Geriatric Emergency Management PLUS Program
Costing Analysis at the Ottawa Hospital

Regional Geriatric Program of Eastern Ontario

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A Costing Analysis of the Geriatric Emergency Management PLUS Program

1. EXECUTIVE SUMMARY

Introduction

This report describes a costing analysis for the Geriatric Emergency Management PLUS (GEM+) Program that was designed and then tested using clinical and administrative patient data from the Ottawa Hospital (TOH) during the 2012/13 fiscal year. The methodology developed was designed to support future costing analysis of other hospitals with the GEM+ Program.

The GEM+ PLUS Program

The GEM+ Program is an evidence based approach designed to enhance age-appropriate care provided to seniors in Emergency Departments that are at high risk for unnecessary hospital utilization. GEM+ ED nurses, with special training in Geriatric Medicine, provide a targeted geriatric assessment, focusing on the geriatric giants, to support early identification and intervention of reversible and preventable medical issues. The GEM+ ED nurses then work with the multidisciplinary team within the ED, and with specialized geriatric service (SGS) and community support service (CSS) organizations to help ensure that an effective and efficient plan is in place to support a safe sustainable discharge back into the community with appropriate support and follow up. The ultimate goal is to improve the trajectory, safety, quality, and durability of ED discharges and thus improve ED flow, and reduce unnecessary hospital utilization (e.g., repeat ED visits or hospital admissions).

Goals of this Study

Limited healthcare funding drives healthcare programs to demonstrate their cost effectiveness. The goals of this study were to:
- Design a costing methodology for GEM+ Programs
- Test out this methodology at TOH and determine if the GEM+ Program resulted in bed days saved or cost avoidance
- If the method is durable, then expand the costing analysis to other hospitals involved with the GEM+ Program.

Analysis

The TOH GEM+ costing study was based on 7,706 TOH Emergency Department (ED) patients seen in 2012/13 fiscal year (FY) that were 75 years of age or older, living independently in the community that received a Canadian Triage and Acuity Scale (CTAS) score of 3, 4 or 5 at their index ED visit. The study group included 932 patients seen by a TOH GEM+ nurse. The comparator group included 6774 patients that accessed the ED but were not seen by a GEM+ nurse.

The following actions were conducted at TOH to develop and test the costing methodology:

1. Sampling criteria identified and the order for including and excluding data determined
2. Measurement tools selected to identify differences in co-morbidities and risk of dying
3. All terms defined and specific indicators provided with a numerator, denominator, and the required statistical analysis
4. TOH Costing data set built
5. Analyzed data for differences in admission rates and ALC rates
6. Analyzed data for per case differences for a) ED cases, b) admitted cases, and c) admitted cases that become ALC
7. Determined impact on bed days
8. Determined impact on cost avoidance
9. GEM+ Program costs defined
10. Total impact of GEM+ on hospital resources and costs determined for the TOH GEM+ Program in the 2012/13 FY.

Data Sources

TOH data from the Med2020 DAD NACRS database and the TOH Data Warehouse were sourced through the TOH Performance Measurement Department. Data was identified for TOH patients aged 75 years of age and older that accessed the TOH Civic or General Emergency Department Campuses during the 2012- 2013 fiscal year.

Overall Findings

The costing methodology revealed the following regarding the GEM+ study group patients:
A. Overall, the GEM+ study group diverted more in-patient hospitalizations than the Non-GEM+ comparator group.
B. On average, admitted GEM+ patients had a shorter average length of stay (ALOS) and a lower total cost than the Non-GEM+ comparator group. This translated into more bed days saved and greater overall cost avoidance for TOH.

The total TOH resource savings and cost avoidance due to the GEM+ study group in 2012/13 fiscal year was as follows:
- 1310 bed days were saved by the GEM+ study group
- $1,941,340.79 of costs were avoided by the GEM+ study group

Key Limitations

- The biggest limitation of this costing methodology was the lack of costing data and available indicator data prior to program implementation.
- Costing data was not available in 2012/13 fiscal year for several TOH departments (Mental Health, Rehabilitation cases, and the Heart Institute). Therefore, these cases were excluded from the analysis.
- GEM+ cases included in this analysis were defined as those cases that were seen by a GEM+ nurse and had a full GEM+ assessment conducted. Therefore, many cases with partial GEM+ assessments were excluded.
- ED patients are sourced for the GEM+ program in two ways; 1) Referral by ED Physicians and staff or by 2) the GEM+ administrative screen. The data for "percent of cases sourced by referral or admin screen" was not available. Therefore, the administrative screen exclusion rule of "a second ED visit within 6 months" was not applied consistently to all GEM+ patients and was therefore not applied to the comparator group.
- The data included in this analysis was limited to patients with CTAS 3-5 levels at their ED index visit. Therefore, patients re-visiting the ED with a CTAS level of 1 or 2 were excluded. Future analysis should include these cases.

Key Lessons Learned

- Ensure that the GEM+ cases and the Non-GEM+ cases are two exclusive groups over the length of the study.
- Take the time required for staff and data analysts to fully understand the definitions and processes of key aspects of the GEM+ program, the costing analysis
- Ensure only one data analyst is selected to source data for both the study and the comparator groups.
- Select one program representative to liaise with the data analyst.
- Ensure only "clean" data is utilized.
- Have the analyst walk through the results of the data and explain what they did and how they did it.
- Utilize a process map to facilitate understanding of the program and to interpret the data provided by the analyst.

Recommendations

- Re-run this data when costing data is available for all TOH departments.
- Encourage TOH GEM ED to start collecting data for the number and percent of GEM+ patients referred by ED staff or sourced through the GEM+ administrative screen. Collect this data over multiple fiscal years to ensure a large enough population for future costing analysis.
- During the next run of this costing analysis only include patients referred via the administrative screen. The study group would include patients seen by a GEM+ nurse while the comparator group would include patients not seen by a GEM+ nurse (e.g., after hours, weekends etc.).

2. INTRODUCTION

This report describes the findings of a study designed to examine resource use and cost avoidance of the Geriatric Emergency Management Plus (GEM+) Program located at The Ottawa Hospital and operated by the Regional Geriatric Program of Eastern Ontario (RGPEO). Throughout this costing analysis the most conservative methods were selected to facilitate an objective analysis of the program.

