results are subject to a degree of uncertainty.
- The uncertainty in the estimates was explored in sensitivity analysis. The results were sensitive to the vaccine cost, administration cost, direct medical costs and incidence of RV infection. Although the results were sensitive to variation in the key parameters, the conclusion that RV vaccination, under base case assumptions, would not be considered cost-effective remained unchanged. The results of the probabilistic sensitivity analysis (PSA) confirm the conclusions from the base case analysis that RV vaccination, under base case assumptions, would not be cost-effective.

Conclusion

RV vaccination would not be considered a cost-effective use of resources in Ireland from a healthcare payer perspective. If a cost-effectiveness threshold of €45,000/QALY is acceptable to decision makers, RV vaccination would only be considered cost-effective if we include the HRQoL impact on those children that do not seek medical attention in the analysis. It would also be considered cost-effective at a €45,000/QALY threshold, if we include the HRQoL benefit for two parents for those infants seeking medical attention only and we adopt a societal perspective. If a cost-effectiveness threshold of €20,000/QALY is acceptable to decision makers, RV vaccination would only be considered cost-effective if we include those cases that do not seek medical attention and we adopt a societal perspective. Therefore, RV vaccination may be cost-effective at a lower cost of vaccination or if a wider perspective is considered.