

## Data Impact Challenge II Answer Submission Template

**Question:** What is the reduction in microbial use in hospitals with microbial stewardship programs?

**Team name and list of all team member names:**

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Describing the Data and Analysis

**Data Custodian Organization(s) and data sources:** Data is provided by the Antimicrobial Stewardship Programs at Michael Garron Hospital, Niagara Health System, Mount Sinai Hospital, and University Health Network.

Michael Garron Hospital (MGH), formerly Toronto East General Hospital, is a 515-bed hospital in Toronto, Ontario with nearly 20,000 in-patients annually. Their antimicrobial stewardship program (ASP) started in 2010.

Niagara Health System (NHS) comprises of six sites totalling 722 beds across the Ontario Niagara region. In 2015, NHS had 182,273 in-patient days and 7,962 surgical in-patient cases. Their ASP started its first unit in 2010.

Mount Sinai Hospital (MSH) is a 3,535-bed hospital in Toronto, Ontario. In 2015, there were 169,532 inpatient admissions.

Toronto General Hospital (TGH) and Toronto Western Hospital (TWH) have 417 and 261 beds, respectively, and are two of the sites comprising University Health Network. Several of their units are part of the Mount Sinai Hospital-University Health Network Antimicrobial Stewardship program (MSH-UHN ASP), which started in 2009.

**Description of intervention:** All programs used prospective audit and feedback (PAAF) as the primary mode of ASP delivery providing PAAF at least twice weekly. Teams consisted of a specially trained pharmacist and an Infectious Diseases content expert. Feedback was provided to clinical teams to optimize antimicrobials either in person or through notes in the patient's electronic record.

**List of Datasets Used** (e.g. names of database and/or data origins): Defined Daily Dose (DDD) data is derived from consumption data in pharmacy databases: BDM Centricity (TGH and TWH), Cerner Pharmnet (MSH) and Meditech pharmacy database (NHS). Days Of Therapy (DOT) data is based on drug administration data in electronic medication administration records: Cerner PowerChart (MGH).

**Data timeframe:** Start dates for each unit are different. Baseline data is calculated on one year’s worth of data up until but not including the starting month of the ASP, with the following exceptions: MGH ICU only has data for 3 months prior to ASP, and MGH Surgical Ward (A5/B5) only has data for 6 months prior (see Appendix A). The baseline is compared to consumption from the month of ASP adoption plus eleven months after that (12 months in total), except for two NHS medical/surgical units (4A and 4E/W), which only have 9 months of post-ASP data (see Appendix A).

**Exclusions:** Non-systemic antimicrobial drugs are not included. The hospitals involved track antimicrobial drugs that are at higher risk to cause antimicrobial resistance to develop. For the MGH ICU, Apr 2009 – Dec 2009 are excluded due to unavailability of data. For the MGH Surgical Ward (A5/B5), July 2009 – Dec 2009 are excluded due to unavailability of data. For NHS medical/surgical units (4A and 4E/W), Jan 2016 – Mar 2016 data is not available.

**Nature and Size of Cohort** (e.g. geographic area covered, number of patients included, number of sites, etc.): A total of 444,150 patient days are included, covering a two year timeframe (except for the MGH ICU, which has 3 months of data available prior to ASP adoption). All Intensive Care Units (ICUs) and medical/surgical in-patient units (M/S-IP) actively monitored by the respective ASPs are included in our analysis.

**Please provide a brief summary of the analysis methodology:**

Antimicrobial consumption (DDDs/1000 patient days or DOTs/1000 patient days) for the time period prior to ASP adoption (12 months, with exceptions, see Appendix A) is compared to consumption during the following 12 months (with exceptions, see Appendix A). For units that don’t have the full 12 months of data prior or post-ASP, the same months are used for comparison to control for potential seasonal variations. For example, MGH ICU only has Jan 2010 – Mar 2010 data pre-ASP, so for post-ASP, only Jan 2011 – Mar 2011 data is used.

The increase or decrease in consumption rates for all five ICUs are averaged. Rates from all five M/S-IPs are also averaged.

In addition, the change in standard deviation between the same two years of data is calculated to understand the variation of consumption from month to month.

Describing the Findings

**Calculation Formula** (as specified in the question definition).

- For each unit type (ICU or M/S-IP):

$$\frac{(\text{Antimicrobial Consumption}^{\wedge} \text{ after ASP} - \text{Antimicrobial Consumption before ASP})}{\text{Antimicrobial Consumption before ASP}}$$

*^Expressed as DDD or DOT per 1000 patient days.*

**State the key statistics from your analysis.**

- Average change in antimicrobial consumption<sup>^</sup> across ICUs in scope was a **decrease of 6.6%** at one year after ASP adoption.
- Average change in antimicrobial consumption across M/S-IPs in scope was a **decrease of 19.0%** at one year after ASP adoption.

<sup>^</sup>Expressed as DDD or DOT per 1000 patient days.

**Summary of findings including any key limitations or interpretation issues** (may also include figures/tables)

- While the overall trend is decreased consumption, the range of the percentage changes are from -29.2% to +33.4%. This is likely due to differences in complexity and size of units. See Table 1.