A. Problem Statement

There is limited funding for health care. For a program to maintain funding it needs to show that it provides the best care at the lowest cost. The RGPEO designed this costing analysis to determine whether the GEM+ Program was cost neutral, saved or required more TOH bed days and whether more TOH costs were avoided or required.

The Goals of this study were to:
- Design a costing methodology that can be used by other hospitals in the Champlain region
- Test out the costing methodology on the TOH GEM+ Program and determine the impact of the program with regards to TOH bed days saved and TOH cost avoidance.
- If methodology is durable, expand to other hospitals with the GEM+ Program

B. Geriatric Emergency Management PLUS (GEM+) Program

The Program

GEM+ nurses, with special training in Geriatric Medicine, provide a targeted geriatric assessment in the Emergency Department, focusing on the geriatric giants, to support early identification and intervention of reversible and preventable medical issues. The GEM+ nurses then work with the multidisciplinary team within the ED, and with specialized geriatric service (SGS) and community support service (CSS) organizations to help ensure that an effective and efficient plan is in place to support a safe sustainable discharge back into the community with appropriate support and follow up. The ultimate goal is to improve the trajectory, safety, quality, and durability of ED discharges and thus improve ED flow, and reduce unnecessary hospital utilization (e.g., repeat ED visits or hospital admissions).

The GEM+ Program in the Champlain Region

In 2007, the Ministry of Health and Long Term Care implemented the Aging at Home strategy and in 2008 the GEM+ Program was established in the Champlain region with the support of the Regional Geriatric Program of Eastern Ontario (RGPEO). The GEM+ integrated regional program coordinates and incorporates evidence based GEM+ initiatives in 9 separate hospital emergency department's with over 20 partner organizations including Specialized Geriatric Services (SGS) and Community Support Services (CSS) essential to sustain high risk seniors in the community as long as possible.

Key Components of the Regional Program

The PLUS (+) component is a unique feature of the GEM+ in comparison to other Provincial programs and a critical aspect of the program in the Champlain region as it brings multiple organizations and service sectors together in a coordinated effort to support high risk seniors.

Urgent capacity response processes and accountability agreements with CSS and SGS, ensure an advantage to GEM+ nurses who can access services on a priority basis thus preventing unnecessary hospital admissions. This is further validated by 72% of the GEM+ budget being directed to the plus services (SGS and community services)

The magnitude of collaboration with the SGS and CSS partners is significant, and results in the application of consistent care processes for high risk seniors throughout the Champlain region. This approach supports seniors to remain healthy and independent at home while enhancing the continuum of care through timely and effective transition to SGS and CSS.

Regional Governance

The GEM+ Program is governed by a Project Leadership Team (PLT). The PLT has the mandate to oversee the growth, coordination and evolution for the GEM+ Program throughout its existence. The PLT sets direction and policies based on the project requirements as set out by the Champlain LHIN. The PLT has embraced a shared governance model that supports decision making through distributed and shared power to include regional coordination and local planning and service.

The Integrated Program Management and a Shared Decision-Making Model of the Project Leadership Team
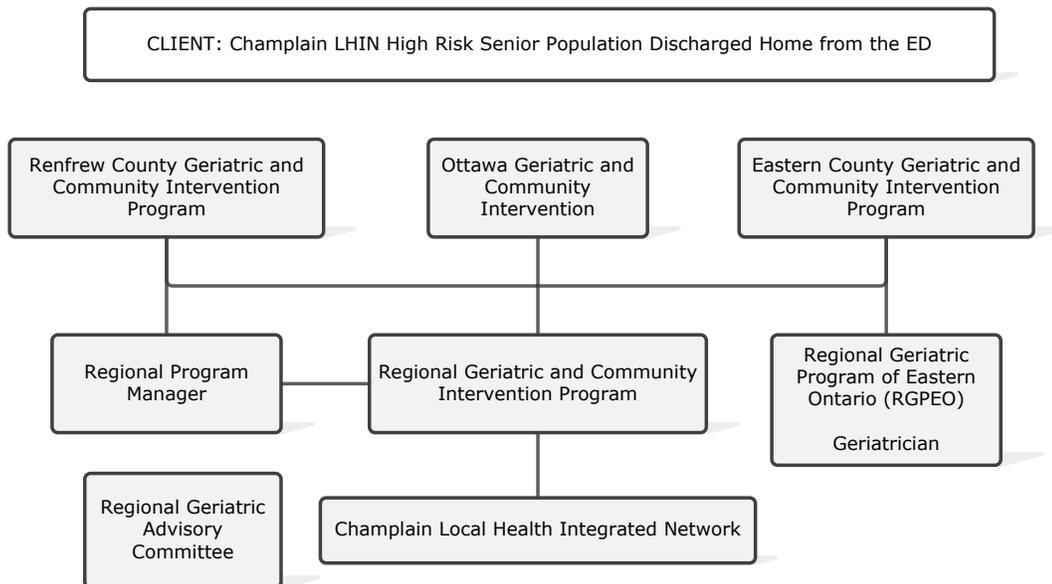
Program Processes

A. The Two Stage Screening Process

An evidence based two-stage screening approach is implemented at the ED to identify high risk seniors who present to the ED that are likely to be discharged home and who could benefit from GEM+ services. The administrative screen and the ISAR screening tool and the administrative screen constitute the two stage targeting process.

1. The administrative screen captures patients presenting to the ED who are:
   ▪ ≥75 years of age;
   ▪ a resident in the Champlain LHIN;
   ▪ not currently in Long Term Care;
   ▪ have previous ED visit within the last 6 months; and
   ▪ categorized as CTAS 3, 4, or 5.

2. The Identification of Seniors at Risk (ISAR) tool developed by McCusker (2000) is a validated screening tool in both official languages (French and English). It is used in the ED for early identification of seniors at risk who could benefit from a GEM+ targeted assessment. The tool consists of six questions covering:
   ▪ cognitive impairment;
   ▪ functional loss;
   ▪ polypharmacy;
   ▪ visual impairment; and
   ▪ frequent hospitalizations.

B. Targeted Geriatric Assessment

Once a patient has been identified by the two screen approach, a targeted geriatric assessment is completed by the specially trained GEM+ nurses focusing on geriatric giants. They identify priority areas, assess risk and formulate recommendations, enhancing age-appropriate care for seniors in ED thus improving the care received and the safety, quality, and durability of ED discharges for seniors at high risk for a hospital admission.

