

Contrast of Prophylactically Protecting Canadian Health Care Workers and Emergency Service Providers: A Moderate Canadian Pandemic Mathematical Assessment

Life at Risk[®] Infectious Disease Study
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Presentation Structure

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Background to RiskAnalytica

- An independent group of risk managers, mathematicians, economists and health policy advisors
- Specialize in population-based simulations of health interventions
- Since 2003 has conducted over 60 health and economic studies for chronic disease, injury and infectious disease in Canada (e.g. 5 year contract with Health Canada to conduct yearly analysis)
- Past 12 months has seen the development of an infectious disease simulation platform working with an infectious expert panel:
 - Dr. Mark Loeb: Professor, Department of Pathology and Molecular Medicine, McMaster University;
 - Dr. Alison McGeer: Director Infection Control, Department of Microbiology, Mount Sinai Hospital;
 - Dr. Neil Simonsen: Canadian Science Centre for Human and Animal Health National Microbiology Laboratory.

Objective of the Study

- The role of health care workers (HCWs) and emergency service providers (ESPs) in administering care and essential services to the community are particularly vital during a pandemic.
- Canadian Pandemic Influenza Plan (CPIP) and the Task Group on Antiviral Prophylaxis (TGAP) do not recommend prophylaxis use of antivirals for ESPs and limited prophylaxis use is recommended for HCWs.
- Objective of this research study is to contrast the life and economic benefits associated with an additional antiviral stockpile that would allow for the prophylaxis of all Canadian HCWs and ESPs
- Study was prepared independently by RiskAnalytica at the request of Hoffmann-La Roche Canada Limited (Roche). At no time during the course of the study had Roche sought to influence the results or the way in which the results were reported.

Approach

- Deterministic SIIR (Susceptible, Infected, Infectious, Recovered) infectious disease model capable of antiviral intervention analysis was developed and integrated with a Canadian economic simulation model
- All model inputs supported by literature or Canadian Pandemic Influenza Plan
- Independent group of recognized Canadian infectious disease experts forming the Infectious Disease Advisory Board (IDAB) were consulted throughout the model development
- Independent group of frontline healthcare workers and emergency service providers were brought together to serve as a Pandemic Advisory Committee (PAC) which was consulted throughout this study
- Reduction of pandemic burden due to intervention (value proposition)
 - = Pandemic simulation (without intervention) – Pandemic simulation with intervention
- Performance of different interventions graded according to all combinations of* (1) reduced population deaths; (2) reduced hospitalizations; (3) reduced general practitioner visits; (4) HCW reduced deaths; (5) ESP reduced deaths; (6) HCW reduced absences; (7) ESP reduced absences; (8) net present value added from the intervention.

* Different performance measures represent different motivations. By testing results across all combinations of performance measures, the interventions that satisfy the most combinations of motivations are identified.

Key Assumptions

- A moderate pandemic that is antiviral sensitive. Underlying assumptions taken from literature
- Pandemic begins in the United States and Mexico simultaneously on 1st January 2010. Infectious individuals begin to enter Canada from the United States and Mexico according to a travel matrix.
- Canada is stratified into 37 regions (urban versus rural)
- No other public health measures adopted
- Travel is not restricted during a pandemic. A “travel matrix” was developed based on Statistics Canada’s Canadian travel survey
- Antivirals used when cumulative confirmed deaths due to novel influenza A in Canada reaches 20 in total
- Total Canadian antiviral stockpile on hand in 2009 of 80.98m doses.
 - National Stockpile: 55.7 million doses distributed on a per capita basis
 - Federal Stockpile: Back-up stockpile of 14.9 million doses distributed on a per capita basis
 - Ontario Stockpile: Sufficient to treat 25% of population. A portion comes from national stockpile while the remainder is an independent stockpile to meet the 25% (10.38m doses computed)
- Absenteeism assumptions taken from CPIP where relevant (e.g. proportion of sick people seeking treatment, absenteeism for caregiving, work avoidance)
- Impact of absenteeism on aggregate production set at output-hours elasticity of 60%

Utilization Scenarios of Current Antiviral Stockpile

- **Treatment Only, Tx:**
 - Antivirals for all sick who seek treatment from current stockpile while available
 - No post-exposure prophylaxis for anyone
 - No pre-exposure prophylaxis for anyone
- **TGAP Interpretation 1:**
 - Antivirals for all sick who seek treatment from current stockpile while available
 - Post-exposure prophylaxis for workers in closed facilities* only, from current stockpile while available
 - No pre-exposure prophylaxis for anyone
- **TGAP Interpretation 2:**
 - Antivirals for all sick who seek treatment from current stockpile while available
 - Post-exposure prophylaxis for workers and patients in closed facilities* only, from current stockpile while available
 - No pre-exposure prophylaxis for anyone

