

A STUDY OF THE IMPACT OF CLINICAL EDUCATION ON ACADEMIC HOSPITAL EXPENSES

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by Alexandra Flatt and Rami Rahal

The objective of this study was to describe the impact of teaching activity on academic hospital operating expenses and to develop an approach for quantifying it financially. The costing methodology developed in the study (the infrastructure and support, and the direct patient care components) was intended to form a foundation for a more comprehensive and definitive academic hospital costing study. Financial impact figures produced in this study should be regarded as directional in nature and are provided to demonstrate the application of the methodology; they are not intended to be used as is for actual funding allocation or other policy decisions.

Executive Summary

Study Objectives

This study is aimed at identifying and quantifying the incremental costs borne by academic hospitals (CAHO member hospitals) in educating future clinicians. The study focuses on medical education costs, while also providing a high level description of the parameters associated with nursing education.

The scope of this work includes an examination of the following:

- The contribution of academic hospitals to the education of medical trainees, relative to community hospitals.
- Infrastructure and support resources incurred by academic hospitals in educating medical trainees.
- The differences in direct patient care costs between academic and community hospitals.

The study also includes a preliminary review of nursing education activity in academic hospitals.

General Approach

The Council of Academic Hospitals of Ontario (CAHO) represents all Ontario academic and research hospitals that are fully affiliated with university medical or health sciences schools. CAHO's 22 hospitals constitute approximately half of the hospital sector resources, conduct the greatest majority of all hospital-based clinical training and nearly all of the health research in the province of Ontario, Canada (additional background information is available at the CAHO website www.caho-hospitals.com).

This report summarizes all of the information collected through interviews, surveys, the literature and data analysis. Much of the work draws upon information that is not regularly reported, which was obtained through the efforts of CAHO and its member hospitals.

The study began with a review of the literature to identify new developments in the measurement and quantification of the costs associated with clinical education in hospitals. Data provided by the Ontario Ministry of Health and Long Term Care (Ministry of Health, MOHLTC) on the numbers and types of medical trainees was then analyzed to identify the trends in the provision of medical trainee education across Ontario's hospitals. Interviews were then conducted with leaders in medical and clinical education from hospitals and universities to better understand the components of the academic mission for medical and nursing trainees. This was followed by a micro-costing survey to estimate the hospital infrastructure and support costs associated with

medical trainees. Finally, an analysis of patient-level or case cost data was conducted to better understand differences in direct patient care costs between academic and non-academic (i.e., non-CAHO member) hospitals.

The results of the study provide further clarity regarding the role of academic hospitals in clinical education and provide more detailed estimates of the financial impacts of this role on hospitals. Recommendations regarding improvements to the case mix grouping methodologies, to better reflect the resource patterns of types of cases treated mostly in academic hospitals, are also presented, as well as recommendations on improvements to the clinical education data collection tools to facilitate future cost impact studies.

Academic Hospital Cost Factors Identified Through the Literature

A comprehensive literature review was conducted for CAHO in March of 2005, by the HayGroup, entitled “*The cost impact of the academic mission of teaching hospitals – a review of the literature*” (available at www.caho-hospitals.com). A less extensive literature review was conducted for this study to complement and update the information obtained in the previous review.

Overall, the literature identifies that the cost differential between academic and community hospitals is attributed to one or more of the following factors:

- Actual and measurable difference in case mix between academic and community hospitals.
- Unmeasured differences in case mix.
- Differences in the content and cost of care related to the early adoption of high technology.
- A necessity to maintain standby capacity for highly specialized patient care.
- Higher utilization rates and lower patient throughput.
- A higher quality of care in academic hospitals (explained by such factors as more comprehensive service delivery or better outcomes due to higher volumes in more specialized cases).
- Direct and indirect investments associated with the provision of medical education.
- Costs associated with the health research mandate.

Role of Ontario Academic Hospitals in Medical and Nursing Education

Ontario Academic Hospitals commit a wide range of resources in support of the education of medical and nursing students. A significant amount of physician and nursing leadership is dedicated to ensuring a high quality education for students. The main categories of resources provided are as follows:

- Management, coordination, and clerical support to the students.
 - Physical space in the form of lecture halls and classrooms, duty rooms, locker rooms, etc.
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- Higher consumption of clinical and other supplies (e.g., gowns, masks, gloves, pagers).
- Additional information technology including networking, computer terminals, and internet access.
- Clinical technology to support education.
- Additional library and audiovisual services and capacity.
- Additional personnel services (e.g., occupational health and safety).

In addition to the resources mentioned above, hospital clinical staff dedicate significant portions of their time to training and mentoring students and residents. The impact of training and mentoring on staff productivity has not been thoroughly examined in the literature reviewed, but is an important aspect of ‘systemic sustainability’.

Analysis of Medical and Nursing Trainee Activity in CAHO and Non-CAHO Hospitals

An analysis of medical trainee data was then conducted to better understand the roles of academic versus community hospitals in the provision of medical education. The analysis was conducted on medical trainee days, which are reported annually by all Ontario hospitals. Undergraduate students in years 1 and 2 are not comprehensively tracked across the province and are therefore excluded from the analysis. The analysis revealed that:

- There is a slow and steady increase in the contributions of community hospitals (i.e., non-CAHO member) to the training of medical students. Academic hospitals, however, still train the overwhelming majority of medical students (over 80%).
- This trend does not represent a shift of training from academic to community hospitals but rather a system-wide increase in training capacity (with overall medical student days increasing by 9% in 2004/05).
- Academic hospitals train a higher proportion of post-graduates, with 90% of residents and 99% of fellows being trained by academic organizations. While the academic proportions have not decreased in the years examined, they are expected to (for residents) as more medical students trained in community hospitals complete their residency in those locations.
- Family Medicine is the one specialty where a substantial proportion of trainees (approximately 40%) are trained in community hospitals.

Academic hospitals train Registered Nurses (RNs), Registered Practical Nurses (RPNs), Clinical Nurse Specialists (CNS), and other post graduate, advanced practice, and retraining programs. The larger academic hospitals train over 2,000 nurses per year.

While nursing students are trained in both community and academic hospitals, academic hospitals have a higher proportion of placements and they typically have more internal resources to manage and support the placements (through the Nursing Administration or Nursing Education office). Academic hospitals also train a proportionately higher number of RNs and post graduate nurses versus RPNs.

There is very little information in the literature on the impact of nursing education on hospital operating expenses. The majority of studies focus on the implications of medical education. However, nursing education leaders interviewed in this study reported a number of implications of training students on staff work life issues and hospital operating costs, including:

- Higher infrastructure and support expenses related to the nursing education office acting as a liaison with management, the university and staff.
- Possible higher consumption of medical and surgical supplies by students.
- The impact of educating nurses on staff nurses' workload leading to higher overtime and potentially a higher risk of burnout and associated sick time.
- There is no measurable impact of nursing education on patient service utilization (according to those nursing education leaders interviewed).

An analysis of a sample of nursing student statistics in academic hospitals identified that the requirements for RN preceptorship total over 50 RN FTEs in large academic hospitals. This statistic requires validation in subsequent studies that will focus more on nursing resource impact.

Analysis of Infrastructure and Support Costs Associated with Medical Education

To provide an estimate of the infrastructure and supporting operating costs dedicated to the provision of medical education, a micro-costing survey was conducted. A survey was created and completed by three academic hospitals. Considerable amount of time was spent ensuring that the surveys were completed consistently across the sites and the results provide a first attempt to quantify the infrastructure and support related costs to medical education.

The infrastructure and support operating expenses related to the education of medical trainees in academic hospitals was calculated at \$42 per medical trainee day. These costs represent 0.9% - 1.5% of total operating costs in the larger acute care academic hospitals and an average of 1% of operating costs across all CAHO hospitals or \$58 million.

This survey did not attempt to measure the initial 'set-up' capital infrastructure costs associated with teaching (i.e., the cost of building new space).

Analysis of Patient Care Cost Differences between Academic and Community Hospitals

The final component of this study focused on the differential direct patient care costs between academic and community hospitals, to evaluate the degree to which this differential is related to:

- Unmeasured severity in the patient grouper and/or
 - Differences in care models and/or utilization patterns at the functional centre level.
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Patient-level data provided by the Ontario Case Costing Initiative was the primary source of information for this analysis. A number of analyses were conducted and are summarized below.

An analysis was first conducted to estimate the academic direct cost differential among typical cases. The study tested for differences in direct costs (typical cases only) across a reference group of 13 Case Mix Groups (CMGs) with relatively homogenous resource patterns controlling for case mix, length of stay (LOS) and hospital-specific factors. The analysis identified that differences in LOS among academic and community hospitals explain only a small part of the academic direct cost differential. In addition, the analysis identified that, controlling for differences in LOS, the academic cost differential among typical cases is equivalent to 12% (i.e., on average, academic direct costs are 12% higher than community costs after controlling for LOS and other factors). This differential is likely a result of higher non-LOS utilization (e.g., drugs) and/or higher cost per unit (e.g., cost of standby capacity).

A second analysis was conducted that focused on LOS outlier cases only. The analysis identified that among the outlier cases, the average direct cost of academic hospitals was at least twice that for community hospitals for over 100 CMGs. In addition, the 75th percentile typical LOS (a proxy for overall severity) and direct cost ratio is substantially greater in academic hospitals in 85 CMGs. This analysis identifies that there is an unmeasured case mix effect in academic hospitals and suggests that for at least a sub-set of CMGs, the groups are heterogeneous and not accurately measuring resource intensity in academic hospitals. A list of CMGs with a significant amount of heterogeneity are provided within the body of the report.

The last set of analyses, focused on clarifying the academic cost differential at a functional centre level. An analysis of the direct costs of a relatively homogeneous group of CMGs at the modal (most common) LOS revealed wide variations in costs within academic organizations and across academic/community organizations. A second analysis by cost centre provided further clarity on this variation and indicated that the academic cost differential varies on clinical program and cost centre. The results indicated that by clinical program (for typical cases and controlling for LOS):

- Perinatal cases in academic organizations tend to cost approximately 23% more than cases in community hospitals
- Surgical cases in academic organizations tend to cost on average 19% more than community hospitals
- Medical cases in academic organizations tend to cost on average 14% more than community hospitals

Analysis at the cost centre level revealed that the highest cost differentials between academic and community hospitals were in Pharmacy, Clinical Laboratory, and Allied Health.

These evidence-based findings have significant policy, funding and resource implications.

Conclusions and Recommendations

The study identified that significant costs are borne by academic hospitals as a direct result of their teaching mandate. Academic (CAHO member) hospitals continue to train the vast majority of medical students and residents and almost all fellows. In addition, the number of medical trainees at academic hospitals continues to rise annually. They also train a large number of nurses annually, over 2,000 in the larger academic centres.

Academic hospitals make available an important part of their infrastructure and support services towards the education of medical trainees. This represents around \$58 million annually or 1% of total operating costs, most if not all of it funded through the hospital's own global budget.

Direct patient care costs in academic hospitals were found to be 12% higher than in non-academic hospitals controlling for length of stay and case mix. Unmeasured case mix effects were identified as contributing an additional 6% differential.

Upon reviewing the results of this study (specifically as it pertains to the heterogeneity found within the current case mix grouper), the CAHO Council recommended actions in response. These include:

- Implementation of Short Term Policy Action: The Ministry of Health and Long Term Care and the Joint Policy and Planning Committee's (JPPC) Funding Committee should be asked to more accurately and comprehensively account for the teaching cost factors identified in this study in the redevelopment of hospital funding and performance measurement tools.
- Implementation of Longer Term Policy Action: The Canadian Institute for Health Information (CIHI) should be asked to fast track the redevelopment of the Case Mix Grouping methodology. The objective would be to address the current gaps in the ability of the case mix grouping tools to accurately reflect patient care resource patterns typical of academic hospitals.

The study also makes the following recommendations for improving the Ontario system's ability to accurately measure the cost impact of clinical education:

1. The methodology used in this study should be further refined. This includes refinement of the micro-costing methodology and the case costing analysis to allow for a more comprehensive and thorough investigation of the infrastructure and support costs related to pursuing the academic mission. Given the expansion of the medical model in Ontario, additional evidence pertaining to operating and infrastructure-related impacts on hospitals, would be helpful.
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2. A process should be implemented to report provincial nursing education activity similar to that for the medical trainee data.
3. The infrastructure and support costing approach should be applied to nursing education, as well as to diagnostic and therapeutic services.
4. In the longer term, a prospective, standardized data collection process should be developed to facilitate ongoing, reliable quantification of clinical education costs (beyond medical trainee costs) in academic and community hospitals.

Note on Terminology:

This report makes references to academic and community hospitals. This does not suggest that those hospitals defined as community do not have an academic mandate (i.e. teaching and research) because many do. The terms are used to simplify the differentiation between organizations that have full affiliation agreements with medical schools (and are such formally assigned as teaching hospitals by the Ministry of Health and Long Term Care) and those that do not. The report also refers to CAHO and Non-CAHO hospitals as a more explicit term referring to formal membership in CAHO.

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1. INTRODUCTION

Study Objectives

This study is aimed at identifying and quantifying the incremental costs borne by academic hospitals in educating future clinicians. The study focuses on medical education costs while also providing a high level description of the parameters associated with nursing education.