C. Support and Follow-up

The GEM+ nurse then works with the multidisciplinary team within the ED, and with specialized geriatric service (SGS) and community support service (CSS) organizations to help ensure that an effective and efficient plan is in place to support a safe sustainable discharge back into the community with appropriate support and follow up.

3. METHODOLOGY

A. Setting
The findings of this study relate specifically to The Ottawa Hospital (TOH), a tertiary acute care academic health science centre. The GEM+ Program is provided at the two TOH Emergency Departments located at the Civic and the General campuses.

TOH Budget
The budget for the TOH GEM+ program in 2012/13 was $384,944.00.

TOH Staffing
In the 2012/13 FY the TOH GEM+ program had 3.9 full time equivalent positions working in the TOH Emergency Department (ED) who had specialized geriatric training who worked in the ED. This included a 0.6 FTE Advanced Practice Nurse position, 1.0 FTE GEM+ Nurse Specialist position and 2.3 FTE Registered Nurse positions. It is worth noting that the cost for the TOH GEM+ program is higher than other sites because of the increased salary for an APN and a GNS positions.

B. Scope
Administrative and clinical healthcare data was identified for TOH patients aged 75 years of age and older who accessed the TOH Civic or General Emergency Department campuses for emergency department (ED) index visits from April 1, 2012 until March 31, 2013 and for ED re-visits up until April 30th 2013.

C. Data Sources
Data from the Med2020 DAD NACRS database and the TOH Data Warehouse were accessed by a Methodologist in the TOH Performance Measurement Department. The GEM+ data program budget and staffing levels during the 2012/13 FY were provided by the Director of the RGPEO.

D. Matching of the Study and Comparison Groups
Canadian Triage and Acuity Scale (CTAS) levels were provided for the GEM+ study group and the Non-GEM+ comparator group. This data showed that the comparator group included more cases with a higher acuity (CTAS 2). However, data for CTAS 3-5 cases (study and comparator groups) showed that the acuity levels were not significantly different from each other. Therefore, to minimize the impact of the acuity discrepancies, this report includes data for CTAS 3-5 cases.

The study and comparison groups (GEM+ vs Non-GEM+) were not significantly different with regards to CTAS levels.

Acuity Level	86 GEM+ cases	1696 Non-GEM+ cases	
CTAS 3	95.3%	97.6%	No significant differences found
CTAS 4	4.7%	2.3%	
CTAS 5	0.0%	0.1%	

The GEM+ study group and the Non-GEM+ comparator group were not significantly different with regards to other variables:

	GEM+	Non-GEM+	
Risk adjusted mortality (Escobar)	0.12	0.12	No significant differences were found
Resource intensity weight (RIW)	1.97	2.31	
Co-morbid scale (Elixhauser)	2.94%	3.73%	
Admitted by ambulance	67.4%	66.0%	

The total number of cases included in this study

	7706 CTAS 3-5 ED Cases	
	GEM+	**Non-GEM+**
# ED cases	932 Total GEM+ ED Index Visits	6774 Total Non-GEM+ ED Index Visits
# admitted cases (in 30 days)	162 Admitted ▪ 86 admitted at ED Index visit ▪ 76 admitted at ED Re-Visits	1955 Admitted ▪ 1696 admitted at ED Index Visit ▪ 259 admitted at ED Re-Visits
# admitted cases that became ALC (in 30 days)	47 Admitted become ALC ▪ 30 become ALC at ED Visit ▪ 17 become ALC at ED Re-Visits	341 Admitted become ALC ▪ 304 become ALC at ED Visit ▪ 37 become ALC at ED Re-Visits

E. Validated Measures

The following measures were used during the costing analysis:

Canadian Triage and Acuity Scale
The Canadian Triage and Acuity Scale (CTAS) is an instrument that endeavors to more accurately categorize patients according to the type and severity of their initial presenting signs and symptoms. There are five CTAS levels, Level 1 represents the sickest patient and level 5 represents the least ill patient. Patients designated CTAS 3 and 4 are considered urgent and less urgent. As a general rule, patients with lower CTAS scores are sicker, tend to use more resources and cost more per case. To determine resource use and cost avoidance of the GEM+ program, GEM+ and Non-GEM+ case data was grouped according to CTAS scores to limit the impact of acuity of cases on the analysis.

The Elixhauser Comorbidity Index
This index was selected For the TOH GEM+ costing analysis as it looks at more conditions (e.g., chronic conditions and some acute conditions) that are then weighted to get a comorbidity score. Therefore, more data is available to determine if the populations are similar.

The Escobar model
This model was selected as it calculates the probability of dying using data only available at the time of admission, which prevents confounding by complications during that hospitalization.

F. GEM+ Costing Process

A detailed methodology was developed to support this analysis and can be found in Appendix A of this document. An overview of the actions conducted for the costing analysis is outlined below:

1. Sampling criteria identified and the order for including and excluding data determined
2. Measurement tools selected to identify differences in co-morbidities and risk of dying
3. All terms defined and specific indicators provided with a numerator, denominator, and the required statistical analysis
4. TOH Costing data set built
5. Analyzed data for differences in admission rates and ALC rates
6. Analyzed data for per case differences for a) ED cases, b) admitted cases, and c) admitted cases that become ALC
7. Determined impact on bed days
8. Determined impact on cost avoidance
9. GEM+ Program costs defined
10. Total impact of GEM+ on hospital resources and costs determined for the TOH GEM+ Program in the 2012/13 FY.

G. Limitations of the Costing Analysis

- The biggest limitation was the lack of costing data and available indicator data from before the program was implemented. In addition, there was no way to randomly select the cases for the costing analysis.
- No costing data was available for 2012/13 fiscal year TOH Mental Health cases, TOH Rehabilitation cases and Heart Institute cases at the time of the study. Therefore, these cases were excluded from the analysis.
- GEM+ cases included in this analysis were defined as those cases that were seen by a GEM+ nurse and had a full GEM+ assessment conducted. Therefore, many cases with partial GEM+ assessments were excluded.
- There are two methods that ED patients are sourced for the GEM+ program; 1) Referral by ED Physician or ED staff or by 2) the GEM+ administrative screen. The data for "percent of cases sourced by referral or admin screen" was not available. Therefore, the administrative screen exclusion rule of "a second ED visit within 6 months" was not applied consistently to all GEM+ patients and was therefore not applied to the comparator group.
- The data included in this analysis is limited to patients with CTAS 3-5 levels. Therefore, patients re-visiting the ED with a CTAS level of 1 or 2 were not included in the analysis. Future analysis should include these patients.
- It was noted that factors other than acuity impact CTAS coding (e.g., patients stated pain level). Therefore a patient could have a high CTAS code without high acuity.
- Palliative care patients do not qualify for the GEM+ program, but it was not possible to exclude palliative ED cases from the comparator data as the data for percent of palliative Emergency Department cases is not collected by TOH. Inpatient data for percent of patients that are palliative is collected and this percent was monitored throughout the data analysis. However, the value of this data is limited as it is not possible to determine whether the patient was palliative when accessing ED or became palliative during their stay.