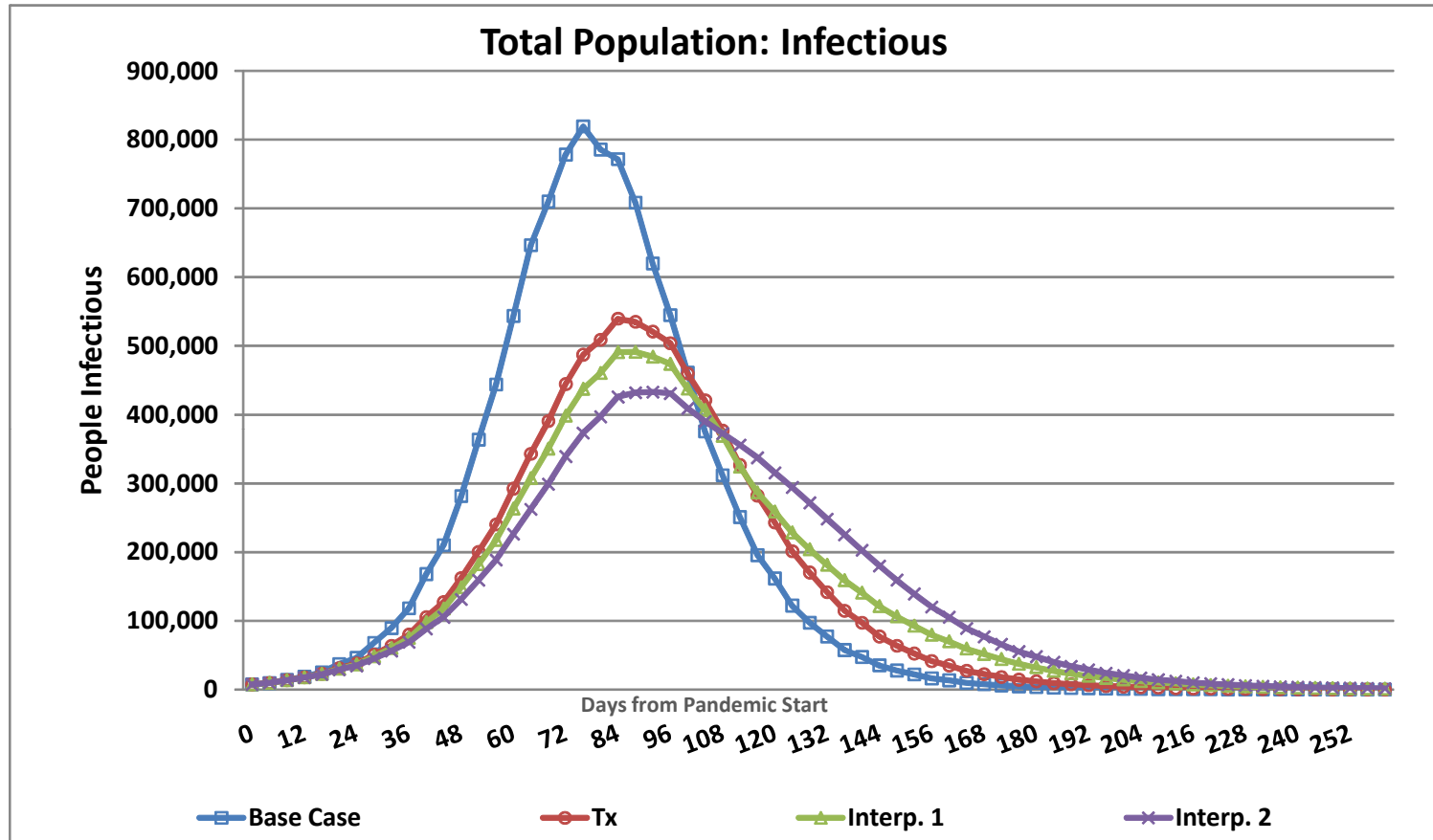
* Closed facilities include hospitals, LTC facilities, nursing homes, psychiatric institutions, correctional facilities.

Results of a Moderate Pandemic

Base Case Results for Total Population	Impact
Number Infected	11,162,574
Attack Rate	32.9%
Deaths (using 1957/58 age dependent case fatality rates)	16,800
Hospitalizations	66,961
General Practitioner Visits	5,393,801
2010 Societal Perspective of Cost of Pandemic	\$11.9 billion
2010 Government Perspective of Cost of Pandemic	\$4.5 billion
Base Case Results for HCW and ESP Populations	
Number Infected	238,875
Attack Rate	23.8%
Deaths (using 1957/58 age dependent case fatality rates)	90
HCW Peak Absenteeism	24.3%
ESP Peak Absenteeism	25.0%

Peak HCW absenteeism of 24.3% corresponds to a peak absence of 125,721 HCWs. Peak ESP absenteeism of 25.0% corresponds to a peak absence of 121,346 ESPs. PAC members had advised that ordinary service expectations could not be met during such peak absences, and that a pandemic would only exacerbate the challenges.

Results of Current Antiviral Stockpile Utilizations



	Base	Tx	Interp. 1	Interp. 2
Number Infected	11,162,574	9,005,811	9,141,152	9,336,120
Attack Rate	32.9%	26.5%	26.9%	27.5%
Deaths	16,800	10,152	10,635	11,650
Mortality CFR	0.15%	0.11%	0.12%	0.12%
Hospitalizations	66,961	51,481	52,771	54,408
GP Visits	5,393,801	4,351,644	4,417,041	4,511,251
Initial Stockpile	0	80,980,000	80,980,000	80,980,000

Results of Current Antiviral Stockpile Utilizations (cont.)