Currently, the provincial hospital funding formula known as the Integrated Population Based Funding Allocation or IPBA includes an adjustment for teaching activity in assessing a hospital's expected cost per weighted case. This adjustment is derived from a regression formula that uses the ratio of medical trainee days over total hospital patient days as a proxy for teaching activity. There is no explicit reference in this formula to the factors contributing to this measured teaching cost effect. To date, few studies have been done in Ontario, or elsewhere for that matter, to objectively identify and quantify these factors in a comprehensive manner.

The purpose of this study, is to provide insight and clarity on the hospital resources consumed in providing clinical education (specifically, medical education). To do so, the study attempts to address the following questions:

- What is the contribution of academic hospitals to the education of medical trainees relative to community hospitals and how is that changing?
- What infrastructure and support resources do academic hospitals provide for the education of medical trainees and what is their impact on the operating costs?
- What is the difference in direct patient care costs between academic and community hospitals and what are some of the explanations for that difference?

The study also provides a preliminary review of nursing education activity in academic hospitals as a precursor to a more comprehensive analysis (similar to what was done in this study for medical education). The Council of Academic Hospitals of Ontario (CAHO) may also consider expanding the scope to include all health professional education including Allied Health services.

The study employs the following approaches:

- A literature review to complement and update the comprehensive literature review conducted for CAHO in March of 2005 titled "The cost impact of the academic mission of academic hospitals – a review of the literature".
- Interviews with medical and nursing education leaders in a number of academic hospitals and in medical and nursing schools.

- An analysis of the Ministry of Health and Long Term Care's medical trainee database to identify trends in the number and type of medical trainee for CAHO and non-CAHO hospitals.
- A micro-costing survey and analysis to examine the infrastructure and support costs incurred by hospitals in the education of medical trainees.
- An analysis of provincial case cost data to examine the differences in direct patient care costs between academic and community hospitals.

Each of the above approaches are described in more detail in the relevant sections to follow.

Academic Hospital Cost Factors

The cost differential between academic and community hospitals has been examined in a number of studies and research projects, in Ontario and beyond. These efforts attribute this cost differential to one or more of the following factors:

- **Actual and measurable difference in case mix compared to community hospitals:** This relates to the evidence that academic hospitals tend to treat a high percentage of more complex and resource intensive types of cases than non-academic hospitals. The higher complexity can be measured using available case mix grouping and weighting tools. A U.S. study measuring academic hospital costs found that approximately one-third of the difference between academic and community hospital costs are due to case mix (Koenig et al, 2003).
- **Unmeasured differences in case mix:** This relates to those characteristics of the patients treated by academic hospitals that lead to higher treatment costs (described above) but that cannot be easily identified or measured using available case mix grouping and weighting tools. The IPBA funding formula for example, includes a tertiary adjustment that at least in part, attempts to address the issue of unmeasured complexity among tertiary and quaternary cases.
- **Differences in the content and cost of care related to the early adoption of high technology:** Academic hospitals tend to adopt advanced technology and newly introduced and expensive modalities ahead of community hospitals (e.g., neonatal extracorporeal circulation machines - ECMO). This is to carry out their research and teaching mandate, to treat the more complex cases they tend to care for, and because they often have critical mass (of professionals and patients) to justify this early introduction (Covey and Friedlander, 2004). Our interviews also indicated that academic organizations may be early adopters to attract students and/or new physicians at their organization.
- **A necessity to maintain standby capacity for highly specialized patient care:** Academic hospitals tend to provide very specialized services that are aimed at treating relatively rare types of illnesses and injuries (e.g., specialized burn units). Academic hospitals have more critical mass to support these services than community hospitals yet not enough to achieve economies of scale typical of less specialized hospital services. These

specialized services may be technological in nature but, could also be highly specialized staff members.

A U.S. study identified that 19% of the difference between academic and non-academic hospital costs was due to stand-by capacity (Koenig et al., 2003).

- **Higher utilization rates and lower patient throughput:** There are numerous references to the argument that medical trainees tend to order more services (such as laboratory tests or medical images) and increase patient length of stay (due to delayed discharge) as a result of their learning process. A recent study in the U.S found that patients cared for by residents cost as much as 30% higher than if they were cared for by attending physicians (Charlson et al 2005). Another study examined the impact of teaching on operating room time and found it to be almost 70% longer on average when residents are involved (Bridges et al, 1999). There is also evidence to suggest that having medical trainees around an ambulatory care clinic increases the duration of the visit and reduces patient throughput, consequently increasing the fixed cost per patient visit (Denton et al, 2005). The introduction of innovative training techniques such as the surgical skills centre (e.g. Mount Sinai) whereby the hospital creates a laboratory for students to practice basic and complex procedures will only add to the fixed costs borne by academic centres.
- **A higher quality of care:** There are a variety of published studies, especially in the United States, that suggest that academic hospitals deliver a higher quality of care than community hospitals for the same types of cases and that this entails higher costs. This higher quality is often associated with higher volumes in academic hospitals, especially for complex surgeries (Dimick et al, 2004), and also with a more comprehensive spectrum of diagnostic and therapeutic services often available in academic hospitals (NSW Australia Department of Health, 2004).
- **Direct and indirect investments associated with the provision of medical education:** Academic hospitals are required to provide additional resources for the purposes of medical education that community hospitals are not required to do. This may include resources such as physical plant capacity (libraries, duty rooms, classrooms), specialized facilities such as medical simulation theatres and clinical skill laboratories, information technology services, and education, coordination and support staff.
- **Costs associated with the research mandate:** While research activities are often funded through grants, academic hospitals are still often responsible for building the research infrastructure (personnel and capital). Also, research activities may translate to higher utilization of hospital services (e.g., Diagnostic Imaging, Clinical Laboratories) which may not always be fully funded. Koenig et al (2003) identified that six percent of the academic cost differential is related to research related activities.

While it is recognized there are cost differences between academic and community hospitals, these costs can be viewed as investments in health/medical education and

research that provide a long-run value to society; the investments help ensure a sustainable health care system.

Cost of Nursing Education

Far less research has been focused on the impact of nursing education on hospitals costs. One window into the relationship between nursing and medical education costs is the Medicare funding methodology. In 1991, approximately 11% of Graduate Medical Education funding in the United States went to hospitals for the training of nurses (Aiken et al, 1995). Hence, although the majority of funds are dedicated to the training of medical students, a substantial proportion of costs are also incurred in the training of nursing students.

A Finnish study examined the impact of nursing as well as medical education on hospital costs and found a significant statistical relationship between the number of nursing placements and hospital costs (Linna et al, 1988). The same study suggested that nursing students are less productive and that they use more time, materials and tests for the same task as professionals contributing to the higher costs.

Ontario academic hospital nursing leaders interviewed, reported that nursing staffing ratios are not increased to accommodate the preceptorship and mentoring time required of the nursing staff for nursing students. This has a significant impact on increased workload burden leading to higher overtime and increased burnout leading to higher sick time. Besides the significant work life implications, these translate to an operating cost impact on the academic hospitals that train a large number of nurses.

Despite the added costs incurred by academic hospitals in fulfilling their mandate, there is an extraordinary benefit to existing and future patients from having a place for the provisions of the most complex care. This flows from ensuring a continued supply of highly qualified health professionals, the knowledge attained through health research enterprise which contributes to improved provision of care and better quality of life.

Note on Terminology:

This report makes references to academic and community hospitals. This does not suggest that those hospitals defined as community do not have an academic mandate (i.e. teaching and research) because many do. The terms are used to simplify the differentiation between organizations that have full affiliation agreements with medical schools (and are such formally assigned as teaching hospitals by the Ministry of Health and Long Term Care) and those that do not. The report also refers to CAHO and Non-CAHO hospitals as a more explicit term referring to formal membership in CAHO.

2. DESCRIPTION OF TEACHING ACTIVITY IN ACADEMIC HOSPITALS

This section provides a qualitative and quantitative description of the medical and nursing education and training activity that occurs in academic hospitals. The qualitative information was obtained through interviews with academic hospitals and universities and colleges while the quantitative information was obtained through an analysis of the Ontario Ministry of Health medical trainee data and nursing trainee data from select academic facilities.

2.1 Description of Medical Education & Training Activity

2.1.1 Qualitative Description of Medical Education and Training Programs

Methodology:

Interviews (face-to-face and phone) were conducted with the Vice Presidents of Medical Education in the following academic hospitals:

- Sunnybrook and Women's Health Science Centre
- London Health Sciences Centre and St. Joseph's Health Care, London
- The Ottawa Hospital
- Kingston General Hospital
- St. Joseph's Hospital – Hamilton.

Interview Guides were provided to each hospital prior to the interviews. The guides contained interview questions and basic information forms that hospitals were asked to complete and are provided in Appendix 1.

The purpose of interviews was to better understand the roles played by academic hospitals in the training of medical students, residents, and fellows and to identify the types of hospital resources used in the education and training activity.

As part of this qualitative review, interviews were also conducted with select medical schools to obtain the perspectives of the education facilities on the role of academic hospitals in the medical education. Interviewees included personnel from the University of Toronto, Queen's University, and the University of Ottawa.

The findings of this qualitative review are summarized in the following section.

Findings:

Ontario academic hospitals provide a wide range of direct and indirect resources in support of the training of medical and nursing students. There is some variation among academic hospitals in the scope and magnitude of resources provided. This is especially true as it relates to the degree to which classes and lectures are delivered in the hospital versus on the university campus. The majority of indirect medical education resources are financed through the academic hospitals' operating budget. The main categories of resources provided include:

- Management, coordination, and clerical support to the students provided by designated staff in the Medical Education and/or Nursing Administration offices.
- Physical space in the form of lecture halls and classrooms, duty rooms, locker rooms, etc. This space requires plant operation, maintenance, and housekeeping resources as well as sundry supplies, furnishings, and information and audiovisual technology.
- Higher use of clinical and other supplies (e.g., gloves, scrubs, pagers, ID badges).
- Additional information technology including networking, computer terminals, and internet access.
- Clinical technology to support education – this may include more equipment time (for education, e.g. CT/MRI simulation time, Radiation Technology training, etc.) or the need for more advanced equipment to ensure up-to-date education standards.
- Additional Library and Audiovisual services and capacity.
- Additional personnel services (e.g., occupational health and safety).

While medical trainees from all years utilize hospital resources, significant use of hospital facilities and resources typically begins in the clerkship years (undergraduate years 3 and 4). In the first two undergraduate years, trainees typically spend less than two days per week from September through April at the hospital (although this may vary by university). Year 3 and 4 clerks are assigned to patients and will write medical orders (typically counter-signed by staff physicians). There are some variations from this undergraduate training model, notably McMaster, where students spend significant time at the hospital throughout the three-year program (no summer breaks).

Post-graduate medical trainees have comparable impact on hospital infrastructure and support costs as staff physicians since they are essentially functioning as hospital physicians. Large academic hospitals typically have more than 200 residents practicing in any given year. On the other hand, the residents are not compensated directly by the hospital for the medical services they provide. This constitutes a financial *advantage* for academic organizations over community hospitals that typically pay for comparable medical services (provided by hospitalists, locums, intensivists, etc).

Besides undergraduates (clerks) and residents, academic hospitals are the primary training sites for medical fellows. While many fellows are compensated through private funds, many others are paid directly by the hospitals in which they practice. This constitutes an additional financial *burden* on academic hospitals.

Most of those interviewed felt that medical trainees increase clinical service utilization. This utilization impact was cited to be most pronounced for diagnostic services (ordering more tests/exams than is necessary) and in increased length of stay (reluctance to discharge patients). This impact is noted starting with Year 3 and 4 undergraduates as they begin writing orders (that are countersigned) and continues for post graduates whose orders do not need to be counter-signed (although they do not have admitting privileges).

More and more hospitals are setting up clinical skill and simulation laboratories for training medical students. These are usually funded by the hospital although some receive private capital funds. This is becoming another significant resource burden for academic hospitals.

Academic hospitals also typically provide free clinic and office space to their clinical fellows and GFTs. Community hospitals do not typically provide this service.

2.1.2 Quantitative Analysis of Medical Education and Training Programs

Methodology:

The data source for the analysis conducted in this component of the study is the Ontario Ministry of Health and Long Term Care Medical Trainee Database. The database was obtained for the fiscal years 2001/02 through 2004/05. The medical trainee data is submitted by all Ontario hospitals to the Joint Policy and Planning Committee (JPPC) on an annual basis. The primary purpose of this database is to inform the development of the teaching adjustment in the provincial population based hospital funding allocation formula. The data provides the number of medical trainee days by individual medical trainee and also provides trainee year or level (undergraduate or graduate year of training) and the clinical program the training was associated with.

In this study, the database was used to study the trends in medical education activity over the last four years and the proportion of this activity provided in CAHO versus non-CAHO hospitals.

Note that the reporting of medical trainee days for the first two under-graduates years is not mandatory and, as such, is not consistently or reliably reported. When

examining undergraduate days in this analysis, only students in Year 3 or 4 are included.

Findings:

In the analysis of medical trainee days, hospitals were identified as CAHO and non-CAHO hospitals. Appendix 2 provides a list of the CAHO hospitals as identified for this analysis.