4. FINDINGS

The costing analysis demonstrated that there were two potential sources of resource savings and cost avoidance for the GEM+ Program:

A. Admission Rate and ALC Rate Differences

The findings for "admission rate and ALC rate differences" were based on the differences between the GEM+ study group and the Non-GEM+ comparator group with regards to admission rates and ALC rates.

- The analysis showed that the GEM+ study group had a lower ED admission rate and ALC rate. This difference resulted in cases being diverted from becoming inpatients or ALC inpatients.

The 11.5% lower admission rate and a 1.3% lower ALC rate translated into 19 diverted hospital admissions or admissions that became ALC.

B. Per Case Differences

The findings for "per case differences" were based on the differences between the GEM+ study group and the Non-GEM+ comparator group with regards to the average length of stay and the average total cost per case.

- The analysis showed that the GEM+ study group had a shorter average length of stay and lower total cost per case for admitted cases.

Therefore, there was overall resource savings and cost avoidance for these cases. Those cases that were "admitted at the ED index visit" and those cases "admitted at the ED index visit that later became ALC" had the greatest resource savings and cost avoidance. Whereas, the opposite was true for cases that were admitted at the ED re-visit.

The comprehensive GEM+ ED assessment costs slightly more per case ($91.86 for cases admitted at ED visit and $75.33 for cases admitted at ED re-visit), however, this cost was easily mitigated by the overall cost avoidance for GEM+ admitted cases and GEM+ ALC cases admitted at the ED index visit.

C. Total Resource Savings

When the bed days for per case differences was subtracted from the bed days saved by the diverted cases there were:
- 1310.7 bed days saved by the GEM+ program in 2012/13 FY.

D. Total Cost Avoidance

When the cost avoidance for the diverted cases ($2,096,781.82) was added to the cost avoidance from the per-case differences ($229,502.97) there were $2,326,284.79 costs avoided. When the TOH costs for running the GEM+ program ($384,944.00) were subtracted from this the findings were:

- $1,941,340.79 in avoided costs in the 2012/13 FY

5. CONCLUSION

A costing methodology was developed and tested on the TOH GEM+ Program. The findings showed the program saved resources and supported cost avoidance for the Ottawa Hospital in the 2012/13 fiscal year.

- Over a thousand bed days were saved and over 1.9 million in costs were avoided.
- The program successfully diverted cases from being admitted into hospital or becoming ALC in the 2012/13 FY due to the programs 11.5% lower admission rate and 1.3% lower ALC rate.
- Additional resources were saved and costs avoided due to the shorter average length of stay and the overall lower total cost per case and for cases admitted at the ED index visit.
- The overall cost avoidance easily mitigates the cost of running the program.

6. LESSONS LEARNED

The following lessons were learned when analyzing costing data for the TOH GEM+ Program. (Please note that "Appendix A: Detailed Methodology" includes processes developed based on these lessons learned.)

Lessons Learned regarding Data
- Ensure that the GEM+ cases and the Non-GEM+ cases are two exclusive groups over the length of the study. For example, a patient might visit the ED in May as a Non-GEM+ patient, re-visit in June as a GEM+ patient and then not re-visit again until the following February as a Non-GEM+ patient.
- Ensure one data analyst is selected to source data for the GEM+ study group and the Non-GEM+ comparator group. This ensures the same sampling criteria and order for implementing the inclusions/exclusions are followed.
- It was determined that the most valid approach for comparing the two groups was when the denominator for the calculations was the total population (N).
- Only utilize "clean" GEM+ data.
- Utilize the visual process map to review the data and to better understand the multiple paths that GEM+ ED, admitted and ALC patients follow when accessing care (e.g., at index ED visit, at ED re-visits)

Lessons Learned regarding Communication
- Understand the role of each stakeholder and their different use of the GEM+ data/costing data
- Take the time to fully understand the definitions and processes of key aspects of the GEM+ program and the costing analysis. Write down these definitions and processes and have all key stakeholders agree that these are accurate. Provide this written information to the data analyst.
- Select one key person to liaise with the data analysis that can answer, or source answers from other stakeholders, in between full stakeholder meetings. It is helpful if this liaison person also calculates the resource savings and cost avoidance for the costing analysis if the analyst is not available to do so.
- When the dataset has been built by the analyst set up a meeting to review the data and to assist with interpretation.

7. RECOMMENDATIONS

- Re-run this data when costing data is available for all departments in TOH.
- Collect data for number and percent of GEM+ patients referred by ED staff or through the administrative screen.
- Consider re-running this costing analysis and only including patients referred via the administrative screen. The study group would include patients seen by a GEM+ nurse while the comparator group would include patients not seen by a GEM+ nurse (e.g., after hours, weekends etc.). Collect data over multiple fiscal years to ensure a large enough population.

APPENDIX A: DETAILED COSTING METHODOLOGY

The following pages provide a detailed step by step process for conducting a costing analysis based on those used for the TOH costing analysis.