Reduction of Burden due to Current Stockpile Antiviral Use

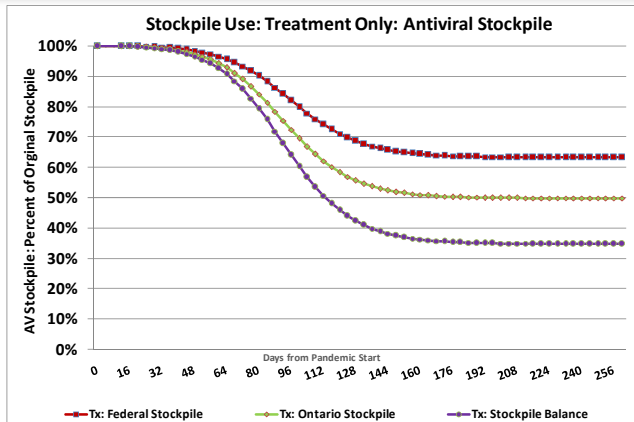
	Treatment only	TGAP Interpretation 1	TGAP Interpretation 2
Reduced Population Infected	-19.3% (-2,156,763)	-18.1% (-2,021,422)	-16.4% (-1,826,454)
Reduced Population Deaths	-39.6% (-6,648)	-36.7% (-6,165)	-30.7% (-5,150)
Reduced Hospitalizations	-23.1% (-15,480)	-21.2% (-14,190)	-18.7% (-12,553)
Reduced GP Visits	-19.3% (-1,042,157)	-18.1% (-976,759)	-16.4% (-882,550)
Reduction of Societal Economic Impact	-23.9% (-2.85 billion)	-22.6% (-2.70 billion)	-19.8% (-2.36 billion)
Reduced HCW Infections	-21.1% (-19,095)	-70.5% (-63,887)	-59.5% (-53,974)
Reduced HCW Deaths	-38.0% (-13)	-75.1% (-25)	-62.7% (-21)
Reduced HCW Peak Absenteeism	-20.2% (-25,369)	-41.8% (-52,589)	-43.3% (-54,488)
Reduced ESP Infections	-19.3% (-28,667)	-16.9% (-25,071)	-14.3% (-21,166)
Reduced ESP Deaths	-37.0% (-21)	-34.0% (-19)	-27.8% (-16)
Reduced ESP Peak Absenteeism	-20.7% (-25,102)	-23.7% (-28,760)	-27.5% (-33,411)

Ethical issue emerges for TGAP 1 and TGAP 2 as population health is traded for the health of HCWs.

The reduction of the burden of a moderate pandemic that accrues from the antiviral utilization scenario is indicated in parenthesis.

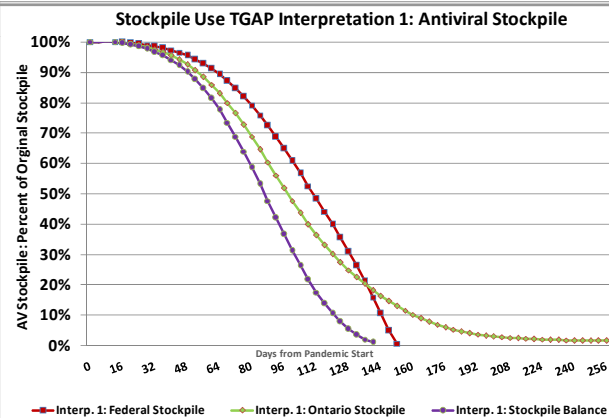
Reason Behind Ethical Issue: Current Antiviral Stockpile Depletions

Treatment Only



Sufficient stockpile to support a treatment only scenario, with 63.2% of the Federal stockpile, 49.8% of the Ontario stockpile and 34.7% of the balance of Canada stockpile left after the passing of the pandemic.

TGAP Interpretation 1

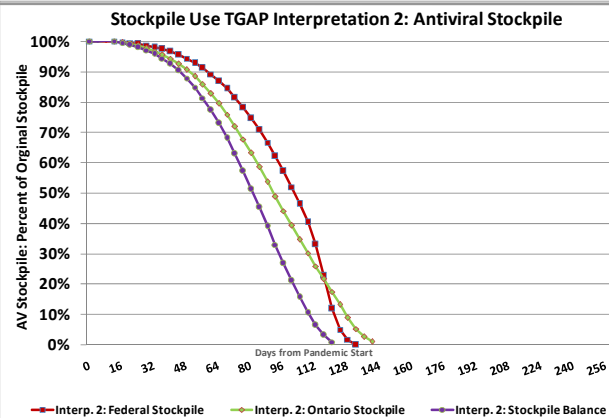


Federal stockpile runs out 152-156 days after antiviral use initiated.

Ontario additional stockpile does not run out with 1.4% remaining (448,277 doses).

National stockpile for the rest of Canada runs out 140-144 days after antiviral use initiated.

TGAP Interpretation 2



Federal stockpile runs out 128-132 days after antiviral use initiated.

Ontario additional stockpile runs out 140-144 days after antiviral use initiated.

