EE182

COSTS AND HEALTH IMPACT OF WASTEWATER COMPARED TO CLINICAL SURVEILLANCE TO GUIDE RESPIRATORY SYNCYTIAL VIRUS PROPHYLAXIS IN CANADA

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Introduction

- Respiratory syncytial virus (RSV) is the leading viral cause of childhood bronchiolitis and pneumonia resulting in over 3 million hospitalizations and 100,000 deaths in children under 5 years of age annually[1,2]
- Wastewater-based surveillance (WBS) has proven an effective early warning system for high-consequence pathogens, including SARS-CoV-2, polio, mpox and influenza,[3] but has yet to be fully leveraged for RSV surveillance
- A Canadian study undertaken in Ontario recently reported that RSV-WBS resulted in a 12-day lead time of pediatric RSV hospitalization (RSVH) surge and 36-day lead time in defining the start to the pediatric RSV season *versus* clinical surveillance alone (CS)[4]
- These initial results suggest that WBS may provide an important, population-level, early warning signal to prime policy decision-makers to plan and implement timely RSV prevention strategies

Objective

- **To compare the costs and clinical consequences of WBS- *versus* CS-guided RSV prophylaxis programs in Ontario, Canada**

Methods

Cost-consequence model

- A cost-consequence model was developed that considered all infants aged <6 months at the start of the RSV season and eligible for nirsevimab prophylaxis (Table 1)
- Predicated on the recent Canadian study,[4] the RSV season was determined to start 1 month earlier using WBS than CS and, in both scenarios, last for 5 months

Table 1. Overall assumptions

- 68 wastewater testing locations across Ontario
  - In line with current testing being performed under the province of Ontario Wastewater Surveillance Initiative (WSI)
- Off-season sampling frequency (total of 7 months)
  - 1 sample *per* week *per* location
- On-season sampling rate (total of 5 months)
  - 5 samples *per* week *per* location

Prophylaxis inputs

- Nirsevimab efficacy at preventing RSVH, medically-attended emergency room/outpatient RSV infections (MARI) and subsequent respiratory morbidity (RM) was adjusted in the CS scenario by having 1 month at the no-prophylaxis rate (to reflect a one-month delay in timing of prophylaxis initiation *versus* WBS) (Table 2)

Table 2. Summary of prophylaxis inputs

	WBS	CS*
RSVH rate[5]		
- Nirsevimab	0.6%	0.8%
- No prophylaxis	1.6%	
MARI rate[5]		
- Nirsevimab	1.01% (OP) 0.17% (OP+ED+FU) 0.02% (ED+FU)	1.65% (OP) 0.28% (OP+ED+FU) 0.03% (ED+FU)
- No prophylaxis	4.2% (OP only); 0.72% (OP+ED+FU); 0.09% (ED+FU)	
RM rate[†,6]		
- Nirsevimab	18.4% (after RSVH) 5.4% (after MARI)	23.0% (after RSVH) 6.7% (after MARI)
- No prophylaxis	41.4% (after RSVH); 12.1% (after MARI)	

*Nirsevimab efficacy adjusted for 1 month delay in prophylaxis. †Assumed to be equivalent to that reported for palivizumab.[6]
CS: clinical surveillance; ED: emergency department; FU: follow-up; MARI: medically-attended RSV infection; OP: outpatients; RM: respiratory morbidity; RSVH: RSV-related hospitalization; WBS: wastewater-based surveillance

Methods [Cont.]

Cost inputs

- Assuming that RSV-WBS was added to an existing provincial WBS system, the cost was budgeted at CAN$76,840/year, whereas for setting-up a new system, the cost was $1.47m in the first year and $810,560 in subsequent years (Table 3)
- For CS, no additional costs were assumed

Table 3. WBS assumptions

Costs (CAN$) associated with RSV-WBS built upon an existing WBS program

- Cost of laboratory analyses of samples:
  - Off-season sampling rate (total 7 months): $9/sample
  - In-season sampling rate (total 5 months): $4/sample
- Cost of data verification and reporting: $3/sample

Costs (CAN$) associated with a new RSV-WBS that will monitor solely RSV, and no other viral pathogen targets

- Cost of collection and transport of samples: $35/sample
- Cost of laboratory analyses of samples:
  - Off-season sampling rate (total 7 months): $55/sample
  - In-season sampling rate (total 5 months): $45/sample
- Cost of data verification and reporting: $3/sample
- Capital cost associated with initiating WBS in new locations in Ontario
  - Cost of autosampler: for all locations, a one-time capital cost of $9000/location
  - Cost of autosampler installation: for all locations, a one-time capital cost of $400/location
  - Cost of coolers and sampling bottles: for all locations, a one-time capital cost of $350/location

RSV: respiratory syncytial virus; WBS: wastewater-based surveillance

- Other costs considered included (equivalent for both WBS and CS): nirsevimab; RSVH episode; intensive care unit episode; MARI episode; and RM episode/year (Table 4)

Table 4. Clinical costs

Item	Cost (CAN$)
Nirsevimab	• $952.28 for both 50mg and 100mg vials (dosing: 50mg for <5kg and 100mg for ≥5kg infants) • Nurse admin cost/injection: $14.37[7]
RSVH episode	$8,353[7]
ICU episode	$5,747[7]
MARI episode	$175 (Initial OP); $91 (FU OP); $337 (ED)[8,9]
RM episode/annum	$1,116[10]