Lessons Learned to Facilitate the Methodology

In order to conduct an effective costing analysis it is important that all involved attend a meeting to ensure all fully understand the GEM+ program, the funding of the program, the program processes from triage to discharge, the data collected on patients, the data collected for the comparator group, and any restrictions on data analysis methods due to limited data analysis software and human resources.

a) Stakeholders: Ensure key stakeholders attend the initial meeting. This could include GEM+ program directors, GEM+ managers, GEM+ nursing staff, hospital data analysts with access to identified data sources, and methodologists. Basically, all involved in running the program, entering the data, accessing the data and analyzing the data.

b) Timing: Determine the fiscal year(s) that the costing analysis will be based on. Clarify that costing data will include data collected from April 1st to March 31st for index visits and for re-visit data up until April 30th.

c) CTAS levels: Discuss whether the data set will include CTAS 2-5 cases or just CTAS 3-5 cases. The TOH data set included CTAS 2-5 cases so that it could be determined how the CTAS 2 cases were impacting the outcomes of the GEM+ program. Please note that additional human resources and time were required to analyze the additional data.

d) Flow Chart: During the meeting utilize the *GEM+ flow chart template* (located in the appendix) to discuss typical paths that GEM+ and Non-GEM+ patients took in the fiscal year selected (for the costing analysis).

e) Prior to Selecting Definitions: Utilize the flow chart to ensure all stakeholders at the meeting agree on factors that will impact the selection of inclusion/exclusion criteria, and definitions and metrics
   ➢ Discuss how the GEM+ program, hospital policies, staffing and triage methods were different in the fiscal year selected (if applicable) and how this impacts inclusion/exclusions criteria and limitations of findings.
   ➢ Discuss how patient flow impacts definitions. For example, there are multiple ways to define "total # of admissions". It could be defined as "admitted at ED index visit" or "admitted at ED index visit + all ED re-visits within 30 days of an index visit" or "admitted at ED re-visits within 30 days of index visit".
   ➢ It is important that the data analysts fully understand the GEM+ program. To address any incorrect assumptions, ask them to describe the GEM+ program and the processes using the flow chart.
   ➢ Ask the data analysts to discuss limitations of the Med2020 DAD NACRS database, the GEM+ data or the analytic software that could limit their ability to meet the definitions developed.

f) Data Selection: When selecting data for the costing analysis ensure the following:
   ➢ GEM+ Program data has been cleaned by the data analysts.
   ➢ One data analyst is selected to source GEM+ Program data and to access the hospital data.
   ➢ Ensure that the comparator group only includes admitted patients that were admitted through the ED.

1. Select sampling criteria and determine the order for including/excluded data

It is important that the GEM+ study group and the comparator group meet the same inclusion/exclusion rules for the two groups to be comparable. The order of implementing each of the inclusion/exclusion rules used for the TOH GEM+ costing analysis is also important and is detailed below.

Order for implementing	Inclusion/Exclusion Categories	Inclusion/Exclusion Rules
Step 1	Access all data for Emergency Department encounters	
Step 2	Timing	Include all encounters from April 01, 2012 to April 30 2013 (includes one month extra to look at 30 day post visit activity)
Step 3	Age	Include encounters where patient age >=75 at index visit

Step 4	Acuity	Include encounters where CTAS score is between 2 and 5
		     CTAS 2: Emergent - Conditions that are a potential threat to life, limb or function
		     CTAS 3: Urgent - Conditions that could potentially progress to a serious problem requiring emergency intervention
		     CTAS 4: Less Urgent - Conditions that are related to patient age, distress, or potential for deterioration
		     CTAS 5: Non-Urgent - conditions that may be acute but not urgent as well as conditions which may be part of a chronic problem with or without evidence of deterioration

Step 5	Acuity	Exclude cases where patient
		   - left without being seen
		   - left without treatment
		   - left against medical advice

Step 6	Acuity	Exclude cases where dead on arrival
Step 7	Missing data	Exclude cases where abstract data missing

Step 8	Living independently in community	Exclude encounters where coming from:
		    -long term care
		    -chronic institutions
		    -home for the aged

Step 9	Missing costing data	Exclude encounters where patient costing data not available
Step 10	Link GEM+ dataset to total number of "complete" GEM+ encounters (partial GEMs excluded)	
Step 11	Encounters of Index visit	GEM+: index = first ED visit in fiscal year Non-GEM+ index = first ED visit with GEM+ in fiscal year
Step 12	GEM+ costing data	Exclude GEM+ patients with encounters where cost information missing
Step 13	Index visit data	Include only index visits

2. Select measurement tools to identify differences in comorbidities and risk of dying.

a) Comorbidity:
   The Elixhauser Comorbidity Index was selected For the TOH GEM+ costing analysis as it looks at more conditions (e.g., chronic conditions and some acute conditions) that are then weighted to get a comorbidity score. Therefore, more data is available to determine if the populations are similar.

b) Risk Adjusted Mortality
   The Escobar model was selected as it calculates the probability of dying using only data available at the time of admission, which prevents confounding by complications during that hospitalization. The baseline risk of mortality is based on age; sex; acuity of admission; Charlson comorbidity score (ref); primary condition and the Laboratory-based acute physiology score.

3. Clarify all definitions and identify numerator, denominator and required statistical analysis

If the definitions of the data are not accurate then the costing data will not be accurate. Clear definitions are best when the definition is supported with metrics. The definitions used in the TOH GEM+ costing analysis are outlined below and include the numerator, denominator and statistic required (where applicable).

Definitions			
	Numerator	**Denominator**	**Statistic**
Number of Patients	▪ GEM+: the number of patients that had a GEM+ consult during any ED visit during FY 2012/13. ▪ Non-GEM+: the number of patients that did not have any GEM+ consult during any ED visit during FY 2012/13.	All patients	N
Encounters of Index visit	▪ GEM+: First ED visit with GEM+ in fiscal year ▪ Non-GEM+: The first visit to the ED within the fiscal year.		
Admitted at ED index visit	▪ GEM+: cases admitted on their GEM+ index visit, or first visit to GEM+, but 2nd+ visit in 6 months to ED (not a subsequent GEM+ visit within 30 days of the index visit). ▪ Non-GEM+: cases admitted from ED on any visit		
Discharged at ED visit	▪ GEM+: Patients discharged on their GEM+ index visit and from re-visits within 30 days of index visit. ▪ Non-GEM+: Patients discharged from ED index visit and from re-visits within 30 days of index visit.		
Re-visit ED within 30 days	Patients who had at least 1 other ED visit that started within 30 days of their index visit.	All patients	N (%)
Re-visit ED and admitted within 30 days	Patients who had at least 1 other ED visit and were admitted within 30 days of their index visit.	All patients	N (%)
ALC Patients	Patients that had an alternate level of care (ALC) status during their inpatient stay.	Patients that were admitted as inpatient	N (%)
Palliative Patients	Patients admitted that had a palliative care status during their stay	Patients that were admitted as inpatient	N (%)
ED Length of Stay (LOS)	Length of time (in hours) between "Arrival" to the emergency department and "Gone" from the emergency department (e.g., discharged home or admitted)	All patients	Mean (SD)
Acute Length of Stay (LOS)	Length of stay (in days) from when the patient was admitted to an inpatient bed and when they were discharged from the hospital	All patients	Mean (SD)
ALC Length of Stay (LOS)	Length of stay (in days) of a patient's inpatient stay when they were flagged as alternate level of care (ALC).	All patients	Mean (SD)
Direct cost:	Direct (absorbing) costs are costs that are attributed to providing direct patient care. Direct costs are all the expenses in direct functional centres including salaries, supplies, and equipment amortization.		
Indirect cost:	Indirect costs are an overhead allocation based on a percentage of the activity in the functional centre		
Total cost:	Total cost for an encounter is equal to the direct costs plus the indirect costs	All patients	Mean (SD)
Total ED cost	Total cost of ED portion of visit.	All patients	Mean (SD)
Age:	Age at of patient at index ED visit	all patients	Mean (SD)
Gender	Male or female gender at index ED visit	All patients	Mean (SD)