**Table 1: Consumption Rates One Year Before and After ASP Adoption**

Unit	Pre ASP Sum (DDD)/SUM (Patient days)*1000	Post ASP Sum (DDD)/SUM (Patient days)*1000	Percentage Increase/Decrease
TWH ICU	784.314	764.371	2.5 % ↓
TGH ICU	2606.363	2034.288	21.9% ↓
MSH ICU	1779.884	1835.352	3.1% ↑
MGH ICU* (DOTs/1000 Patient Days)	924.282	1233.191	33.4% ↑
NHS ICU	824.819	645.619	21.7% ↓
NHS PCU	408.619	352.451	13.7% ↓
TWH GIM	610.826	472.365	22.7% ↓
TGH GIM	854.261	809.429	5.3% ↓
MSH GIM	504.496	483.188	4.2% ↓
MGH Medical Wards (A3/B3) (DOTs/1000 Patient Days)	438.479	312.120	28.8% ↓
MGH Surgical Wards(A5/B5) <sup>~</sup> (DOTs/1000 Patient Days)	727.635	592.955	22.7% ↓
NHS Telemetry/Medicine (2A)	236.156	169.458	28.2% ↓
NHS Medical Ward (3B)	342.983	317.839	7.3% ↓

NHS Surgical Ward (5A/5B)	271.711	203.321	25.2% ↓
NHS Medical Ward (6E/6W)	349.727	297.257	15.0% ↓
NHS Stroke Unit (FUNC/FUD/FASU)	306.557	240.583	21.5% ↓
NHS Medical Ward (4A)^	891.457	631.459	29.2% ↓
NHS Surgical Ward (4E/W)^	332.998	272.131	18.3% ↓

\*Calculated from 3 months of data

~Calculated from 6 months of data

^Calculated from 9 months of data

- One limitation is several units did not have a full year's worth of data for comparison, which may not have been enough to accurately reflect pre-ASP and post-ASP consumption.
- MGH ICU and M/S-IP data is captured in DOTs, which may have trended differently if it was captured in DDDs.
- It is possible that longer term benefits are not captured within the two year time frame.

#### Additional analysis or insight that goes beyond what was asked in the question.

- Consistent with the trends stated above, it is observed that the standard deviation of antimicrobial use has generally decreased post ASP with the exception of MSH ICU which had increased by a substantial amount (see Table 2), possibly due to limitations cited above. This may suggest that the introduction of ASP reduces the variability of antimicrobial consumption towards a best practice standard.
- A note that for the calculation of standard deviation, all units of the same unit type (ICU or M/S-IP) are grouped if they belong to the same hospital.

**Table 2: Standard Deviation Pre and Post ASP Adoption**

Site	Standard deviation for 1 year Pre ASP	Standard deviation for 1 year Post ASP	Trend
TWH ICU – TWH	173.1	171.5	↓
TGH ICU - TGH	405.6	256.7	↓
MSH ICU	259.3	362.0	↑
MGH ICU	13.9	20.3	↑
NHS ICU	25.6	21.8	↓
TWH M/S-IP – TWH	75.6	75.4	↓
TGH M/S-IP - TGH	127.4	108.1	↓

MSH M/S-IP	124.7	65.2	↓
MGH M/S-IP	53.5	40.5	↓
NHS M/S-IP	31.8	26.8	↓

**Implications of this analysis for policy.**

- While most units have shown decrease in antimicrobial consumption after one year of adoption, evaluation of the efficacy of ASPs may need to be more long term when seen at a unit level.
- The variability in changes in antimicrobial consumption after ASP implementation suggests that hospital, provider or type of ASP intervention may influence ASP effectiveness.
- ASPs may have a role in informing local best practices to minimize the amount of variation in antimicrobial prescription.
- Measuring changes in overall antimicrobial consumption may not correctly capture the value of ASPs. The goal of ASP is to optimize antimicrobial use to improve healthcare outcomes. This may be seen as an improvement in the way antimicrobials are used, such as a reduction in broad-spectrum use, rather than an absolute decrease in overall antimicrobial consumption.

**Appendix A:****Timeframe for pre and post Antimicrobial Stewardship Program (ASP) for all units in scope**

<b>Site and Unit</b>	<b>Pre ASP</b>	<b>Post ASP</b>
TWH ICU	Apr 2008 – Mar 2009	Apr 2009 – Mar 2010
TGH ICU	Apr 2009 – Mar 2010	Apr 2010 – Mar 2011
MSH ICU	Apr 2008 – Mar 2009	Apr 2009 – Mar 2010
MGH ICU	Jan 2010 – Mar 2010	Apr 2010 – Mar 2011
NHS ICU	Jul 2012 – Jun 2013	Jul 2013 – Jun 2014
NHS PCU	Oct 2012 – Sep 2013	Oct 2013 – Sep 2014
TWH GIM	Jul 2012 – Jun 2013	Jul 2013 – Jun 2014
TGH GIM	Jul 2012 – Jun 2013	Jul 2013 – Jun 2014
MSH GIM	Jul 2012 – Jun 2013	Jul 2013 – Jun 2014
MGH Medical Wards (A3/B3)	Apr 2011 – Mar 2012	Apr 2012 – Mar 2013
MGH Surgical Wards(A5/B5)	Jan 2010 – Jun 2010	Jan 2011 – Jun 2011
NHS Telemetry/Medicine (2A)	Apr 2013 – Dec 2013	Apr 2014 – Dec 2014
NHS Medical Ward (3B)	Apr 2013 – Mar 2014	Apr 2014 – Mar 2015
NHS Surgical Ward (5A/5B)	Jul 2013 – Jun 2014	Jul 2014 – Jun 2015
NHS Medical Ward (6E/6W)	Oct 2013 – Sep 2014	Oct 2014 – Sep 2015
NHS Stroke Unit (FUNC/FUD/FASU)	Jan 2014 – Dec 2014	Jan 2015 – Dec 2015
NHS Medical Ward (4A)	Apr 2014 – Dec 2014	Apr 2015 – Dec 2015
NHS Surgical Ward (4E/W)	Apr 2014 – Dec 2014	Apr 2015 – Dec 2015