Exhibit 1 below shows the medical trainee days broken down by trainee level (undergraduates in Year 3 or 4, Residents, Fellows and other post-graduates) and is shown for CAHO and non-CAHO hospitals. Note that medical trainee days for Fellows and other Post Graduates were reported beginning in the 2002/03 fiscal year. The analysis shows total medical trainee days in 2004/05 as approaching 1.5 million trainee days of which less than 0.25 million are undergraduates (Years 3 or 4).

Exhibit 1: Medical Trainee Days by Level and CAHO Membership (2001/02 to 2004/05)

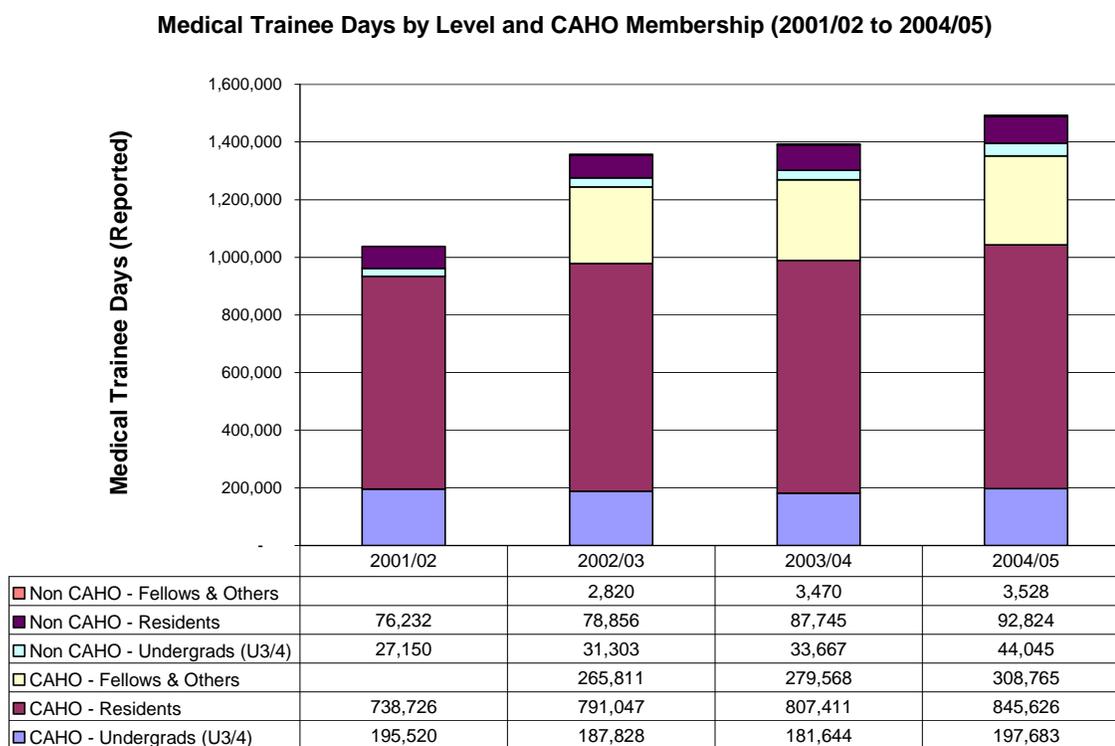
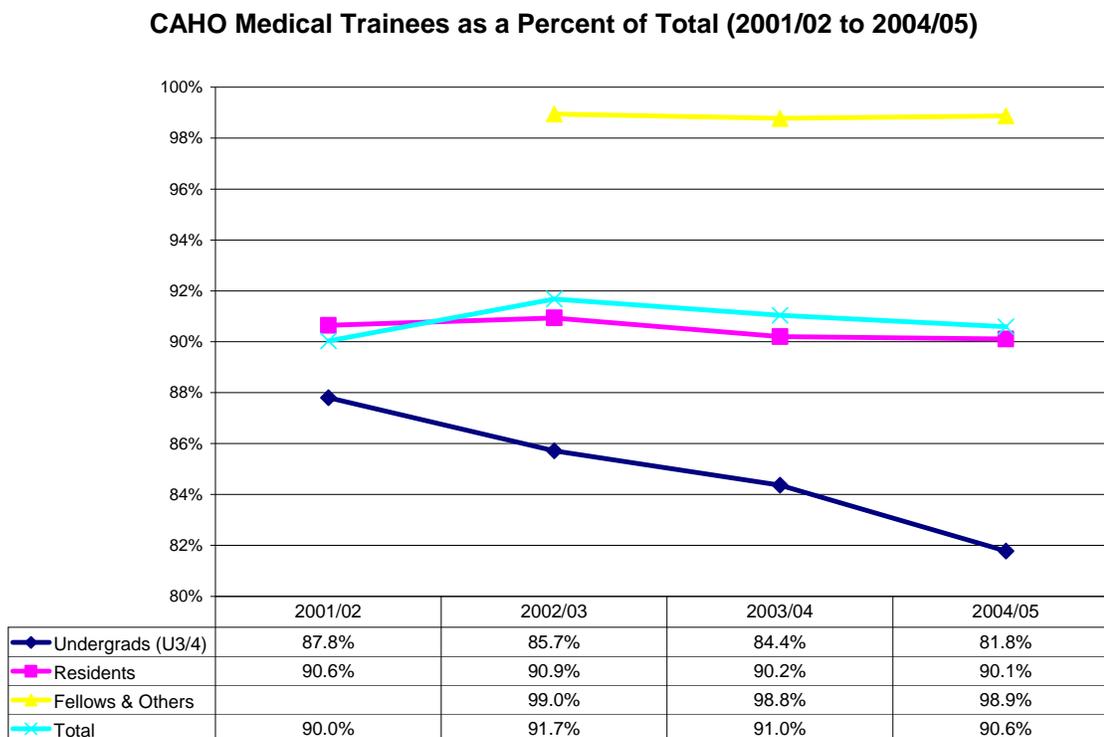


Exhibit 2 indicates the trends in the percent of medical trainee days trained by CAHO hospitals by trainee level over the four years studied. The most obvious trend noted is in undergraduate activity where the percentage of undergraduate days trained by CAHO hospitals decreased from 88% in 2001/02 to 82% in 2004/05. There was no obvious trend for the Resident and Fellow Days. Overall, the percent of medical trainee days in CAHO hospitals dropped slightly from 91.7% in 2002/03 to 90.6% in

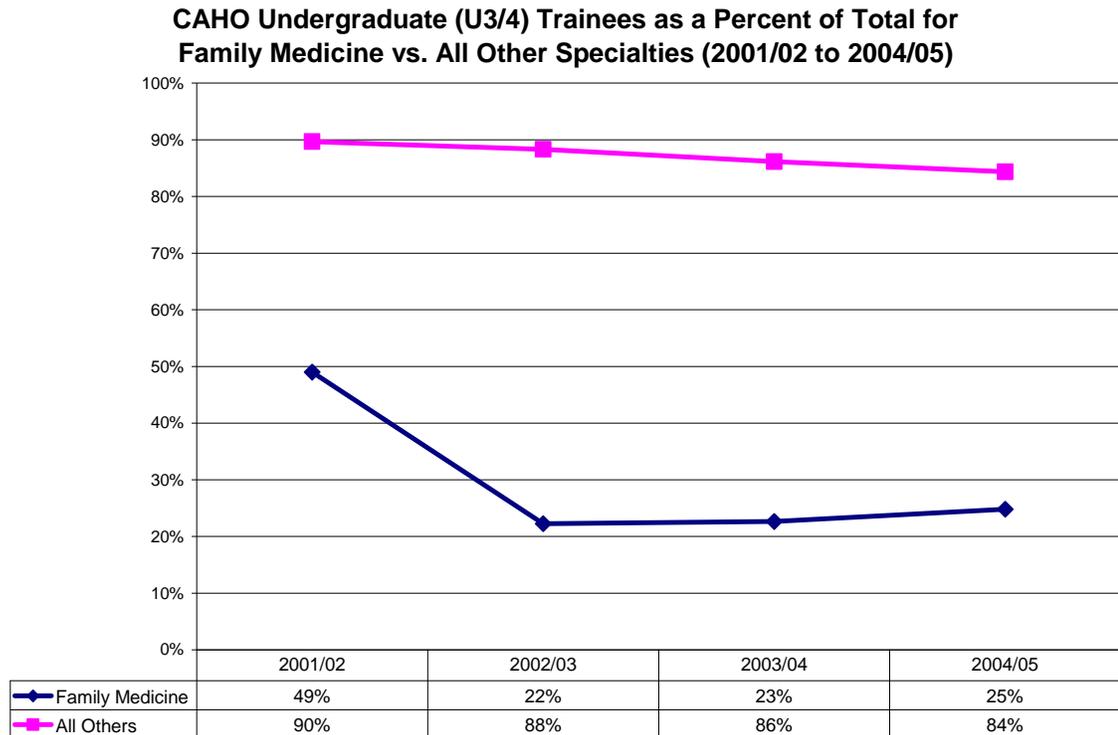
2004/05 (Note: that the total trend is influenced more by the graduate trends than by the undergraduate trends because of the much higher number of graduate trainee days). The increase in the percentage of undergraduate trainees in non-CAHO hospitals does not appear to represent a shift from CAHO to non-CAHO hospitals but more likely an absorption of the continuously increasing demand for training across the system.

Exhibit 2: CAHO Medical Trainee Days as a Percent of Total Medical Trainee Days (2001/02 to 2004/05)



An analysis was then conducted separating out Family Medicine rotations given that undergraduate Family Medicine rotations tend to occur more often in community hospitals rather than academic hospitals. The analysis investigated the extent to which trends in Family Medicine training influence the proportion of undergraduate training being conducted in CAHO hospitals. Exhibit 3 shows that, as expected, the percent of Family Medicine medical trainee days in CAHO hospitals is much lower than the percent in Other Specialties. Notwithstanding 2001/02 which appears to have data quality issues, however, the percent of Family Medicine undergraduate days in CAHO hospitals is actually increasing (from 22% in 2002/03 to 25% in 2004/05) while the percent for other specialties is decreasing (from 88% to 84% over the same timeframe).

Exhibit 3: CAHO Undergraduate Trainee Days as a Percent of Total for Family Medicine versus Other Specialties



Additional analysis was then conducted more generally by clinical program (specialty) for resident days to identify potential variations in the proportion trained by CAHO hospitals. As Exhibit 4 shows, the percentage of resident days trained at CAHO hospitals in 2004/05 is above 90% for all programs with the exception of Family Medicine residents at 60.8% and General Surgery residents at 83.6%.

Exhibit 4: Percent of Resident Trainee Days in CAHO Hospitals by Clinical Program

Percent of Resident Days in CAHO Hospitals by Program (2004/05)

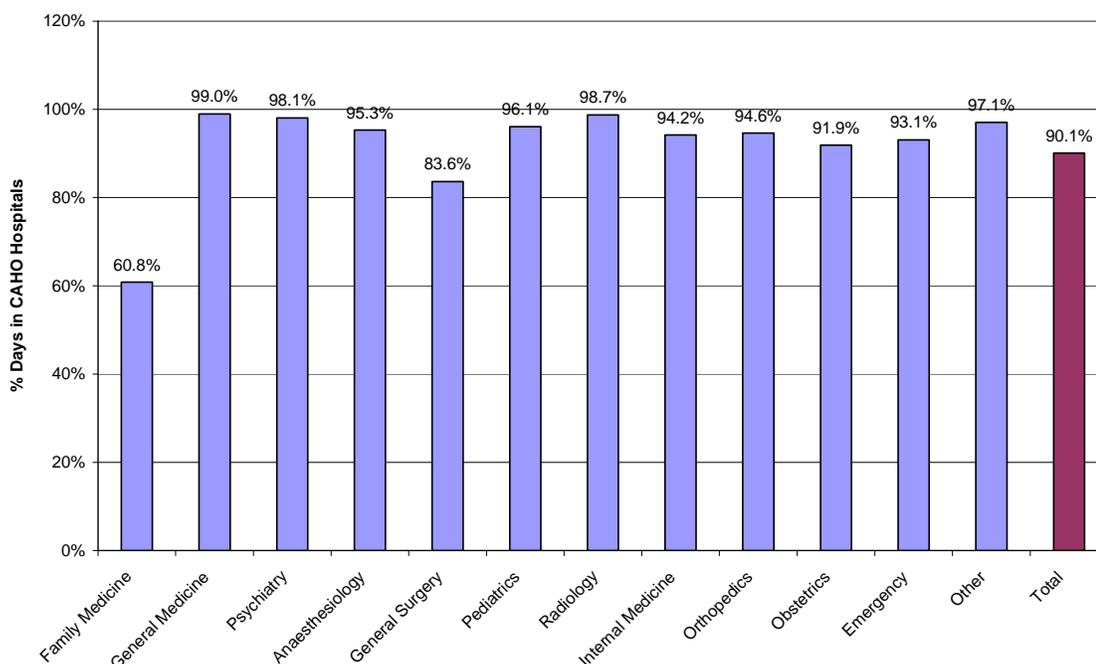


Exhibit 5 summarizes the actual number of medical trainee days by CAHO hospital (and total for non-CAHO hospitals) by level and year. Note the dip in trainee days in 2003/04 due to SARS.