Canadian Triage Acuity Scale (CTAS)	A scale assigned to categorize the patient according to the type and severity of the patient's initial presenting signs and symptoms. The CTAS is used to determine the triage level. This scale was developed by the Canadian Association of Emergency Physicians. - CTAS 1: Resuscitation - Conditions that are threats to life or limb (or imminent risk of deterioration) - CTAS 2: Emergent - Conditions that are a potential threat to life, limb or function - CTAS 3: Urgent - Conditions that could potentially progress to a serious problem requiring emergency intervention - CTAS 4: Less Urgent - Conditions that are related to patient age, distress, or potential for deterioration - CTAS 5: Non-Urgent - conditions that may be acute but not urgent as well as conditions which may be part of a chronic problem with or without evidence of deterioration		
Comorbid Score:	Comorbidities are a patient's pre-existing diagnoses (at the time of admission). A comorbidity score reflects burden of these comorbidities which is especially useful for risk adjustment.	All patients	Mean (SD)
Risk Adjusted Mortality Score	The predicted probability of dying in hospital.	All patients	Mean (SD)
Admit by Ambulance	Patients that arrive at the emergency department by way of ambulance.	All patients	N (%)
Resource Intensity Weighting (RIW)	A relative cost weight value derived from case-cost data submitted to CIHI's Case Mix department. All RIW cost weights are relative to the average typical inpatient case such that the sum of the typical cases is equal to the sum of the typical weighted cases.	All patients	Mean (SD)

4. Data analyst builds the data set and facilitates interpretation of the data set

Provide the analyst with this detailed methodology to assist them with setting up the dataset for the costing analysis. Organize a meeting to review the costing data with the data analyst.

a) Have the analyst walk through the results of the data and explain what they did and how they did it. Take this time to make sure that the data makes sense to the program director, program manager, evaluator and analyst.

b) Compare the Non-GEM+ data from Med2020 DAD to the GEM+ Program data and determine if the two groups are similar enough to compare. Review the percentages for each variable; age, gender, CTAS scores, comorbidities, risk adjusted mortality, admit by ambulance, ALC, palliative, resource intensity weights.

Table 1: Total Study and Comparator Populations

CTAS 3-5 in ____ FY	Study Group GEM+	Comparator Group Non-GEM+
# Cases	(N=total GEM+ population)	(N=total non-GEM+ population

5. Part A: Analyze the Data for Differences in Admission Rates

The following methods outline how to determine the potential impact of lower or higher GEM+ admission rates on bed days and cost avoidance.

Table 1

% Difference between GEM+ and Non-GEM+ admission rates	# Cases diverted	Resulting bed days Saved	Resulting hospital beds Saved	Total costs avoided
A	B	C	D	E

(Note: Place the results of each calculation in the above table)

A. Calculate % difference in GEM+ and Non-GEM+ Admission rates
Compare the Non-GEM+ data from Med2020 DAD to the GEM+ Program data accessed through the TOH Warehouse data and determine any differences in admission rates or ALC rates.

a) % GEM+ cases admitted within 30 days

$$\frac{\text{Total GEM cases admitted at ED index visit } + \text{ Total GEM cases admitted at ED re-visit within 30 days}}{\text{Total N population for GEM+}}$$

b) % Non-GEM+ cases admitted within 30 days

$$\frac{\text{Total Non-GEM cases admitted at ED index visit } + \text{ Total Non-GEM cases admitted at ED re-visit within 30 days}}{\text{Total N population for Non-GEM+}}$$

c) % Difference in GEM+ vs Non-GEM+ admission rate *(Note: place finding in Table __ in box #1)*

% GEM cases admitted within 30 days **-** % Non-GEM cases admitted within 30 days = _____

B. Calculate number of cases diverted
Rationale for calculation: If the GEM+ program was not available, then the cases regularly seen by GEM+ nurses would have been seen by Non-GEM+ ED nurses and the Non-GEM+ admission rate would apply. If the Non-GEM+ admission rate is higher, this would lead to more ED cases being admitted. The number of additional admitted cases is then interpreted as the number of cases diverted by GEM+.

Total GEM ED cases in the fiscal year (N) **x** % difference in GEM+ vs Non-GEM admission rates= _____

C. Calculate bed days saved
Rationale for calculation: The Non-GEM+ average length of stay (ALOS) is utilized because if the GEM+ program was not available then those cases would be seen by Non-GEM+ staff and the Non-GEM+ ALOS would apply. Note: length of stay is made up of acute length of stay and the ALC length of stay and both are included in this calculation.

cases diverted by GEM **x** (Non-GEM+ Acute Length of stay + Non-GEM ALC Length of Stay) = _____

D. Calculate hospital beds saved

$$\frac{\text{# bed days saved}}{\text{365 hospital days a year}} = _____$$

E. Calculate cost avoidance
- Rationale: The Non-GEM+ total cost for each case is utilized because if the GEM+ program was not available then those cases would be seen by Non-GEM+ staff and the Non-GEM+ total cost would apply.

admissions diverted by GEM **x** Total cost of a Non-GEM admitted case = _____

5. Part B: Analyze the Data for Differences in ALC Rates

The following methods outline how to determine the potential impact of lower or higher GEM+ ALC rates on bed days and cost avoidance.