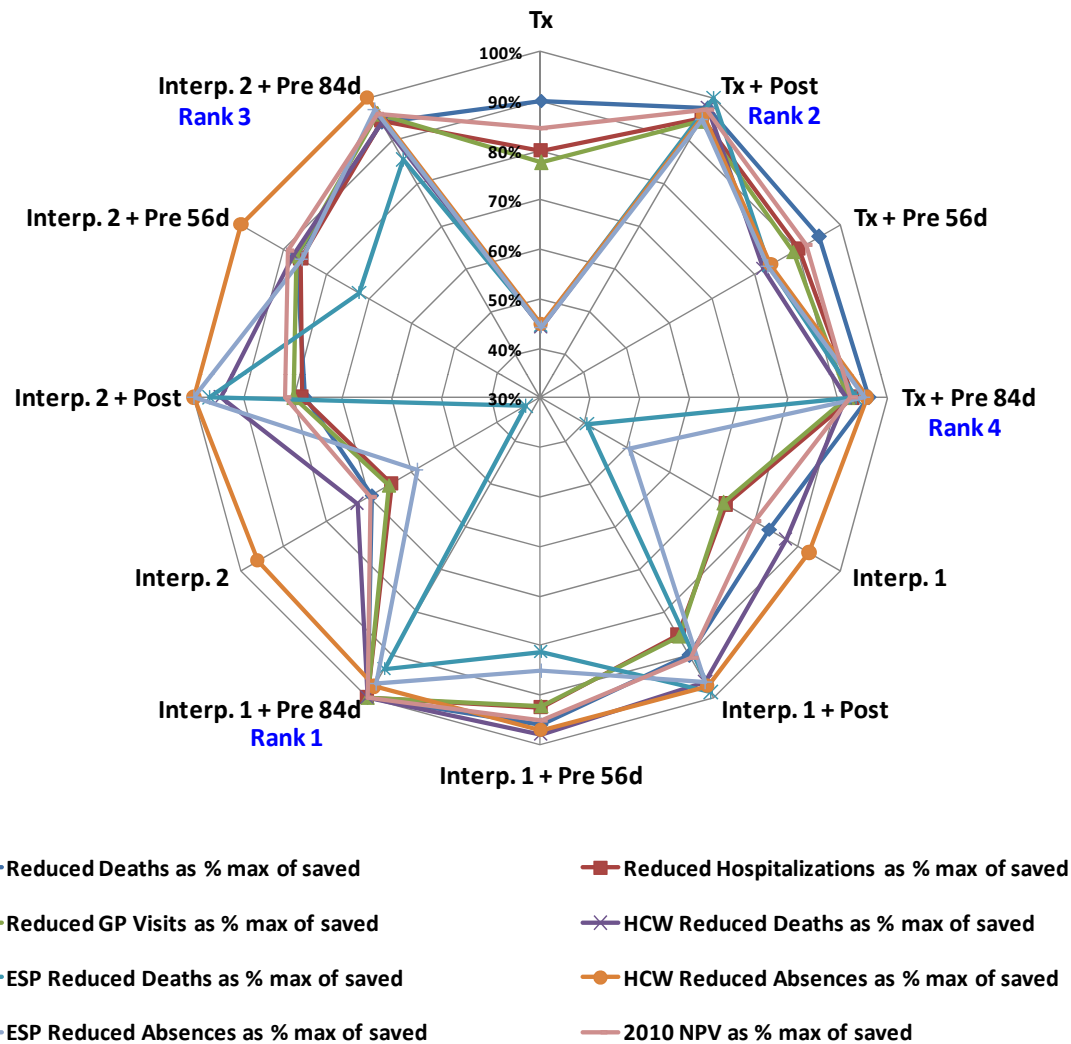
National stockpile for the rest of Canada runs out 120-124 days after antiviral use initiated.

Additional Antiviral Scenarios Tested

- Current Canadian stockpile used as treatment only (Tx) plus:
 - Additional antiviral stockpile of 51.04m doses for post-exposure prophylaxis of all HCWs and ESPs after high risk contact (Tx + Post).
 - Additional antiviral stockpile of 53.78m doses for 56 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 64 days after 20 cumulative Canadian deaths (Tx + Pre 56days)
 - Additional antiviral stockpile of 82.77m doses for 84 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 48 days after 20 cumulative Canadian deaths (Tx + Pre 84days)
- Current Canadian stockpile used as TGAP Interpretation 1 (TGAP1) plus:
 - Additional antiviral stockpile of 28.07m doses for post-exposure prophylaxis of all HCWs and ESPs after high risk contact (TGAP1 + Post).
 - Additional antiviral stockpile of 54.42m doses for 56 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 64 days after 20 cumulative Canadian deaths (TGAP1 + Pre 56days)
 - Additional antiviral stockpile of 83.15m doses for 84 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 48 days after 20 cumulative Canadian deaths (TGAP1 + Pre 84days)
- Current Canadian stockpile used as TGAP Interpretation 2 (TGAP2) plus:
 - Additional antiviral stockpile of 37.23m doses for post-exposure prophylaxis of all HCWs and ESPs after high risk contact (TGAP2 + Post).
 - Additional antiviral stockpile of 54.41m doses for 56 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 64 days after 20 cumulative Canadian deaths (TGAP2 + Pre 56days)
 - Additional antiviral stockpile of 83.07m doses for 84 day pre-exposure prophylaxis of all HCWs and ESPs. Prophylaxis starts 48 days after 20 cumulative Canadian deaths (TGAP2 + Pre 84days)

Relative Performance of Scenarios

Relative Performance of Antiviral Use Scenarios



Relative comparison on results across 8 different evaluation measures

The more points near the boundary of the web the better.

Four top ranked scenarios were:

1. TGAP1 + Pre 84days
2. Tx + Post
3. TGAP2 + Pre 84days
4. TX + Pre 84days

Results of Additional Antiviral Scenarios: Incremental

Incremental reduction of a pandemic burden for society: Four top ranked antiviral utilization scenarios

	TGAP Interpretation 1 plus Pre 84days % Change to Treatment only	Treatment only plus Post % Change to Treatment only	TGAP Interpretation 2 plus Pre 84 days % Change to Treatment only	Treatment only plus Pre 84 days % Change to Treatment only
Further Reduced Population Infected	-5.6% (-628,808)	-4.2% (-472,165)	-4.6% (-518,699)	-3.6% (-406,515)
Further Reduced Population Deaths	-4.5% (-750)	-3.3% (-558)	-1.9% (-321)	-2.8% (-479)
Further Reduced Hospitalizations	-5.8% (-3,890)	-4.4% (-2,955)	-4.2% (-2,836)	-3.8% (-2,539)
Further Reduced GP Visits	-5.6% (-303,839)	-4.2% (-228,152)	-4.6% (-250,631)	-3.6% (-196,430)
Further Reduction of Societal Economic Impact	-4.4% (-521m)	-3.5% (-\$421m)	-3.3% (-394m)	-2.3% (-270m)

Incremental results measures the net benefit of the additional stockpile over and above the current stockpile (used as treatment only).