Exhibit 5: Medical Trainee Days by CAHO Hospital (2001/02 to 2004/05)

Hospital	Undergrads (U3&4)				Residents				Fellows & Others		
	2001	2002	2003	2004	2001	2002	2003	2004	2002	2003	2004
UHN	21,131	24,890	19,678	24,333	97,083	94,593	97,512	102,042	56,005	74,619	76,028
Ottawa	21,867	21,039	24,832	21,307	94,087	110,812	119,450	126,698	10,629	11,067	18,197
London HSC	24,699	25,928	29,778	30,589	87,065	91,944	91,112	103,237	13,107	14,295	23,262
Hamilton HSC	16,885	9,036	6,873	12,568	95,458	84,757	86,005	98,507	18,060	16,963	20,942
Sunnybrook & Women's	21,609	18,895	15,003	17,395	61,038	65,300	67,389	74,555	23,640	31,867	34,511
St. Michael's	18,560	19,346	16,127	21,341	58,397	62,263	69,903	71,044	19,794	20,139	22,019
Sick Children	2,993	1,137	2,696	3,807	25,556	57,670	45,863	39,937	74,079	61,540	63,102
Mount Sinai	15,230	16,181	15,112	14,216	48,986	50,605	52,011	53,494	26,513	18,015	22,934
Kingston General	18,630	19,975	18,862	18,803	45,341	43,111	46,102	47,568	1,777	1,620	1,821
St. Joseph's - Hamilton	8,350	4,694	3,506	6,344	37,447	36,797	37,527	39,093	5,210	7,746	8,531
St. Joseph's - London	9,312	10,551	11,401	9,129	29,709	31,769	30,957	26,699	5,143	4,088	5,830
CHEO	7,305	8,001	8,424	9,160	22,040	19,489	20,083	21,630	4,619	7,559	6,235
CAMH	1,413	1,940	2,686	2,563	7,129	10,714	11,923	11,084	3,577	4,113	3,485
Hotel Dieu - Kingston	2,545	1,977	1,623	1,814	4,183	4,492	5,147	5,220			
Thunder Bay Regional	782	309	598	524	5,170	5,677	5,448	7,451	204		178
Sudbury Regional	758	282	448	804	3,607	5,921	5,705	4,888			330
Providence	1,042	1,927	1,985	1,883	4,121	3,898	3,393	3,928			159
Ottawa Heart Institute	698	699	604		4,178	3,605	4,797		944	4,299	
Baycrest	370	240	178	117	3,105	3,617	3,657	4,407	1,439	1,061	865
Royal Ottawa	1,093	699			4,092	3,452					
Royal Ottawa - Psych			952	635			2,881	3,069			
Toronto Rehab	248	82	278	351	934	561	546	1,075			
Bloorview MacMillan											336
Total CAHO	195,520	187,828	181,644	197,683	738,726	791,047	807,411	845,626	264,740	278,991	308,765
Total Non CAHO	27,150	31,303	33,667	44,045	76,232	78,856	87,745	92,824	3,891	4,047	3,528
Grand Total	222,670	219,131	215,311	241,728	814,958	869,903	895,156	938,450	268,631	283,038	312,293

The medical trainee day analysis findings can be summarized as follows:

- Although there is a slow and steady increase in the contributions of non-CAHO hospitals to the training of medical students, CAHO hospitals still train the overwhelming majority of students (over 80%).
- This trend does not represent a shift from CAHO to non-CAHO hospitals but rather a system-wide increase in training capacity as the overall medical student days increase (9% in 2004/05).
- CAHO hospitals also train over 90% of Residents and 99% of Fellows. While the CAHO proportions have not decreased in the years examined, they are expected to (for Residents) as more medical students trained in non CAHO hospitals decide to do their residency there.
- Family Medicine is the one specialty where a substantial proportion of trainees (both undergraduates and residents) are in non-CAHO hospitals.

2.2 Description of Nursing Education Activity

2.2.1 Qualitative Description of Nursing Education Programs

Methodology:

The qualitative review of nursing placement programs in academic hospitals was informed through a similar interview process, with interviews held with Nursing Education leadership. A similar Interview Guide and associated survey forms were provided.

Findings:

Academic hospitals train Registered Nurses (RNs), Registered Practical Nurses (RPNs), Clinical Nurse Specialists (CNS), and other post graduate, advanced practice, and retraining programs. The larger academic hospitals train over 2,000 nurses per year.

While nursing students are trained in both community and academic hospitals, academic hospitals have proportionately higher number of placements and they typically have more internal resources to manage the placements (through the Nursing Administration or Nursing Education office). Academic hospitals also train a proportionately higher number of RNs and post graduate nurses versus RPNs.

Registered Nursing student placements in the first three years are supervised by a university assigned coordinator and typically have 1 to 2 patient assignments. These nursing students still require some level of supervision by hospital RN staff. In the fourth year, each nursing student is assigned to a preceptor designated from the hospital staff. Fourth year nursing students share the patient assignment with their preceptors with supervision levels decreasing in the last weeks of the placement.

RPN programs are three years in length. Placements in years 1 and 2 are supervised by university faculty members but the students are also teamed up with hospital RPN staff.

Final year students are involved in a one-on-one RPN preceptorship. There are typically more placements in non-acute facilities for RPNs relative to RN placements.

Post-graduate placements also typically involve one-on-one preceptorships with hospital RN staff.

There is very little information in the literature on the impact of nursing education on hospital operating expenses. This qualitative review identified the following potential impacts:

- Infrastructure and support expenses
 - Academic hospitals resource nursing education offices with management and liaison staff that coordinate and place all of the students.
 - There is also anecdotal evidence of higher use of medical and surgical supplies by nursing students.
- Impact on nursing staffing complements
 - Staffing assignments in academic hospitals are not generally increased to accommodate student supervision time.
 - It is possible that the contributions of nursing students in advanced years offset the time spent training them by hospital RNs/RPNs.
 - There is consensus that training/supervising nurses does increase nurses' workload and may contribute to higher overtime and potentially a higher risk of burnout and associated sick time.
- Impact on patient service utilization
 - There is no evidence of the impact of nursing education on patient service utilization (i.e. higher LOS) although there is some suggestion of higher general and medical/surgical supply utilization.

2.2.2 Quantitative Analysis of Nursing Education Programs

Methodology:

There is no provincial nursing placement database comparable to the Ministry of Health's medical trainee day database. As such, obtaining province wide data on nursing education activity is more challenging. In this study, detailed nursing student day data was obtained from St. Joseph's Health Care in London and from The Ottawa Hospital. Given that the first is a smaller academic facility with a strong focus on ambulatory care and post-acute programs and the latter is a large, multi-site academic hospitals, the data can be assumed to represent the range of nursing student activity in academic hospitals.

Note that the data collected is self reported and does not necessarily conform to similar standards or definitions.

Findings:

The exhibit below provides information on the nursing student and associated placement hours by type of placement. The average number of student hours per student is also provided for each level. The table also calculates the number of RN placement hours for which a one-on-one RN preceptor is required and the equivalent RN FTEs. This amounts to 6.2 FTEs at St. Joseph's Hospital and 53.6 at the Ottawa Hospital.

Exhibit 6: Nursing Placement Students and Hours for St. Joseph's Health Care London and The Ottawa Hospital (2005)

Program	Student Year of Study	St. Joseph's - London			The Ottawa Hospital		
		Total Students	Total Hours	Average Hours/Student	Total Students	Total Hours	Average Hours/Student
BSCN	Years 1-3	564	38,604	68	510	66,608	131
	Pre-Grad (Year 4)	10	4,217	422	202	62,592	310
Post Grad		13	1,978	152	592	26,264	44
RPN	Years 1-2	216	13,798	64	329	49,128	149
	Pre-Grad	23	6,466	281	109	27,744	255
Out of Region Mixed Preceptorship					45	2,140	48
Total		826	65,063	79	1,742	232,336	133
Hospital RN Preceptor Hours Above in FTEs			10,683			92,476	
			6.2			53.6	

3. ESTIMATING INFRASTRUCTURE AND SUPPORT COSTS OF MEDICAL EDUCATION IN ACADEMIC HOSPITALS

3.1 Objectives and Methodology

As discussed earlier in this report, academic hospitals expend a variety of resources in carrying out their role in medical education. Most of the indirect costs of this education are funded through the hospital's regular operating budget. One of the objectives of this study is to quantify the infrastructure and support costs related to medical education in an academic hospital.

- *Infrastructure Costs* refer to the costs associated with supporting and maintaining the physical space within the hospital used for the purposes of medical education.
- *Support Costs* refer to the costs of people, supplies, and services that are associated with the education of medical trainees.

Note that both cost categories relate to operating costs only and not capital costs. Capital costs (or the cost of building physical plant space) were not included in the scope of the analysis.

The financial and statistical data reported by hospitals to the Ministry of Health does not allow for the identification of infrastructure and support costs related to medical education. As such, a micro-costing study was conducted to estimate these costs. To that end, a survey was developed to collect the information from a sample of academic hospitals. The survey measured the costs related to medical education for the following categories:

- Physical plant (Housekeeping, Maintenance, etc.)
- Medical education office
- Support departments (Information Systems, Library, Occupational Health, etc.)
- General supplies (gowns, scrubs, pagers, etc.)

The micro-costing survey is provided in Appendix 3. The survey was distributed to five academic hospitals with completed surveys received by:

- Sunnybrook and Women's College HSC
- London HSC
- The Ottawa Hospital.

Physical Plant Costing Methodology

Estimating physical plant costs associated with medical education involves the following steps:

- *Step 1: Identify hospital space utilized by medical students and residents.*
Hospitals identify their total physical plant surface area and the surface areas of all hospital building spaces used by medical students and residents. Hospitals then estimate the percentage use of those spaces by medical students and residents. For example, if the survey identified the square footage of the Main Library as 4,000 sq. ft. and that 25% of the Library use is by medical students and residents, then 1,000 sq. ft. of Library space is allocated to medical education space. The hospital areas included in the survey can be categorized as follows:
 - Lecture/classroom/auditorium space
 - Meeting rooms
 - Library/audiovisual/computer room
 - Duty Rooms/lockers/lounges/offices etc.
- *Step 2: Summarize the total surface area utilized by medical students and residents.*
The total square footage utilized by medical students and residents is summed and then divided by the total hospital surface.
- *Step 3: Identify the total operating costs for those departments that support the physical plant.*
Hospitals then identified the operating costs of those hospital departments and services that support the physical plant including:
 - Housekeeping
 - Plant administration
 - Plant operations
 - Plant security
 - Plant maintenance
- *Step 4: Summarize the estimated physical plant costs associated with medical education.*
The total operating costs of the departments identified in Step 3 is multiplied by the percentage identified in Step 2 to arrive at the total Physical Plant costs associated with medical education.

Hospital Medical Education Office Operating Costs

The survey also asked participating hospitals to provide the total operating costs of their Medical Education Office including personnel, supply, and sundry costs. Any external recoveries were netted against these costs.

Hospital Support Department Costs

Hospitals were also asked to identify the operating costs of hospital support departments that provide some level of service to medical students and residents. The departments identified are:

- Library
- Audio-visual Services
- Information Systems/Technology
- Occupational Health and Safety
- Human Resources (Personnel)

In addition to identifying the total operating costs of these departments, the hospitals were asked to estimate the percentage of activity of each department associated with or used by medical students and residents. This percentage is multiplied by the operating costs and summed up to arrive at Total Support Department costs associated with medical education.

General Supply Costing Methodology

The last section of the survey attempted to estimate the cost of basic supplies used by medical students and trainees. These include the operating costs of gowns, gloves, lab coats, scrubs, and ID badges. The cost information was supplemented by information on the frequency of use per day per medical trainee to arrive at total cost per trainee day.

Note that in all costing components described in this methodology, the costs are averaged out across all hospitals to smooth out variations.

3.2 Infrastructure and Support Micro-costing Results

The result of the micro-costing survey and analysis for Physical Plant, Medical Education Office, and the Support Departments is presented in Exhibit 7 for each of the three hospitals and in total.

Exhibit 7: Summary of Physical Plant, Medical Education, and Support Department Annual Operating Costs Associated with Medical Training by Hospital and Total

Expense Item	Sunnybrook	London HSC	Ottawa	Total
Physical Plant	\$357,884	\$499,755	\$436,628	\$1,294,267
Medical Education Office	\$574,520	\$331,897	\$157,428	\$1,063,845
Support Departments	\$1,906,350	\$1,782,775	\$1,085,527	\$4,774,652
Total	\$2,838,754	\$2,614,427	\$1,679,583	\$7,132,764

The general supply costing results are presented in Exhibit 8. The cost per unit represent the average cost across participating hospitals and the use per day numbers were estimated through consultations with the medical education directors at the academic hospitals. The total general supply cost per day is estimated at \$23.32 per medical trainee day.

Exhibit 8: Micro-costing Results for General Supplies used by Medical Trainees

Supply Item	Cost	Use per Day	Est Cost per Day
Cost per Sterile gown to wash	\$5.12	2.67	\$13.65
Costs per pair of gloves	\$0.47	5.00	\$2.35
Cost per lab coat	\$1.50	1.20	\$1.80
Cost per lab coat w/ logo (replacement)	\$18.00	0.10	\$1.80
Cost per scrub to wash (top and bottom)	\$1.10	2.67	\$2.92
Cost per scrub (replacement)	\$15.48	0.05	\$0.77
Cost per ID badge	\$6.00	0.00	\$0.03
Total			\$23.32

The total estimated infrastructure and support cost per medical trainee day was calculated by averaging the micro-costing information from the three hospitals and dividing the total resultant costs by the total medical student and resident days and then adding the average supply cost per day. As Exhibit 9 shows, the average total infrastructure and support cost per medical trainee day is \$42 (ranges from \$35 to \$52 by hospital).