Table 2

% difference between GEM+ and Non-GEM+ admission rates	# cases diverted (due to lower ALC rates for GEM+ cases)	bed days saved	hospital beds saved	Total costs avoided
F	G	H	I	J

F. Calculate percent difference in ALC rates

a) **% GEM+ admitted cases that become ALC within 30 days**

Total GEM admitted cases at ED index visit **+** Total GEM admitted cases after ED re-visit
that become ALC within 30 days   that become ALC within 30 days

_____   = _____
Total N population for GEM

b) **% Non-GEM+ admitted cases that become ALC within 30 days**

Total Non-GEM admitted cases at ED index visit **+** Total Non-GEM admitted cases after re-visit
that become ALC within 30 days   that become ALC within 30 days

_____   = _____
Total N population for Non-GEM

c) **% Difference in GEM+ vs Non-GEM+ ALC rates**

% GEM admitted cases that become ALC   **-**   % Non-GEM cases admitted that become ALC   = _____
within 30 day   within 30 days

G. Calculate number of cases diverted
- Rationale: If the GEM+ program was not available, then the cases regularly seen by GEM+ nurses would have been seen by Non-GEM+ nurses and the Non-GEM+ ALC rate would apply. If the Non-GEM+ ALC rate is higher, this would lead to more cases becoming ALC. The number of additional ALC cases is then interpreted as the number of ALC cases diverted by GEM+.

Total ED GEM cases in the fiscal year (N)   **x**   % difference in GEM ALC rate vs Non-GEM ALC rate   = _____

H. Calculate bed days saved
- Rationale: The Non-GEM+ average length of stay (ALOS) is utilized because if the GEM+ program was not available then those cases would be seen by Non-GEM+ staff and the Non-GEM+ ALOS would apply. Length of stay is typically broken down into the acute length of stay and the ALC length of stay and both are included in this calculation

cases diverted by GEM   **x**   Acute LOS + ALC LOS of Non-GEM admitted cases that become ALC's   = _____

I. Calculate hospital beds saved

     # bed days saved   = _____
365 hospital days a year

J. Calculate cost avoidance
- Rationale: The Non-GEM+ total cost for each case is utilized because if the GEM+ program was not available then those cases would be seen by Non-GEM+ staff and the Non-GEM+ total cost would apply.

ALC cases diverted by GEM   **x**   Total cost of a Non-GEM ALC case   = _____

K. **Total Resource Savings and Cost Avoidance due to Differences in GEM+ & Non-GEM+ Admission Rates & ALC Rates**

Table 3: Summary Data for Diverted Cases

Total # cases diverted	Total bed days Saved	Total hospital beds saved	Total costs avoided
B + G	C + H	D + I	E + J

6. Part A: Analyze Per Case Differences for Admitted Cases

Table 4

# cases admitted at ED index visit	Difference between GEM+ and Non-GEM+ LOS per case	Bed days	Hospital Beds	Cost per case	Cost avoidance for all admitted cases for FY
A	B	C	D	E	F

A. Calculations for # of cases admitted at ED index visit

Total # GEM cases admitted at ED index visit = _____

B. Calculate the difference between GEM+ and Non-GEM+ Length of Stay per case for cases admitted at ED index visit

Difference between (GEM Acute LOS) and   **+**   Difference between (GEM ALC LOS) and   **=** _____
(Non-GEM Acute LOS) Admitted at Index ED visit   (Non-GEM ALC LOS) Admitted at Index ED visit

C. Calculate the # of bed days saved per case for cases admitted at ED index visit

Total GEM cases admitted at ED Index visit **x** Difference between GEM and Non GEM+ LOS (acute and ALC) = _____

D. Hospital beds saved per case for cases admitted at ED index visit

Bed days saved per case for cases admitted at ED index visit = _____
365 hospital days in a fiscal year

E. Cost avoidance per case for each case admitted at index visit

Total cost for a GEM ED index visit **–** Total cost for a Non-GEM ED index visit = _____

F. Total cost avoidance for all cases admitted at index visit

GEM admitted cases **x** Total cost avoidance for an ED index visits = _____

Table 5

# cases admitted at re-visit	Difference between GEM++ and Non-GEM+ LOS per case	Bed days	Hospital Beds	Cost per case	Cost avoidance for all admitted cases for FY
G	H	I	J	K	L

G. # of cases admitted at ED re-visit

Total GEM cases admitted at ED re-visit = _____

H. Difference between GEM+ and Non-GEM+ Length of Stay per case for cases admitted at ED re-visit

Difference between (GEM Acute LOS) and   **+**   Difference between (GEM ALC LOS) and   **=** _____
(Non-GEM Acute LOS) Admitted at ED re- visit   (Non-GEM ALC LOS) Admitted at ED re-visit

I. Bed days saved per case for cases admitted at ED re-visit

Total GEM cases admitted at ED re-visit **x** Difference between GEM and Non GEM+ LOS (acute and ALC) = _____

J. Hospital beds saved per case for cases admitted at ED re-visit

Bed days saved per case for cases admitted at ED re-visit = _____
365 hospital days in a fiscal year

K. Total cost avoidance for each case admitted at re-visit

GEM admitted cases x Total cost for each GEM ED re-visit case = _____

L. Total cost avoidance for all cases admitted at re-visit

Total cost for each case   x   # GEM ED re-visits = _____

M. Total Resource Savings and Cost Avoidance due to Per Case Differences between GEM+ & Non-GEM+ cases

Table 6: Summary Table

Total # cases admitted	Total difference between GEM+ and Non-GEM+ LOS per case	Total Bed days	Total Hospital Beds	Total Cost per case	Cost avoidance for all admitted cases for FY
A + G	B + H	C + I	D + J	E + K	F + L

6. Part B: Analyze Per Case Differences for ALC Cases

Table 7: Data for ED Index Visits

# cases admitted at ED index visit that become ALC	Difference between GEM+ and Non-GEM+ LOS per case	Bed days	Hospital Beds	Cost per case	Cost avoidance for all admitted cases for FY
A	B	D	D	E	F

A. Calculations for # of cases admitted at ED index visit that become ALC

Total # GEM cases admitted at ED index visit = _____

B. Calculate the difference between GEM+ and Non-GEM+ Length of Stay per case for cases admitted at ED index visit that become ALC