	TGAP Interpretation 1 plus Pre 84days % Change to Treatment only	Treatment only plus Post % Change to Treatment only	TGAP Interpretation 2 plus Pre 84 days % Change to Treatment only	Treatment only plus Pre 84 days % Change to Treatment only
Further Reduced HCW Infections	-61.0% (-55,299)	-58.2% (-52,768)	-56.3% (-51,039)	-51.7% (-46,848)
Further Reduced HCW Deaths	-48.1% (-16)	-46.0% (-15)	-43.0% (-14)	-40.9% (-14)
Further Reduced HCW Peak Absenteeism	-23.8% (-29,927)	-23.0% (-28,926)	-24.9% (-31,349)	-23.1% (-29,012)
Further Reduced ESP Infections	-51.1% (-75,770)	-58.3% (-86,388)	-44.6% (-66,073)	-51.4% (-76,190)
Further Reduced ESP Deaths	-40.5% (-23)	-46.1% (-26)	-34.0% (-19)	-40.8% (-23)
Further Reduced ESP Peak Absenteeism	-24.5% (-29,791)	-23.7% (-28,699)	-24.7% (-29,961)	-23.8% (-28,893)

Results of Additional Antiviral Scenarios: Incremental Payback

Societal payback: Four top ranked antiviral utilization scenarios

Societal Payback on Additional Stockpile Cost	TGAP Interpretation 1 plus Pre 84days	Treatment only plus Post	TGAP Interpretation 2 plus Pre 84 days	Treatment only plus Pre 84 days
Societal Payback if Pandemic in 2010	3.20 times (+\$679m)	3.23 times (+\$421m)	4.19 times (+\$889m)	1.28 times (+\$270m)
Societal Payback if Pandemic in 2015	4.89 times (+\$1,039m)	3.57 times (+\$465m)	4.60 times (+\$976m)	1.45 times (+\$307m)
Societal Payback if Pandemic in 2020	2.07 times (+\$658m)	2.10 times (+\$409m)	2.80 times (+\$888m)	0.67 times (+\$210m)

Incremental payback of the additional stockpile.

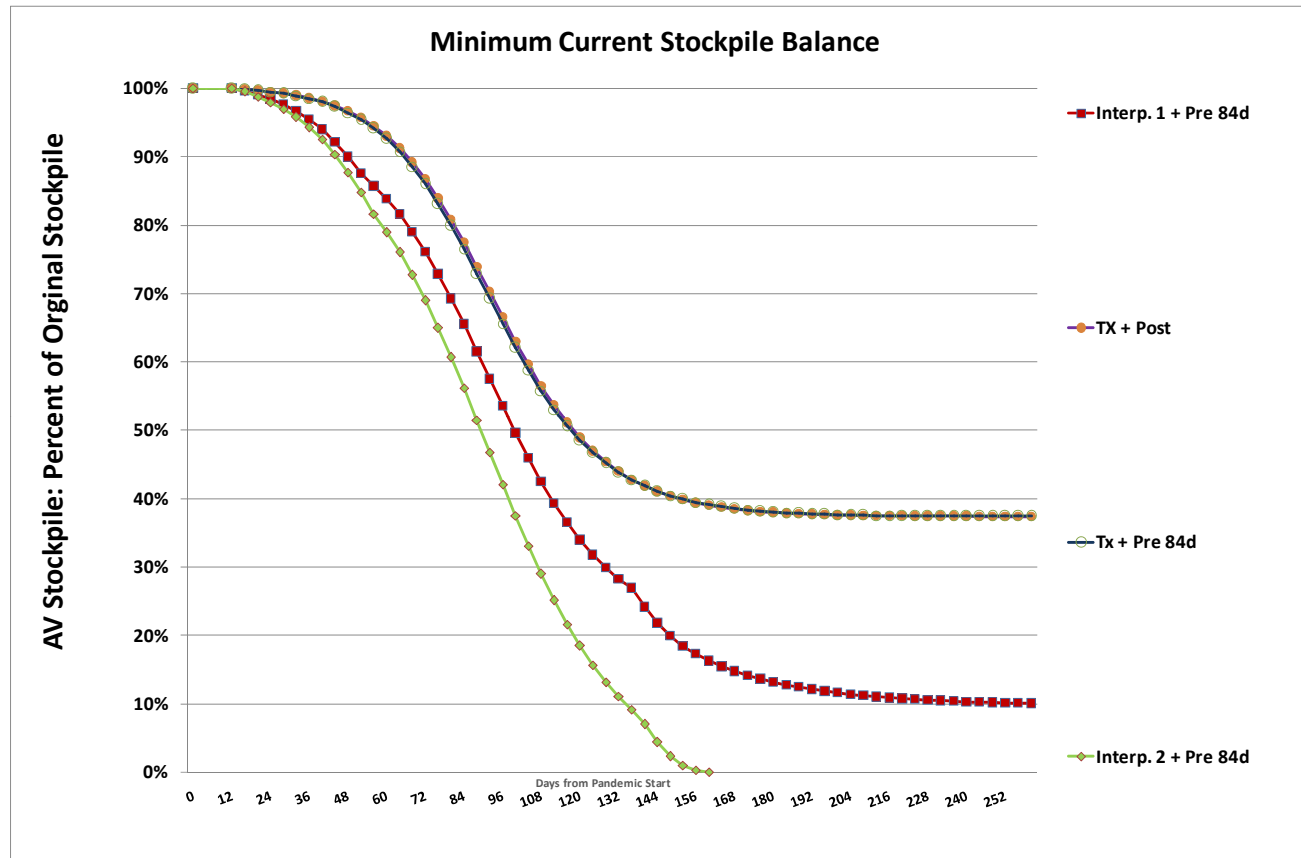
Net present value payback measures the economic benefits as a ratio of the cost of the intervention:

- Payback of zero indicates the intervention's ability to "pay for itself".
- Payback of greater than zero indicates the intervention's ability to generate excess returns.
- Payback of less than zero indicates a net cost of the investment.

Government payback: Four top ranked antiviral utilization scenarios

Government Payback on Additional Stockpile Cost	TGAP Interpretation 1 plus Pre 84days	Treatment only plus Post	TGAP Interpretation 2 plus Pre 84 days	Treatment only plus Pre 84 days
Government Payback if Pandemic in 2010	0.57 times (+\$121m)	0.58 times (+\$75m)	0.91 times (+\$193m)	-0.15 times (-\$33m)
Government Payback if Pandemic in 2015	1.16 times (+\$247m)	0.70 times (+\$92m)	1.06 times (+\$226m)	-0.09 times (-\$18m)
Government Payback if Pandemic in 2020	0.15 times (+\$46m)	0.15 times (+\$29m)	0.39 times (+\$125m)	-0.38 times (-\$121m)

Current Antiviral Stockpile Depletions under Additional Stockpile Assumptions



Note that TX + Post and TX + Pre 84 days have similar impacts upon the current antiviral stockpile depletion rates.

The current stockpile of 80.98 million doses does not run-out during the course of the pandemic under the scenarios of:

- TGAP 1 + Pre 84 days
- Tx + Post
- Tx + Pre 84 days

Mitigates any potential ethical issue for community leaders as the benefits of protecting HCWs and ESPs are congruent with population health impacts.

Current stockpile still runs out under TGAP 2 + Pre 84 days at 160-164 days after antiviral use initiated.

Results of Additional Antiviral Scenarios: Totals

Total reduction of a pandemic burden for society: Four top ranked antiviral utilization scenarios

	TGAP Interpretation 1 plus Pre 84days	Treatment only plus Post	TGAP Interpretation 2 plus Pre 84 days	Treatment only plus Pre 84 days
Population Infected	-25.0% (-2,785,571)	-23.6% (-2,628,928)	-24.0% (-2,675,463)	-23.0% (-2,563,278)
Reduced Population Deaths	-44.0% (-7,398)	-42.9% (-7,206)	-41.5% (-6,969)	-42.4% (-7,127)
Reduced Hospitalizations	-28.9% (-19,370)	-27.5% (-18,435)	-27.4% (-18,317)	-26.9% (-18,019)
Reduced GP Visits	-25.0% (-1,345,996)	-23.6% (-1,270,309)	-24.0% (-1,292,788)	-23.0% (-1,238,586)
Reduction of Societal Economic Impact	-28.3% (-\$3.38 billion)	-27.4% (-\$3.28 billion)	-27.2% (-\$3.25 billion)	-26.2% (-\$3.12 billion)

Total results measures the total net benefit of the additional stockpile with the current stockpile

	TGAP Interpretation 1 plus Pre 84days	Treatment only plus Post	TGAP Interpretation 2 plus Pre 84 days	Treatment only plus Pre 84 days
Reduced HCW Infections	-82.1% (-74,395)	-79.3% (-71,863)	-77.4% (-70,135)	-72.8% (-65,944)
Reduced HCW Deaths	-86.1% (-29)	-84.0% (-28)	-81.0% (-27)	-78.9% (-26)
Reduced HCW Peak Absenteeism	-44.0% (-55,296)	-43.2% (-54,295)	-45.1% (-56,718)	-43.3% (-54,381)
Reduced ESP Infections	-70.5% (-104,437)	-77.6% (-115,055)	-63.9% (-94,740)	-70.7% (-104,857)
Reduced ESP Deaths	-77.5% (-44)	-83.1% (-47)	-71.1% (-40)	-77.8% (-44)
Reduced ESP Peak Absenteeism	-45.2% (-54,893)	-44.3% (-53,802)	-45.4% (-55,063)	-44.5% (-53,996)

Findings and Conclusions

- Under the assumptions, the results of this study suggest that the purchase of an additional antiviral stockpile for the purposes of either an 84 day pre-exposure prophylaxis or post-exposure prophylaxis for all HCWs and ESPs is a worthwhile investment.
- Measured against a current stockpile utilization of treatment only, the additional stockpile investment would incrementally reduce infections by 51-61%, reduce deaths by 40-48%, reduce expected peak absenteeism by 57,600 - 59,704 workers; and provide an incremental net present value gain for society in the range of \$421-\$521 million.
- An additional stockpile investment for all HCWs and ESPs represents a risk reduction strategy that would increase the protection of health care workers and emergency service providers with complementary benefits for the population as a whole (less infections, deaths, hospitalizations and general practitioner visits).