Exhibit 9: Total Estimated Infrastructure and Support Costs per Medical Trainee

Trainee Days	Sunnybrook	London HSC	Ottawa	Total
Undergraduate (U1)	2,465	448	461	3,374
Undergraduate (U2)	3,287	1,173	989	5,449
Clinical Clerks (U3)	10,044	24,830	13,899	48,773
Clinical Clerk (U4)	7,351	4,138	7,408	18,897
Residents	74,555	103,237	126,698	304,490
Total Trainee Days	97,702	133,826	149,455	380,983
Total Expenses	\$2,838,754	\$2,614,427	\$1,679,583	\$7,132,764
Supplies per Day	\$23.32	\$23.32	\$23.32	\$23.32
Cost per Day	\$52.38	\$42.86	\$34.56	\$42.04

Using the \$42 per day, the total infrastructure and support expenses can be calculated by multiplying by the total medical trainee days. As Exhibit 10 shows, the total estimated costs are \$58 million for CAHO hospitals and \$6 million non-CAHO hospitals or a total of \$64 million provincially. Exhibit 11 provides the estimated costs by CAHO hospital. The estimated infrastructure and support expenses ranges between 1 and 1.5 percent of total operating costs for most of the larger CAHO hospitals and an average of 1% of operating costs over all CAHO facilities.

Exhibit 10: Total Estimated Infrastructure and Support Costs for CAHO and Non-CAHO Hospitals (based on 2004/05 medical trainee numbers)

	Trainee Days	Cost Impact
CAHO Hospitals	1,377,849	\$ 57,930,713
Non CAHO Hospitals	146,140	\$ 6,144,349
Total	1,523,989	\$ 64,075,062
% CAHO		90.4%

Exhibit 11: Estimated Medical Education Infrastructure and Support Expenses by CAHO Hospital (based on 2004/05 data)

Hospital	Medical Trainee Days	Estimated Infrastructure & Support Expenses Related to Medical Education	Total Operating Expenses	% of Operating Expenses
UHN	205,576	\$8,640,000	\$689,286,893	1.3%
Ottawa	168,980	\$7,100,000	\$637,593,732	1.1%
London HSC	161,076	\$6,770,000	\$604,994,844	1.1%
Hamilton HSC	133,656	\$5,620,000	\$635,697,127	0.9%
Sunnybrook & Women's	128,729	\$5,410,000	\$534,849,408	1.0%
St. Michael's	117,187	\$4,930,000	\$371,229,635	1.3%
Sick Children	107,342	\$4,510,000	\$367,762,144	1.2%
Mount Sinai	92,498	\$3,890,000	\$259,760,853	1.5%
Kingston General	70,644	\$2,970,000	\$244,954,588	1.2%
St. Joseph's - Hamilton	54,795	\$2,300,000	\$298,519,081	0.8%
St. Joseph's - London	42,848	\$1,800,000	\$328,769,397	0.5%
CHEO	38,219	\$1,610,000	\$115,736,886	1.4%
CAMH	17,466	\$730,000	\$205,071,468	0.4%
Hotel Dieu - Kingston	7,271	\$310,000	\$52,708,265	0.6%
Thunder Bay Regional	8,221	\$350,000	\$175,164,499	0.2%
Sudbury Regional	6,127	\$260,000	\$247,705,967	0.1%
Providence	6,216	\$260,000	\$78,143,537	0.3%
Baycrest	5,404	\$230,000	\$53,326,756	0.4%
Royal Ottawa - Psych	3,787	\$160,000	\$89,313,406	0.2%
Toronto Rehab	1,472	\$60,000	\$104,699,077	0.1%
Total CAHO	1,377,513	\$57,910,000	\$6,095,287,563	1.0%

This study represents the first attempt at quantifying the infrastructure and support costs related to the education of medical trainees in academic hospitals. The micro-costing survey estimates the cost at \$42 per medical trainee day. These costs represent 0.9% to 1.5% of total operating costs in the larger acute care academic hospitals and average 1% of operating costs across all CAHO hospitals or \$58 million.

3.3 Comparisons to Education Expenditures

The Hospital University Education Committee (HUEC) and advisory committee to the Dean of the University of Toronto's Faculty of Medicine, conducted a study of medical

education expenditures in the Toronto system. The study was last conducted in 2002 but is currently being updated. The study identified expenditures by the following categories:

- Category A: Faculty Salaries (academic salaries devoted to the educational endeavour)
- Category B: Administrative Salaries (faculty, managerial, secretarial, or other administrative support to the educational endeavour)
- Category C: Resident and Fellow Support (50% of salary, 100% of tuition support for non-MoHLTC supported residents)
- Category D: Overhead Expenses (operating expenses related to the educational endeavour)

The following payment sources for these expenditures were identified:

- University
- Practice Plans
- Hospitals

The results are presented in the following exhibit. For the University of Toronto System (and in 2002) about a third of total medical education expenditures were borne by hospitals. Hospitals bore the majority of administrative salaries (57%) and of overhead expenses (69%). The micro-costing analysis conducted in this (CAHO) study addresses elements in categories B and D (plus supply costs which are not included here). Although the methodologies cannot be easily mapped, this CAHO study suggests around \$12 million in expenses for the U of T hospitals under category D compared to \$10.9 million in the U of T study.

Exhibit 12: Educational Expenditures by Type and Source of Payment (including percent breakdown by source) from the University of Toronto's Hospital University Education Committee Study (2002)

Payment Source	Category A: Faculty Salaries	Category B: Administrative Salaries	Category C: Resident and Fellow Support	Category D: Overhead Expenses	Total
Total University	9,646,846	4,910,741	544,073	2,955,288	18,056,948
Practice Plans	31,633,715	936,275	4,333,637	482,000	37,385,627
Hospitals	8,096,372	7,595,871	2,924,000	7,509,929	26,126,172
Total	49,376,933	13,442,887	7,801,710	10,947,217	81,568,747
Total University	20%	37%	7%	27%	22%
Practice Plans	64%	7%	56%	4%	46%
Hospitals	16%	57%	37%	69%	32%
Total	100%	100%	100%	100%	100%

4. COMPARATIVE ANALYSIS OF UTILIZATION AND OTHER CASE LEVEL COST VARIATIONS BETWEEN ACADEMIC AND NON ACADEMIC HOSPITALS

4.1 Analysis Objectives

The analysis conducted thus far has focused on understanding the infrastructure and support operating costs related to educating medical students. These costs can be attributed to students as the costs directly support the provision of medical education. The academic mission has also been shown in numerous studies to have an impact on the cost of patient care (Koenig et al, 2003, Charlson et al, 2005, and Denton et al 2005). As the costs are indirectly associated with medical students, the impact of teaching medical students on hospital patient costs is typically estimated at an aggregate level through regression analysis (with the percentage of medical student days acting as a proxy for teaching-ness). The Joint Policy and Planning Committee for example, applies a teaching intensity adjustment to estimate hospital acute inpatient and day surgery cost per weighted case (JPPC, 2004).

The Ontario Case Costing Initiative (OCCI) at the MOHLTC collects patient-level costing and clinical data from numerous organizations across Ontario. As such, the database allows for a more detailed investigation of the academic mission on the cost of patient care. Patient-level data from the OCCI database was therefore, applied to assess differences in direct costs and length of stay (LOS) between academic and community organizations at the patient level. Additionally, the study investigated the degree to which these differences are attributed to:

- Unmeasured severity in the patient grouper and/or
- Differences in care models and/or utilization patterns at the functional centre level.

4.2 Case Cost Analysis Methodology

Ontario case costing data for the period of 2002/03 to 2004/05 was utilized. Data for 2002/03 and 2003/04 was applied to test the assumptions and approach. Conclusions and recommendations in the study were based solely on 2004/05 data only as significant improvements were achieved in 2004/05 in improving the overall quality of the case costing data (based on a 2004 data quality study conducted for the Ontario Ministry of Health and Long Term Care on the quality of the Ontario Case Cost Initiative data).

Data from five academic and five community institutions were included in the analysis:

Academic:	Large Community:
<ul style="list-style-type: none">– The Ottawa Hospital (Ottawa General Site)– St. Michael's Hospital– University Health Network– Mount Sinai Hospital– London Health Sciences Centre	<ul style="list-style-type: none">– Quinte Health Care– Lakeridge - Oshawa– William Osler Health Centre– Trillium Health Centre– Credit Valley Hospital

The data set contained patient specific direct and indirect cost by functional centre and basic patient record data.

The authors acknowledge the support of the Ontario Ministry of Health and Long Term Care in providing access to the above data sets for the purposes of this study.

4.3 Findings:

Several approaches were undertaken to assess the influence of the academic mission on hospital direct costs. The following section details the methodology, results and conclusions by investigated topic.

Five key messages emerged from these analyses and are discussed in detail in this section. These include:

- After controlling for hospital-specific differences, across a homogeneous group of CMGs, the academic mean differential is measured at approximately 12%.
- The typical patient population contains significant heterogeneity (specifically surgical CMGs), suggesting that refinements to the CMG grouper are required.
- However, even across the modal patient, there remains variation among/across organizations.
- The cost differential tends to widen with higher lengths of stay.
- Not surprisingly, there is substantial variation across outlier cases as well.

4.3.1 Average Direct Care Cost Differential for Academic Hospitals

General Approach:

The first step in the analysis focused on identifying the direct care cost differential for academic hospitals. The JPPC Rate model estimates the differential on full costs across all case mix groups. The differential attempts to account for differences such

as acuity, case mix, unmeasured complexity and the indirect costs of teaching. The purpose of this analysis was to attempt to isolate costs related to higher non-LOS utilization (e.g., drugs) and/or higher unit costs (e.g., cost of standby capacity). As such, only direct costs were analyzed across a homogeneous group of case mix groups (CMGs).

The direct costs were first analyzed by functional centre to identify and exclude functional centres that are not accurately or consistently reported. The following direct care cost centres were excluded from the analysis (all other direct care functional centres - inpatient nursing and diagnostic and therapeutic functional centres - were included):

- 71195 Patient Food Services (considered direct in Ontario Hospital Reporting System)
- 71310 General Emergency Services
- 71350 Ambulatory Care Clinics
- 71340 Day/Night Care Services (exceptions included day surgery functional centres: 7134020, 7134025, 7134055)
- 71425 Electrodiagnostic Laboratories
- 71430 Non Invasive Cardiology and Vascular Laboratories
- 71435 Respiratory Services
- 71444 Combined Therapeutics
- 71475 Psychology and Psychometry
- 71480 Pastoral Care
- 71490 Child Life
- 715* Community Services
- Other votes/other sources.

A group of reference CMGs were then selected (mix of medical, surgical and perinatal) that are the most homogeneous with respect to direct cost and length of stay. The coefficient of variation was utilized to compare the degree of variation across CMGs and identify the reference CMGs. Note that only typical cases were included in identifying the reference CMGs. The CMGs identified include:

- 222 Heart Failure
- 253 Major Intest/Rectal Proc
- 262 Simple Appendectomy
- 290 GI Obstruction
- 352 Hip Replacement
- 354 Knee Replacement
- 502 Radical Prostatectomy
- 529 Lower Urin Tract Infection
- 579 Maj Ute/Adn Proc No Malig
- 603 Repeat Caesarean Delivery
- 604 Caesarean Delivery
- 609 Vaginal Delivery w Complicating Dx
- 611 Vaginal Delivery.

Regression analysis was then utilized to identify the cost differential among homogeneous typical CMGs related to academic membership (controlling for case mix, hospital-specific characteristics, length of stay).

Results and Findings:

The exhibit below indicates the percentage of cases for the 13 reference CMGs and illustrates a balance of cases from the large community hospitals and academic hospitals.