Admin: administration; ED: emergency department; FU: follow-up; ICU: intensive care unit; MARI: medically-attended RSV infection; RM: respiratory morbidity; OP: outpatients; RSVH: RSV-related hospitalization

- All costs were in 2022 Canadian dollars with no discounting

Results

- Of 136,571 annual Ontario live births, 124,728 infants were estimated to be <6 months at the start of the RSV season and thereby eligible for nirsevimab prophylaxis
- Compared to CS, WBS was associated with savings of $2.1–3.5m in the first year and $13.7–16.6m over 1–3 years (Table 5)

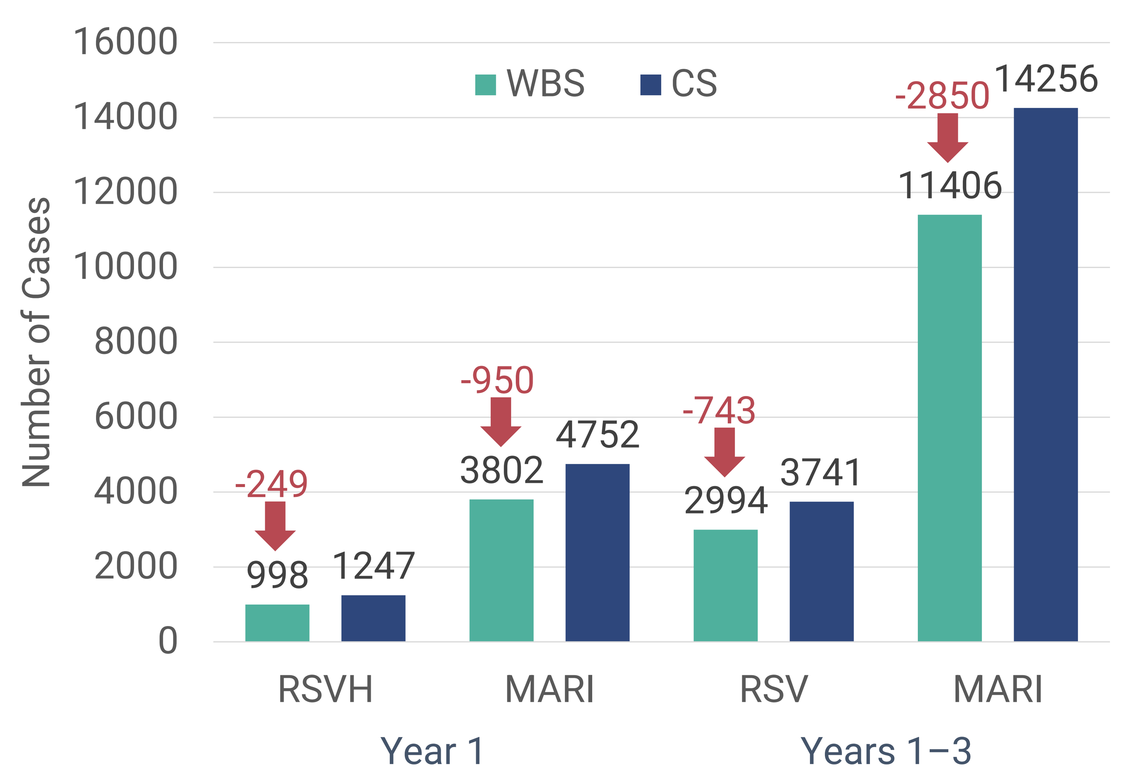
Table 5. Comparative costs from WBS- *versus* CS-guided prophylaxis programs in Ontario, Canada

	Year 1	Years 1–3
	Costs (CAN$)	
WBS	$96,865,669 [$98,262,389]	$264,344,436 [$267,208,596]
CS	$100,378,902	$280,925,634
Savings with WBS *vs* CS (%)	**-$3,513,233 (-3.5%)** [-$2,116,513 (-2.1%)]	**-$16,581,198 (-5.9%)** [-$13,717,038 (-4.9%)]

[ ] Assumes set up of a new WBS system.
CS: clinical surveillance; WBS: wastewater-based surveillance

- Importantly, WBS-guided prophylaxis resulted in 249 fewer RSVHs and 950 fewer MARIs *per* year *versus* CS-guided prophylaxis (Figure 1)

Figure 1. Comparative clinical outcomes from WBS- *versus* CS-guided prophylaxis programs in Ontario, Canada



CS: clinical surveillance; MARI: medically-attended RSV infection; RSVH: RSV-related hospitalization; WBS: wastewater-based surveillance

Limitations

- Key limitations include:
  - Benefits of RSV-WBS (*vs* CS) were based on a single RSV season across only two Canadian cities
  - Lack of data on the efficacy of nirsevimab against long-term RM

Conclusions

This simple model, covering one Canadian province and one preventive strategy, highlights the substantial benefit that WBS can potentially confer in this new era of RSV prevention

Further studies are required to prove that a WBS-based strategy is reproducible and valid throughout sequential RSV seasons and generalizable across communities

Once proven, a fully integrated and publicly-funded network of WBS initiatives across high-, middle- and low-income countries, affords a real opportunity for policy decision makers and public health agencies to intervene early and substantially reduce the devastating global burden of RSV in children by optimizing the timing of preventive measures

▶ **WBS** has the potential to **more accurately detect the start of the pediatric RSV season**, which could significantly **increase the effectiveness of prophylaxis** programs **while saving healthcare costs**

References

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