Regional Breakdown of Additional Stockpile

Additional Stockpile Amounts by Province (millions of doses)

		AB	BC	MB	NB	NL	NS	NWT	ON	PE	QC	SK	YK	Total for Canada
Rank 1	TGAP Interpretation 1 plus Pre 84days	8.727	10.958	2.959	1.908	1.341	2.361	0.179	32.372	0.340	19.457	2.458	0.087	83.146
Rank 2	Treatment only plus Post	5.282	6.578	1.770	1.133	0.791	1.399	0.111	20.254	0.200	12.011	1.461	0.052	51.043
Rank 3	TGAP Interpretation 2 plus Pre 84 days	8.719	10.948	2.956	1.906	1.340	2.359	0.179	32.340	0.340	19.438	2.456	0.087	83.068
Rank 4	Treatment only plus Pre 84 days	8.689	10.910	2.946	1.900	1.335	2.351	0.178	32.220	0.339	19.368	2.447	0.087	82.770

Additional Stockpile Amounts by Province (2009 estimated cost, \$ millions)

		AB	BC	MB	NB	NL	NS	NWT	ON	PE	QC	SK	YK	Total for Canada
Rank 1	TGAP Interpretation 1 plus Pre 84days	\$22.29	\$27.99	\$7.56	\$4.87	\$3.43	\$6.03	\$0.46	\$82.69	\$0.87	\$49.70	\$6.28	\$0.22	\$212.39
Rank 2	Treatment only plus Post	\$13.49	\$16.80	\$4.52	\$2.89	\$2.02	\$3.57	\$0.28	\$51.74	\$0.51	\$30.68	\$3.73	\$0.13	\$130.38
Rank 3	TGAP Interpretation 2 plus Pre 84 days	\$22.27	\$27.96	\$7.55	\$4.87	\$3.42	\$6.03	\$0.46	\$82.61	\$0.87	\$49.65	\$6.27	\$0.22	\$212.19
Rank 4	Treatment only plus Pre 84 days	\$22.20	\$27.87	\$7.52	\$4.85	\$3.41	\$6.01	\$0.46	\$82.30	\$0.87	\$49.47	\$6.25	\$0.22	\$211.43

Table of Model Assumptions

Item	Assumptions
Number, Date and Location of the Initial Infection	Pandemic begins in the United States on 1 st January 2010. Infectious individuals begin to enter Canada from the United States and Mexico according to travel matrix.
Contact Types	Close-contact interactions between individuals are considered. Individuals interact in mixing patterns of household, school, work and community based contacts. Contacts based on population based Multi-country (eight European countries) surveys across 15 age groups (Mossong 2008) ¹ had been adopted in the current model.
Population Types	Model tracks general public, patients in closed facilities, HCW (Health Care Workers) and ESP (Emergency Service Providers) are considered. The proportions and age structure had been adopted from CIHI's 2006/07 surveys ² .
Probability of Virus Transmission	The transmission probability is conditional upon contact with an infectious individual. The relative age group structure had been adopted from Haber <i>et al.</i> (2007) ³ based on 4 age groups (0-4, 5-18, 19-64, >65). The absolute transition probability had been obtained from the current calibration model under the constraint of a 33.4% attack rate.
Attack Rate	An overall 33.4% attack rate had been adopted from Longini <i>et al</i> (2004) ⁴ based on the US data from the 1957/1958 Asian flu pandemic. The attack rate is consistent with the values adopted by most other studies (most prominently, the CPIP).
Mortality Rate	An age-dependant (U shaped) population mortality is assumed based on the US data from the 1957/1958 Asian flu pandemic (Haber <i>et al.</i> 2007). This corresponds to an approximate case specific mortality of around 0.17%.
Average Latency	1.9 days (Expert advice from the Infectious Disease Advisory Board). Incubation period is assumed to be equal to the Latent period.
Average Recovery	4.1 days (Expert advice from the Infectious Disease Advisory Board). Symptomatic cases are always assumed to be Infectious.
Immunity (%)	No prior population immunity to the virus is assumed within the current model (Expert advice from the Infectious Disease Advisory Board)
Asymptomatic Cases	Assumed no asymptomatic cases (Expert advice from the Infectious Disease Advisory Board).

¹ Mossong J., Hens N., Beutels P., Auranen K., Mikolajczyk R., Massari M., Salmaso S., Tomba G., Wallinga J., Haijine J., Todys M., Rosinska M., Edmunds J., Social Contacts and mixing patterns relevant to the spread of infectious diseases, PLOS Medicine, March 2008, Volume 5, Issue 3, e74.

² Canada's Health Care Providers, 1997 to 2006, A Reference Guide . (2006). Retrieved from Canadian Institute for Health Information : http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=hhrdata_personnel_e

³ Haber M., Shay D., *et al.* Effectiveness of Interventions to reduce contact rates during a simulated influenza pandemic, EID Journal , Volume 13, Number 4, April 2007.

⁴ Longini I., Holloran E., Nizam A., Yang Y., Containing Pandemic Influenza with antiviral agents, American Journal of Epidemiology April 1 2004, Volume 159, number 7.