Exhibit 13: Percentage of Typical Cases Academic vs. Community for Reference CMGs

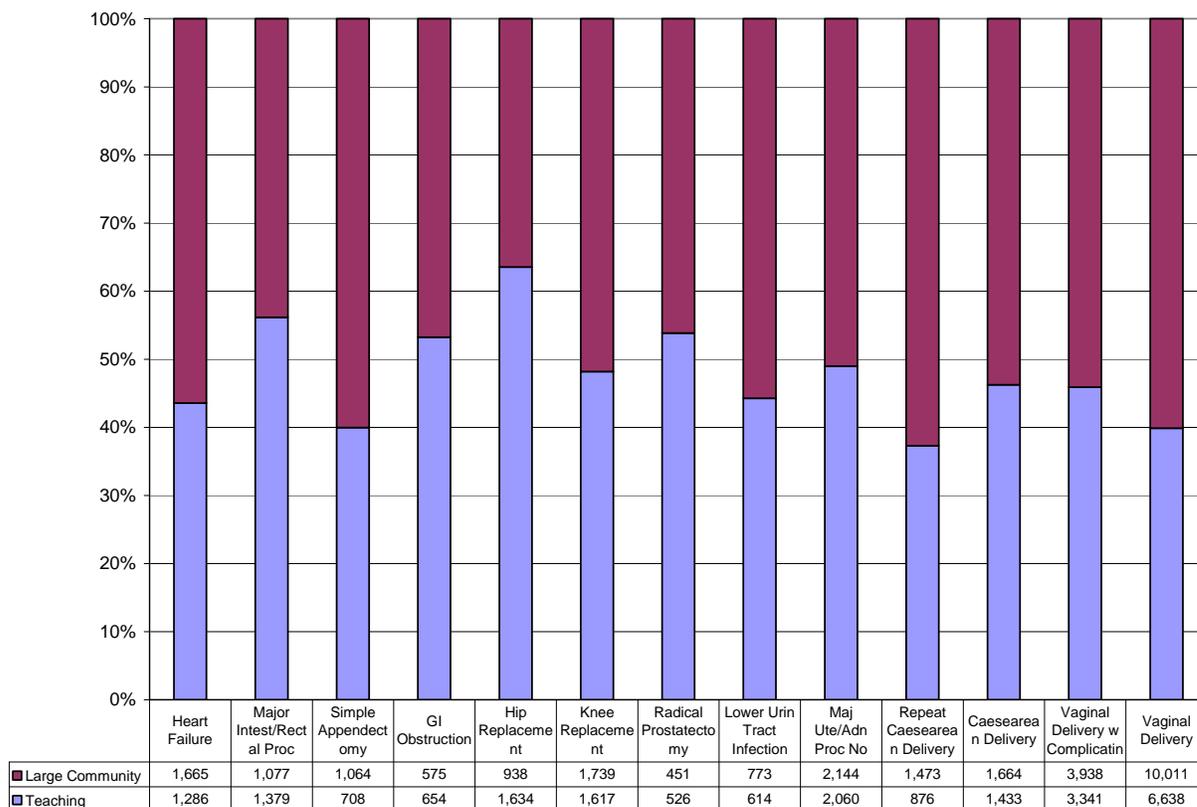
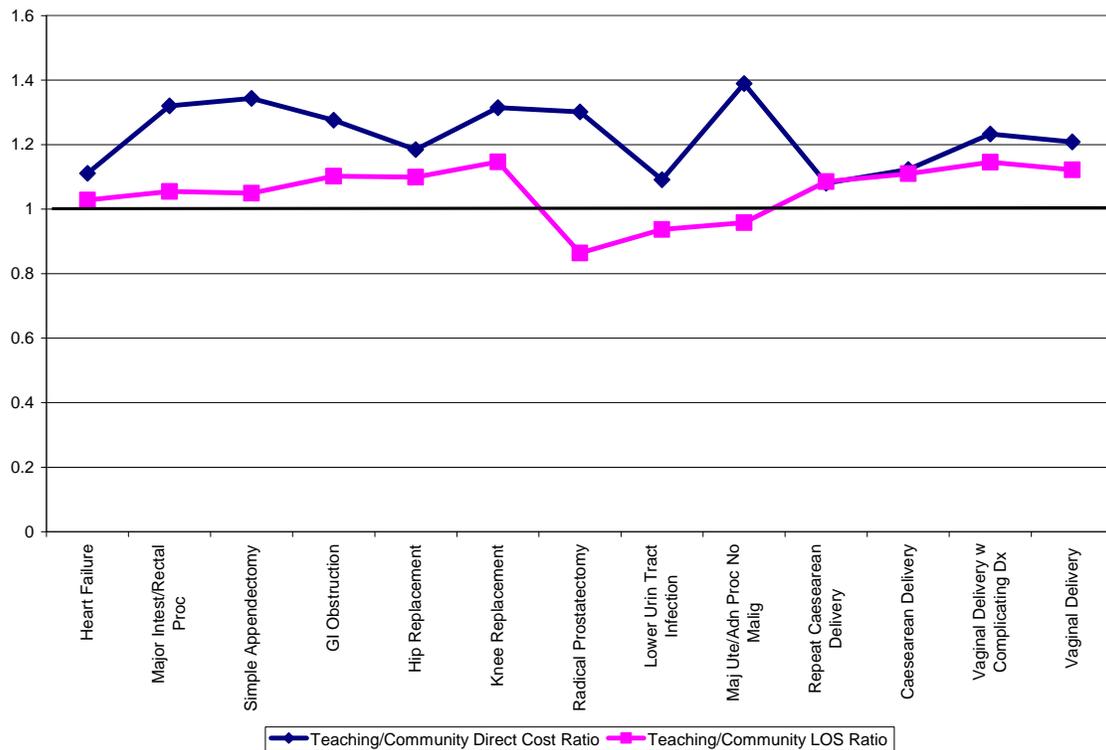


Exhibit 14 below illustrates the academic differential across the reference CMGs for direct cost and LOS. For each CMG, the direct cost differential (for typical cases) was expressed as the ratio of median teaching direct cost to median community direct cost. The LOS differential was expressed as the ratio of median teaching typical LOS to median community typical LOS. Hence, values above 1 represent higher teaching direct costs and/or LOS and values below 1 represent higher community direct costs and/or LOS. The graphic below indicates two important findings:

- The direct cost differential is greater than 1 across all reference CMGs and
- The differential is greater for direct costs then for LOS. In fact, median LOS is greater in community hospitals in three of the reference CMGs.

Exhibit 14: Direct Cost and Length of Stay Comparisons for Reference CMGs



Regression analysis was then employed to empirically estimate the direct cost differential among the reference CMGs. The analysis controlled for variations in case mix, LOS and hospital-specific factors. The results of the regression indicated an 11.6% direct cost differential between academic and community organizations ($R^2 = 66.7\%$, $p < .01$).

Summary of Conclusions:

The results of this analysis highlight two important findings:

- Among the typical case CMGs studied, the differential in direct costs was greater than the differential in LOS. Differences in LOS explain a relatively small portion of the “teaching” cost differential.
- Controlling for LOS, the “teaching” cost differential is equivalent to 12%. This variation is due to:
 - Higher non-LOS utilization (e.g., drugs) and/or
 - Higher cost per unit (e.g., cost of standby capacity).

As previously mentioned, the JPPC Rate model utilizes regression approach across all case mix groups to grossly estimate the total teaching differential. The rate model identifies an average cost differential of 21% (among the academic hospital peer group).

Other influences on the cost differential may be related to:

- Higher admin and support costs
- Greater patient severity

- Other unmeasured differences.

4.3.2 Applicability of the Case Mix Grouper for Academic Hospitals

General Approach:

The previous section discussed the academic cost differential across a homogeneous group of CMGs. The 12% direct cost differential assumes that the cases within CMGs are relatively homogeneous. If the case mix grouper is not sensitive to patient severity and if academic hospitals have a greater share of these cases, then deficiencies in the CMG methodology may artificially inflate the academic differential.

The purpose of this analysis was therefore, to investigate across a wide range of CMGs, the academic differential within typical and outlier cases. As a first step, for CMGs with sufficient volume, the ratio of median teaching direct cost to median community direct cost was calculated for typical and outlier cases. Scatter plots were then produced to evaluate the cost ratios across all CMGs. The data was then aggregated by program cluster and CMGs/program clusters where the direct cost ratio was significantly higher were identified.

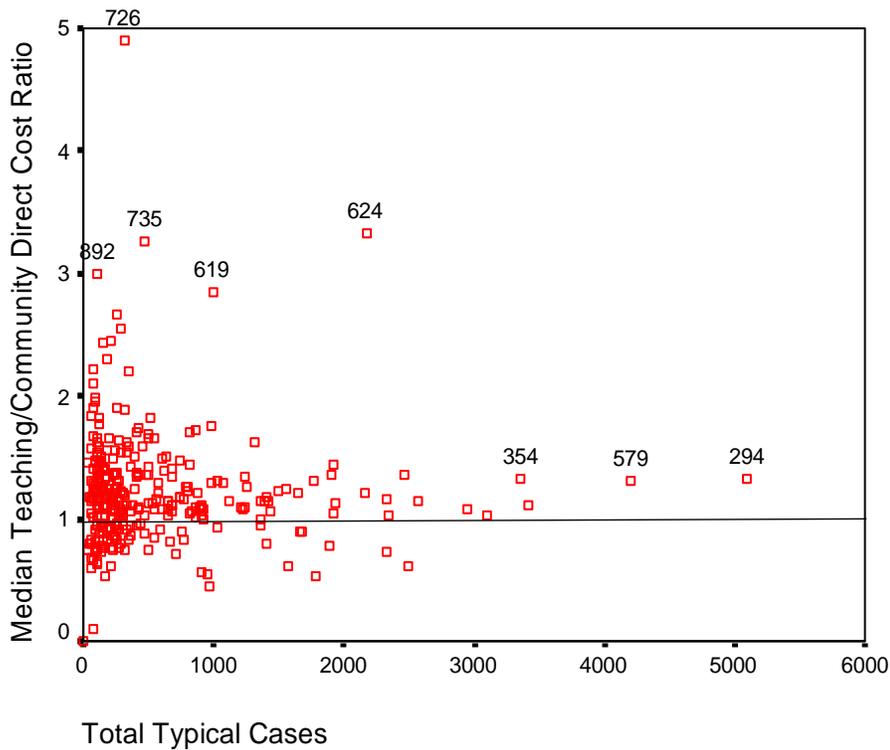
For CMGs with sufficient volume, the direct cost index was compared to a severity index. For each hospital the ratio of the 75th percentile typical teaching LOS to the 75th percentile typical community LOS was calculated as a proxy for overall patient severity. The direct cost ratio was analyzed in relation to the 75th percentile LOS ratio. Those CMGs where both a direct cost differential and a 75th percentile LOS differential exist indicate heterogeneity within the CMG clusters whereby the CMG may not be sensitive enough to differences in patient acuity.

Results and Findings:

Exhibit 15 and 16 illustrate the direct cost index for typical cases and outlier cases. For typical cases the direct cost index is characteristically above one indicating that the median teaching direct cost is greater than the median community direct cost for the majority of cases. For some CMGs, the median teaching direct cost is two to five times the median community direct cost. Those CMGs are identified as:

CMG	CMG Description
294	ESPHG/GSTRO/MSD DGSTV DISEASE
354	KNEE REPLACEMENT
579	MAJ UTE/ADN PROC NO MALIG
619	FALSE LABOUR,LOS <3DAYS(MNRH)
624	ANTEPARTUM DIAGNOSES
726	ACUTE LEUK W/O MAJ PROC
735	RADIATION THERAPY
892	OTHER VASCULAR PROC

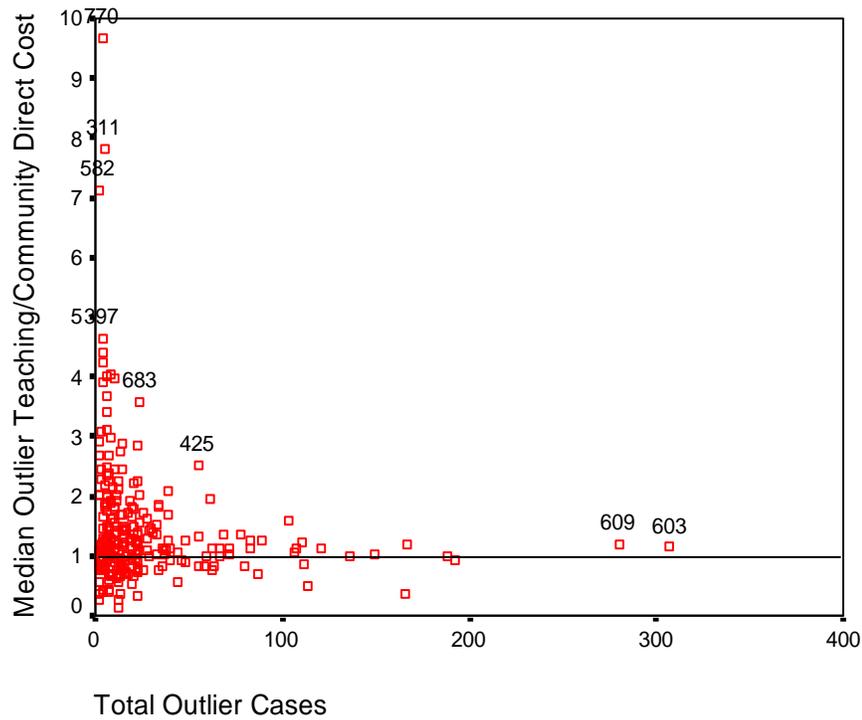
Exhibit 15: Direct Cost Ratio by Case Volume for Typical Cases



For outlier cases the direct cost differential is much greater with a number of academic CMGs that are three to ten times the median cost outlier cost. Again, in general the academic differential is greater than one in the majority of CMGs. Several CMGs with either a significantly high cost differential and/or high volumes were specifically identified and include:

CMG	CMG Description
311	MAJOR PANCREATIC PROCEDURES
397	NON-INFLAMMATORY ARTHRITIS
425	SKGR&WNDDDB(DERM DIS) NO UL/CELL
582	OTH GYN PROCEDURES
603	REPEAT CAESAREAN DELIVERY
609	VAGINAL DEL W COMPLICATING DX
683	INTRACRANIAL INJURIES
770	BIPOLAR MOOD/MANIC NO ECT/AX3