Difference between (GEM Acute LOS) and (Non-GEM Acute LOS)   **+**   Difference between (GEM ALC LOS) and (Non-GEM ALC LOS) = ___
Admitted at Index ED visit that become ALC   Admitted at Index ED visit that become ALC

C. Calculate the # of bed days saved per case for cases admitted at ED index visit that become ALC

Total GEM cases admitted at ED Index visit   **x**   Difference between GEM and Non GEM+ LOS (acute and ALC) = _____

D. Hospital beds saved per case for cases admitted at ED index visit that become ALC

Bed days saved per case for cases admitted at ED index visit = _____
365 hospital days in a fiscal year

E. Cost avoidance per case for each case admitted at index visit that become ALC

Total cost for a GEM ED index visit   **–**   Total cost for a Non-GEM ED index visit = _____

F. Total cost avoidance for all cases admitted at index visit that become ALC

GEM admitted cases   **x**   Total cost avoidance for an ED index visits = _____

Table 8: Data for ED Re-Visits within 30 days

# cases admitted at re-visit that become ALC	Difference between GEM+ and Non-GEM+ LOS per case	Bed days	Hospital Beds	Cost per case	Cost avoidance for all admitted cases for FY
G	H	I	J	K	L

G. # of cases admitted at ED re-visit that become ALC

Total # GEM+ cases admitted at ED re-visit = _____

H. Difference between GEM+ and Non-GEM+ Length of Stay per case for cases admitted at ED re-visit that become ALC

Difference between (GEM Acute LOS) and (Non-GEM Acute LOS) **+** Difference between (GEM ALC LOS) and (Non-GEM ALC LOS) = _____
Admitted at ED re- visit   Admitted at ED re-visit

I. Bed days saved per case for cases admitted at ED re-visit that become ALC

Total # GEM cases admitted at ED re-visit **x** Difference between GEM and Non GEM+ LOS (acute and ALC) = _____

J. Hospital beds saved per case for cases admitted at ED re-visit that become ALC

Bed days saved per case for cases admitted at ED re-visit   = _____
365 hospital days in a fiscal year

K. Total cost avoidance for each case admitted at re-visit that become ALC

GEM admitted cases x   Total cost for each GEM+ ED re-visit = _____

L. Total cost avoidance for all cases admitted at re-visit that become ALC

Total cost for each case   x   # GEM ED re-visits = _____

M. Total Resource Savings and Cost Avoidance due to Per Case Differences for ALC Cases

Table 9: Summary Data for Non-Diverted Cases

Total # cases admitted	Total difference between GEM+ and Non-GEM+ LOS per case	Total Bed days	Total Hospital Beds	Total Cost per case	Cost avoidance for all admitted cases for FY
A + G	B + H	C + I	D + J	E + K	F + L

b.) Total Cost Avoidance for all per case differences in ED visits, Admitted Cases and ALC cases

2012/13 FY CTAS 3-5	ED cost per case	Admission cost per case	ALC cost per case	Per Case Costs
admitted at index visit				
admitted at re-visit				

c.) Cost Avoidance for all per case differences for GEM+ cases in 2012/13 Fiscal Year

2012/13 FY CTAS 3-5	932/232 ED cases in 2012/13 FY	86/76 admitted cases in 2012/13 FY	30/17 ALC cases in FY 2012/13	Total Costs Avoided for all cases in 2012/13 FY
admitted at index visit				
admitted at re-visit				

7. Determine impact on bed days

a) Resource sparing for "admission or ALC rate differences" and "per case differences"

2012/13 FY	Bed days Saved (due to different admission or ALC rates)	Bed days Saved (due to difference in LOS per case for GEM+ cases admitted)	Total Bed days saved
% CTAS 3-5			

2012/13 FY	hospital beds saved (due to different admission or ALC rates)	hospital beds saved (due to difference in LOS per case for GEM+ cases admitted)	Total hospital beds saved
% CTAS 3-5			

8. Determine impact on cost avoidance

a) Cost avoidance for "admission or ALC rate differences" and "per case differences"

GEM cost avoidance for all cases in the fiscal year **-** the cost of running the program (e.g., staffing costs) = _____

9. Identify GEM+ Program Costs

Select the total cost for running the program in the fiscal year selected.

10. Determine total impact of GEM + on hospital resources and costs determined for FY selected

GEM+ Cost Avoidance and Resource Savings	
Total cost avoidance due to differences in admission rates and ALC rates	
Total cost avoidance due to per case differences	
Total	
GEM+ Program Costs	
GEM+ program costs	
Total Resource Savings and Cost Avoidance	

Appendix B: Flow Chart

Total # ED Visits

```
                         ◇ GEM or
                           Non-GEM

   Total # GEM Visits                    Total # Non-GEM Visits

        ◇ Admit or                              ◇ Admit or
          Discharge                               Discharge
```

_____Total # Discharged at Index Visit

 # GEM Discharged
Non-Admits
Discharged Home

 # Non-GEM Discharged
Non-Admits
Discharged Home

_____Total # Admitted at Index Visit

 # GEM Admitted
Direct Admits from
Index visit

GEM Admitted
become ALC

 # Non-GEM Admitted
Direct Admits from Index
visit

Non-GEM Admitted
become ALC

 # GEM Direct Admits become ALC

 # Non-GEM Direct Admits Become ALC

stay discharged

stay discharged

 # GEM Revisit ED

◇ Admit or Discharge

 # Non-GEM Revisit ED

◇ Admit or Discharge

_____Total # Admitted at ED Revisit

 # GEM Discharged
Discharged and were not
admitted ≤ 30 days

 # Non-GEM Discharged
Discharged and were not
admitted ≤ 30 days

 # GEM Admitted
Non-Admits
Revisit + Admitted ≤ 30 days

 # GEM Admitted
Non-Admits
Revisit + Admitted ≤ 30 days

**# GEM
Non-Admits
Discharged**

**# Non-GEM
Non-Admits
Discharged**

**# GEM Total Admits
≤ 30 days**

**# Non-GEM Total Admits
≤ 30 days**

**# GEM
Discharged cases that
re-visit ED ≤ 30 days**

**# Non-GEM
Discharged cases that
re-visit ED ≤ 30 days**

**# GEM
Discharged cases that
revisit ED & are admitted
≤ 30 days**

**# Non-GEM
Discharged cases that
revisit ED & are admitted
≤ 30 days**