Table of Model Assumptions (continued)

Item	Assumptions
Travel and Migration	The migration patterns are adopted from CANSIM 2006 survey ¹ and are assumed to maintain Status Quo. No pandemic-based impacts upon the migration are assumed within the current model. Travel patterns are adopted from the 2004 Canadian Travel Survey and are likewise assumed to be maintained throughout the pandemic period.
Hospitalization Rate	Age dependent hospitalization rate (Source: Haber <i>et al.</i> (2007)).
Absenteeism	Three sources of absenteeism are computed within the current model ² : Due to influenza symptoms (computed within the model) Due to care giving (computed within the model based on CPIP recommendations) Due to prudence (based on CPIP recommendations) ³
GDP absenteeism impacts	Impact of absenteeism on output: aggregate production function with an output-hours elasticity of 0.6 used for absenteeism due to mortality, illness followed by recovery, caregiving and workplace avoidance ⁴ .
Antiviral use start date	Antivirals used when cumulative confirmed deaths due to novel influenza A reaches 20 for Canada in total.
Antiviral Resistance	A 0.4% resistance to antiviral drug use (among adults) is assumed (Source: TGAP report) ⁵
Antiviral Administration	Treatment administration rate is a function of the number of healthy HCW. If all HCW are healthy, mean time to administration is 1 day, if all HCW are sick, mean time to administration is 4.1 days (Average recovery time).
Antiviral Efficacy	Treatment is ineffective if administered more than 2 days after infectious stage begins, but given nonetheless (IDAB recommendation).
Pre-Exposure Start and Duration	56 days and 86 days. The optimization model solved for the start dates (days after cumulative deaths reaches 20 for Canada) that produces the minimum absenteeism for HCWs and ESPs.
Treatment Compliance	53% of people who are infectious will seek treatment ⁶
NESS Stockpile	Distributed across regions according to number of people requiring treatment and administered at half the rate of local stockpile (to account for delays in NESS stockpile redistribution).
HCW Contact and Infection Factor	Health care workers have 1.92 more contacts than public (this corresponds to contact rate which are similar to those in retail industry). They are no more likely to get sick than the general public, so probability of infection is reduced by the same factor. (Source: PAC recommendation).

¹ Canadian Travel Survey, Domestic Travel, 2004, Statistics Canada, Catalogue no. 87-212-XIE CANSIM 2008

² James, S.; Sargent, T. The Economic Impact of an Influenza Pandemic, Working Paper 2007-04; Finance Canada; December 12, 2006

³ The Canadian Pandemic Influenza Plan for the Health Sector, PHAC ([HTTP://WWW.PHAC-ASPC.GC.CA/CP/IP-PCLCPI/S02-ENG.PHP](http://www.phac-aspc.gc.ca/cpip-pclcpi/s02-eng.php))

⁴ James, S.; Sargent, T. The Economic Impact of an Influenza Pandemic, Working Paper 2007-04; Finance Canada; December 12, 2006

⁵ PAN-Canadian Public Health Network Council Report and Policy Recommendations on the use of Antivirals for Prophylaxis during an Influenza pandemic, June 2007.

⁶ Ontario Health Plan for an Influenza Pandemic August 2008 (OHPIP)

Table of Model Assumptions (continued)

Item	Assumptions
POST and PRE Compliance for HCW & EMS	Assumed 100% compliance.
Misdiagnosis Wastage	Assumed no wastage due to misdiagnosis.
Relative costs of POST and PRE Administration	No economic difference between distributing POST or PRE-Exposure prophylaxis.
Life and economic Impact of ESP Absenteeism	Assumed no impact as data was not available to support otherwise.
TGAP Proportions	92.5% of HCW are in “closed facilities” for Interpretation 2 and 3 0% of ESP are in “closed facilities” for Interpretation 2 and 3 0.7% of Public are in “closed facilities” for Interpretation 2, 2.1% of Public are in “closed facilities” for Interpretation 3 ¹
HCW and ESP Numbers	Number of HCW accounts for 1.44% of population Number of ESP accounts for 1.35% of population
GP Visits	48.3% of sick visit a GP (OHPIP, 2008)
Hospitalization Rate	Age dependent hospitalization rate (Source: Haber <i>et al.</i> (2007))
Post-exposure Prophylaxis Limits	84 day limit on repetition of post-exposure prophylaxis cycle.
Relative Efficacy (Pre-Exposure)	The relative efficacy varies in studies between 74% (Hayden 2001) ² and 91% (Peters 2001). In the current model an average of 83% was assumed (average of values from various studies published in the TGAP report).
Relative Efficacy (Post-Exposure)	The relative efficacy varies in studies between 68% (Hayden 2004) and 89% (Welliver 2001) ³ . In the current model a average of 78.5% is assumed (midpoint between the results of the two studies).
Efficacy for reducing pathogenicity	The efficacy for reducing pathogenicity was assumed to be 56% (95% CI: 10,73 Holloran 2006) ⁴
Reduction in the duration of illness	Anti-viral treatment was assumed to have a 25% reduction on the duration of illness (with oseltamivir 75 mg, Nicholson 2000) ⁵

¹ Canada’s Health Care Providers, 1997 to 2006, A Reference Guide . (2006). Retrieved from Canadian Institute for Health Information : http://secure.cihi.ca/cihiweb/disPage.jsp?cw_page=hhrdata_personnel_e

² Hayden F., Perspectives on AV use during pandemic influenza. *Phil Trans R Soc London* 2001; 356:1877-84

³ Welliver R., Monto AS, Carewicz O, et al. Effectiveness of oseltamivir in preventing influenza in household contacts: a randomized controlled trial. *JAMA* 2001;285:748-54.

⁴ Holloran E., Hayden F., Yang Y., Longini I., Monto A., Antiviral effects on influenza viral transmission and pathogenicity: Observations from Household-based trials, *American Journal of Epidemiology*, November 6, 2006: Vol. 165, No.2.

⁵ PAN-Canadian Public Health Network Council Report and Policy Recommendations on the use of Antivirals for Prophylaxis during an Influenza pandemic, June 2007.