Exhibit 16: Direct Cost Ratio by Case Volume for Outlier Cases



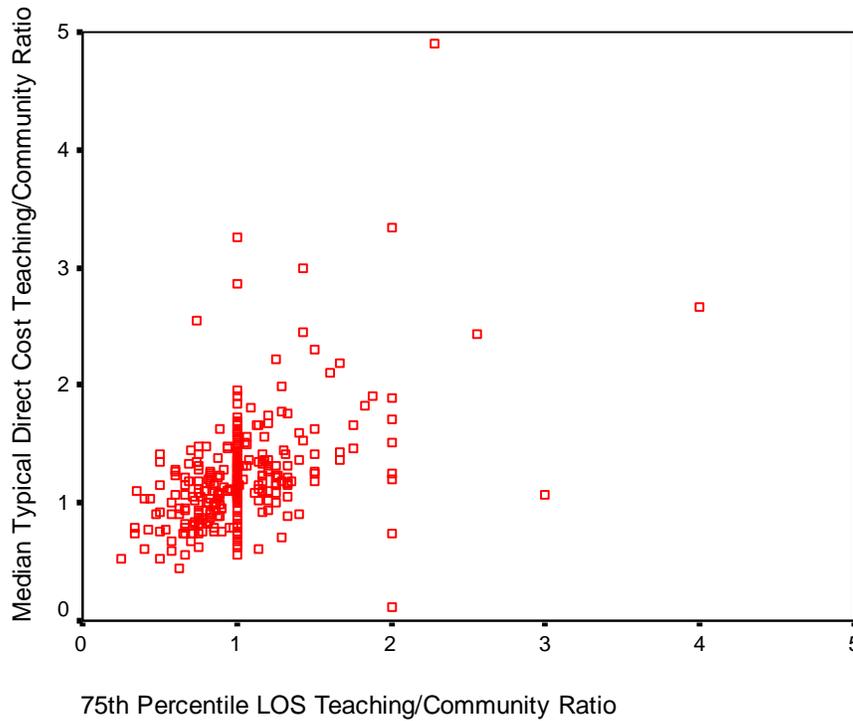
A weighted direct cost index was then calculated by program cluster and is presented in the following exhibit. The table indicates that for most program clusters the direct cost ratio was greater than one. Cardio/thoracic typical cases and neonatology (excluding normal newborns) indicate direct cost ratios less than one however, the majority of cases in these program clusters are performed at academic institutions. The largest differential was not surprisingly among outlier program clusters.

Exhibit 17: Direct Cost and LOS Ratio Comparisons by Program Cluster

Program Cluster	Teaching/ Community		Total Cases	
	Typical	Outlier	Typical	Outlier
DENTAL/ORAL SURGERY	1.96	1.85	86	45
OPHTHAMOLOGY	1.68		82	51
OTOLARYNGOLOGY	1.42	1.59	3,302	1,614
PLASTIC SURGERY	1.41	2.51	684	401
GYNAECOLOGY	1.38	1.43	6,849	3,170
TRAUMA	1.36	1.17	8,111	3,703
OBSTETRICS	1.32	1.04	39,432	23,388
NEUROSURGERY	1.28	1.24	2,008	461
ONCOLOGY	1.27	1.12	6,851	1,669
GASTRO/HEPATOBILIARY	1.25	0.96	12,935	7,076
NEUROLOGY	1.24	1.07	5,522	2,741
ORTHOPAEDICS	1.24	1.02	13,595	5,971
GENERAL SURGERY	1.23	1.37	16,827	7,253
VASCULAR SURGERY	1.20	1.24	1,686	593
RHEUMATOLOGY	1.16	1.78	564	243
PSYCHIATRY	1.16	1.22	9,385	5,456
DERMATOLOGY	1.15	1.65	332	153
UROLOGY	1.15	0.95	7,689	3,951
GENERAL MEDICINE	1.14	1.22	8,027	3,964
HAEMATOLOGY	1.12	1.96	2,027	1,013
CARDIOLOGY	1.05	1.43	14,174	7,976
PULMONARY	1.04	1.34	11,811	6,868
NEPHROLOGY	1.03	1.23	1,559	686
ENDOCRINOLOGY	1.03	1.40	2,899	1,515
CARDIO/ THORACIC	0.91	1.10	10,141	2,334
NEONATOLOGY (excluding Normal Newborn)	0.73	0.68	13,342	7,918
TOTAL	1.18	1.15	199,920	100,213

Finally, a scatter plot was produced expressing the direct cost index as a function of the 75th percentile LOS index. The plot indicates that the 75th percentile LOS (a proxy for overall severity) and direct cost ratio is substantially greater in academic hospitals in 85 CMGs.

Exhibit 18: Direct Cost Ratio vs. 75th Percentile LOS Ratio



Summary of Conclusions:

The analysis indicates that in general, academic hospitals have a comparably higher case cost for typical and outlier cases. The scatter plots indicated that there were 103 outlier CMGs and 15 typical CMGs where the academic hospital median case cost was more than twice the community case cost. Furthermore, across all but two program clusters, the direct cost ratio was higher in academic hospitals.

An analysis of overall patient severity and the direct cost index suggested that patient severity and direct costs are substantially greater in academic hospitals in at least 85 CMGs. Those CMGs with the largest differential included:

CMG	CMG Description	75th %ile Typical LOS Ratio	Median Typical Direct Cost Ratio	Level of Care
726	ACUTE LEUK W/O MAJ PROC	2.3	4.9	S
624	ANTEPARTUM DIAGNOSES	2.0	3.3	T
892	OTHER VASCULAR PROC	1.4	3.0	S
376	MISC MUSCULOSKELETAL PROC	4.0	2.7	T
503	DIALYSIS PROCEDURES	2.6	2.4	P
576	RAD HYSTERECTOMY / VULVECTOMY	1.5	2.3	S
76	MAJOR HEAD & NECK PROCEDURES	1.7	2.2	T
393	RHEUMATOID ARTHRITIS	1.6	2.1	P
129	OTHER RESPIROLOGY PROC	1.3	2.0	T
628	NEO,1000-1499,NO CATASTRPH DX	1.9	1.9	T
77	LESS EXTENSIVE HEAD & NECK PROC	2.0	1.9	S
260	LESS EXT INTESTINAL/RECTAL PR	1.8	1.8	T
212	UNS ANG NO CRD CATH W SPEC CRD COM	1.3	1.8	S
696	UPPER EXTREMITY FRACTURES	3.0	1.1	S

This analysis suggests a deficiency in the current case mix grouping methodology which is characterized in the inability to address subgroups of cases whose resource profile does not confirm to the CMG they belong to and that tend to present at academic hospitals. Further investigation should focus on whether the identified CMGs would benefit from CMG splitting and/or identifying additional outlier notches.

4.3.3 Analysis of the Direct Care Cost Differential by Cost Centre

General Approach:

To attempt to control for differences in patient severity, the direct cost differential was then analyzed across the reference CMGs at the modal LOS (i.e., the most frequent LOS). The purpose of the analysis was to investigate differences in the cost centre unit costs at the modal LOS. Ideally the analysis would have allowed for the decomposition of functional centre unit costs (e.g., into price and volume) to isolate the degree to which the differential is related to higher non-LOS utilization and/or higher unit costs. Although this data exists, the OCCI requires only that hospitals report aggregated functional centre patient-level into the case costing database. Hence, this analysis can only be conducted by acquiring data directly from the ten case costing hospitals.

In addition to comparing cost centre unit costs at the modal LOS across academic and community organizations, the case cost and LOS distributions were examined.

Lastly, the academic direct cost differential was expressed by functional centre by clinical program (i.e., perinatal, medical, surgical) across CMGs with sufficient volume.

Results and Findings:

The average functional centre costs for each of the reference CMGs (typical cases only) at the modal LOS was investigated by hospital and by peer group (i.e., large community vs. academic). The analysis is presented below by clinical group (i.e., medical, surgical and perinatal) and by CMG.

Exhibit 19: Average Case Costs at Modal LOS for Medical Reference CMGs

Functional Centre	HEART FAILURE				G.I.OBSTRUCTION				LOWER URIN TRAC INFECT			
				Contribution to %				Contribution to %				Contribution to %
	Large Community	Teaching	Difference		Large Community	Teaching	Difference		Large Community	Teaching	Difference	
Allied Health	\$25	\$44	1.0%		\$12	\$16	0.3%		\$14	\$25	0.8%	
Clinical Lab	\$93	\$89	-0.2%		\$48	\$48	0.0%		\$59	\$74	1.0%	
Diagnostic Imaging	\$100	\$86	-0.7%		\$161	\$91	-6.1%		\$69	\$81	0.8%	
ICU	\$226	\$155	-3.8%		\$35	\$0	-3.0%		\$40	\$30	-0.7%	
Inpatient Nursing	\$1,299	\$1,113	-9.8%		\$827	\$903	6.7%		\$1,048	\$910	-9.9%	
OR/PARR (incl DS)	\$3	\$0	-0.2%		\$6	\$31	2.2%		\$4	\$8	0.3%	
Pharmacy/Drugs	\$151	\$162	0.6%		\$50	\$98	4.2%		\$153	\$197	3.2%	
Total	\$1,898	\$1,650	-13.1%		\$1,138	\$1,186	4.2%		\$1,387	\$1,324	-4.5%	

Across the three reference medical CMGs, academic organizations tended to identify lower average ICU costs at the modal LOS in comparison to community organizations. Higher average costs were found among academic organizations in Allied Health, Clinical Laboratory and Pharmacy/Drug cost centres. More specifically by CMG the analysis found:

- *Heart Failure*: Higher costs in community hospitals related to higher costs in Inpatient Nursing and Clinical Laboratory (specifically at Trillium).
- *GI Obstruction*: Community Diagnostic Imaging costs were higher than academic hospital average costs; Academic Pharmacy/Drugs and Inpatient Nursing costs higher than community hospital average costs.
- *Lower Urinary Tract Infection*: Community Inpatient Nursing costs generally higher than academic average costs; Pharmacy/Drugs and Allied Health costs higher in academic hospitals (average costs at Mt. Sinai are 60% higher than other academic facilities).

Exhibit 20: Average Case Costs at Modal LOS for Surgical Reference CMGs

Functional Centre	SIMPLE APPENDECTOMY				MAJ UTE/ADN PROC NO MALIG				HIP REPLACEMENT			
				Contribution to %				Contribution to %				Contribution to %
	Large Community	Teaching	Difference		Large Community	Teaching	Difference		Large Community	Teaching	Difference	
Allied Health	\$1	\$0	-0.1%		\$3	\$6	0.2%		\$69	\$182	3.4%	
Clinical Lab	\$35	\$83	5.4%		\$108	\$216	6.8%		\$67	\$71	0.1%	
Diagnostic Imaging	\$82	\$13	-7.7%		\$5	\$11	0.4%		\$61	\$100	1.2%	
ICU	\$3	\$0	-0.3%		\$2	\$7	0.3%		\$9	\$12	0.1%	
Inpatient Nursing	\$397	\$353	-4.9%		\$980	\$1,109	8.2%		\$1,418	\$1,340	-2.3%	
OR/PARR (incl DS)	\$353	\$549	21.8%		\$430	\$509	5.0%		\$1,621	\$1,434	-5.5%	
Pharmacy/Drugs	\$28	\$46	2.0%		\$46	\$78	2.0%		\$116	\$256	4.2%	
Total	\$900	\$1,045	16.2%		\$1,573	\$1,935	23.0%		\$3,360	\$3,397	1.1%	

Functional Centre	KNEE REPLACEMENT			MAJOR INTEST/RECTAL PROC			RADICAL PROSTATECTOMY		
	Large Community	Teaching	Contribution to % Difference	Large Community	Teaching	Contribution to % Difference	Large Community	Teaching	Contribution to % Difference
Allied Health	\$99	\$211	3.5%	\$42	\$57	0.4%	\$5	\$4	-0.1%
Clinical Lab	\$62	\$73	0.4%	\$121	\$245	3.6%	\$279	\$287	0.4%
Diagnostic Imaging	\$54	\$77	0.7%	\$66	\$51	-0.4%	\$3	\$19	0.8%
ICU	\$6	\$14	0.2%	\$137	\$64	-2.1%	\$6	\$4	-0.1%
Inpatient Nursing	\$1,424	\$1,509	2.7%	\$2,186	\$2,310	3.6%	\$1,103	\$1,487	18.0%
OR/PARR (incl DS)	\$1,386	\$1,566	5.7%	\$616	\$979	10.7%	\$646	\$1,010	17.1%
Pharmacy/Drugs	\$127	\$265	4.4%	\$235	\$303	2.0%	\$90	\$193	4.8%
Total	\$3,158	\$3,715	17.6%	\$3,403	\$4,008	17.8%	\$2,132	\$3,004	40.9%

Across the six reference surgical CMGs, the average direct costs in academic hospitals are higher than academic organizations versus community organizations. Across functional centres, academic organizations tended to identify lower average ICU costs at the modal LOS in comparison to community organizations. Higher average costs were found among academic organizations in Clinical Laboratory, Pharmacy/Drug, Allied Health, OR/PARR and Inpatient Nursing cost centres. More specifically by CMG the analysis found:

- *Simple Appendectomy*: Academic organizations identified higher average Clinical Laboratory (specifically LHSC and Mt. Sinai) and OR costs.
- *Major Ute/Adn Procedure No Malignancy*: Clinical Laboratory, Inpatient Nursing and OR expenses significantly higher across all academic sites (excluding St. Michael’s Hospital).
- *Hip Replacement*: St. Michael’s Hospital reported the highest number of cases at the modal LOS and lowest average direct cost (approx. \$2,200/case) – otherwise academic costs would be higher than community.
- *Knee Replacement*: Higher OR, Inpatient Nursing, Pharmacy/Drug and Allied Health average costs contribute to higher costs in academic facility.
- *Major Intestinal/Rectal Procedure*: Higher OR, Inpatient Nursing, Pharmacy/Drug and Clinical Laboratory costs contribute to higher costs in academic facility – St. Michael’s Hospital and The Ottawa Hospital costs lowest among academic organizations (most similar to community cost profile).
- *Radical Prostatectomy*: Higher OR (excluding St. Michael’s Hospital and The Ottawa Hospital), Inpatient Nursing, Clinical Laboratory (excluding St. Michael’s), Pharmacy/Drugs and Diagnostic Imaging contribute to higher costs in academic facility.

Exhibit 21: Average Case Costs at Modal LOS for Perinatal Reference CMGs

Functional Centre	REPEAT CAESAREAN DELIVERY				CAESAREAN DELIVERY				VAGINAL DEL W COMPLICATING DX				VAGINAL DELIVERY			
				Contrib. to				Contrib. to				Contrib. to				
	Large	Teaching	Difference	%	Large	Teaching	Difference	%	Large	Teaching	Difference	%	Large	Teaching	Difference	%
Allied Health	\$3	\$7		0.2%	\$5	\$6		0.1%	\$4	\$10		0.4%	\$5	\$8		0.2%
Clinical Lab	\$23	\$50		1.6%	\$28	\$49		1.0%	\$22	\$53		1.9%	\$16	\$36		1.4%
Diagnostic Imaging	\$3	\$2		0.0%	\$2	\$4		0.1%	\$1	\$1		0.0%	\$1	\$0		0.0%
ICU	\$0	\$1		0.1%	\$0	\$0		0.0%	\$0	\$0		0.0%	\$0	\$0		0.0%
Inpatient Nursing	\$1,652	\$1,838		10.4%	\$2,082	\$2,158		3.4%	\$1,569	\$1,723		9.5%	\$1,388	\$1,579		13.4%
OR/PARR (incl DS)	\$76	\$29		-2.6%	\$80	\$21		-2.6%	\$2	\$0		-0.1%	\$1	\$0		-0.1%
Pharmacy/Drugs	\$29	\$6		-1.3%	\$34	\$10		-1.1%	\$20	\$3		-1.0%	\$14	\$2		-0.9%
Total	\$1,785	\$1,934		8.3%	\$2,230	\$2,248		0.8%	\$1,618	\$1,790		10.6%	\$1,425	\$1,625		14.0%

Among Perinatal CMGs, the average direct cost at the modal LOS was consistently higher in the academic organizations in comparison to the community organizations however, the differential varied by CMG. Generally speaking, lower average OR costs were found in academic organizations. This however, may be a result of procedures occurring more frequently on the unit in academic hospitals rather than in the OR. Lower average Pharmacy/Drug costs were also found among academic organizations in the Perinatal CMGs. ICU and Allied Health costs however, were substantially higher in academic hospitals in comparison to community organizations. By CMG, the analysis found:

- *Repeat Caesarean Section:* Higher Clinical Laboratory and Inpatient Nursing expenses found in academic hospitals. Lower pharmacy/drug expenses found in academic hospitals.
- *Caesarean Delivery/Vaginal Delivery with Complicating Diagnosis/Vaginal Delivery:* Wider variation in community direct costs – Clinical Laboratory and Inpatient Nursing expenses higher in academic hospitals. Lower Pharmacy/Drug expense – Higher costs found at St. Michael’s Hospital (costs relatively comparable among other sites).

In addition to comparing the functional centre costs at the modal LOS, direct cost and LOS distributions were calculated to assess the relationship of LOS and direct cost within a homogeneous group of CMGs. In general, the analysis indicates that academic hospital case costs are higher across the length of stay. Furthermore, in most of the CMGs examined, the case cost gap widens with higher length of stay. Several examples of the distributions examined are presented below.

Exhibit 22: CMG 204 AMI w/ Card Cath No Spec Card Condition

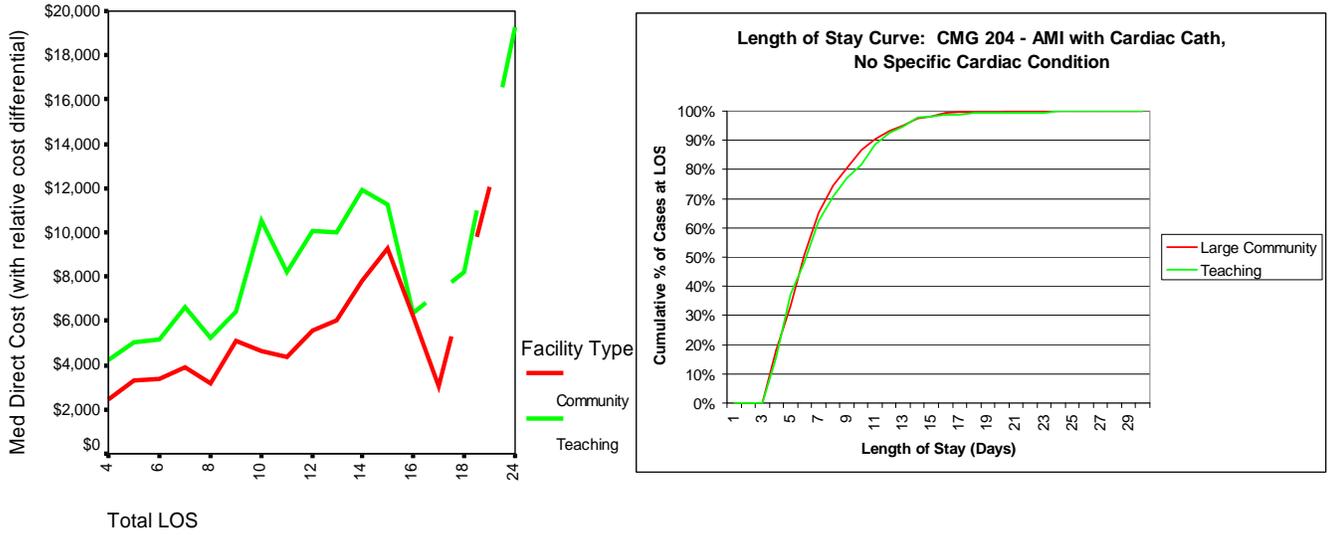


Exhibit 23: CMG 222 Heart Failure

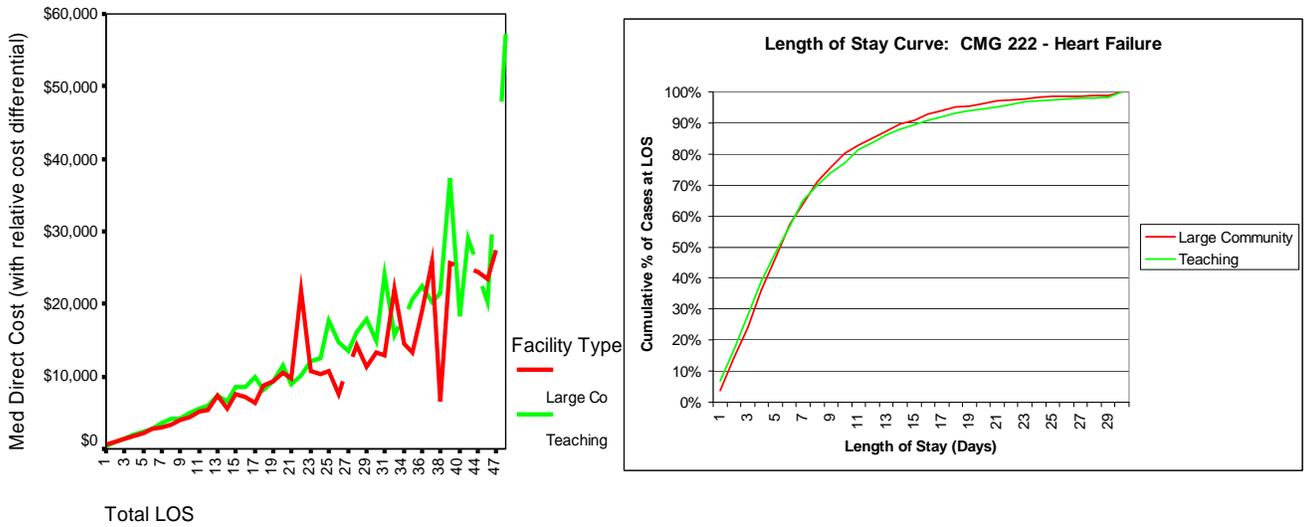


Exhibit 24: CMG 262 Simple Appendectomy

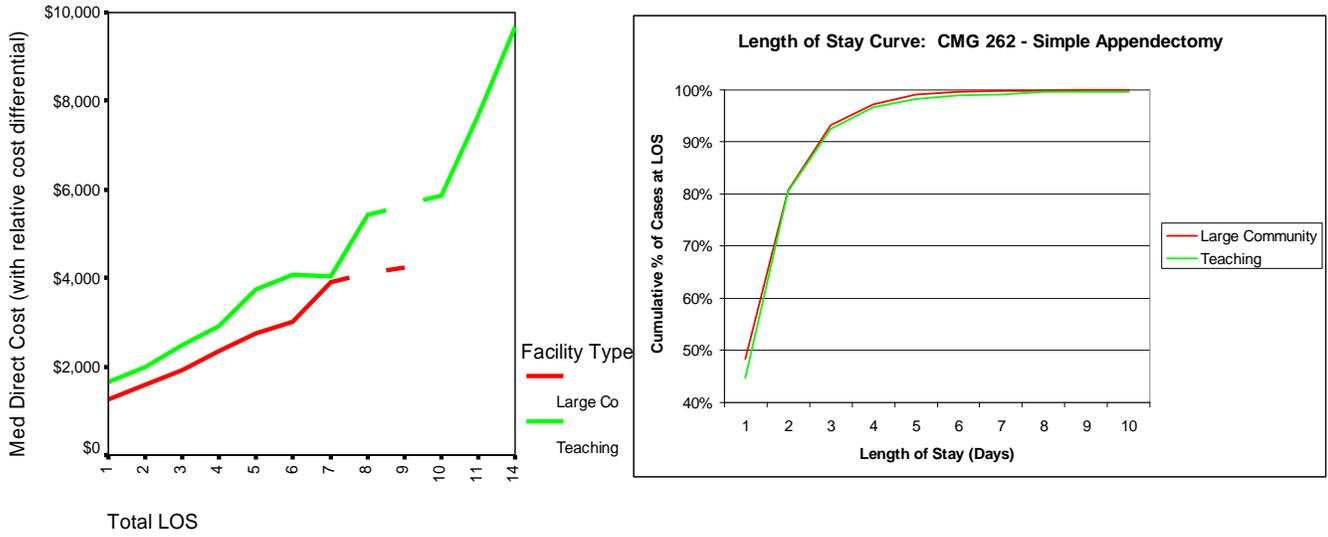


Exhibit 25: CMG 352 Hip Replacement

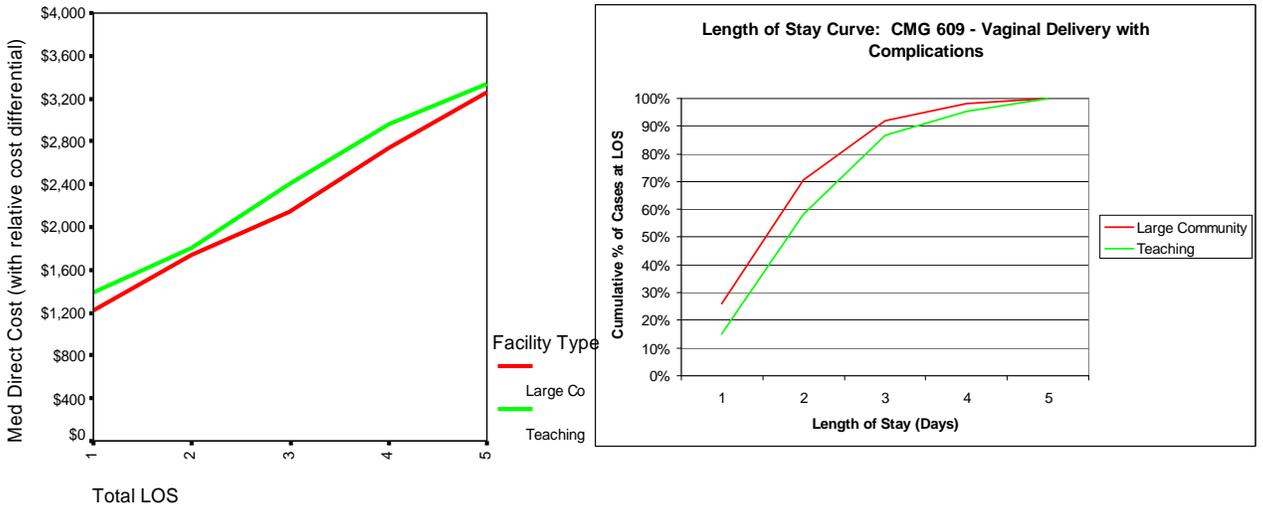
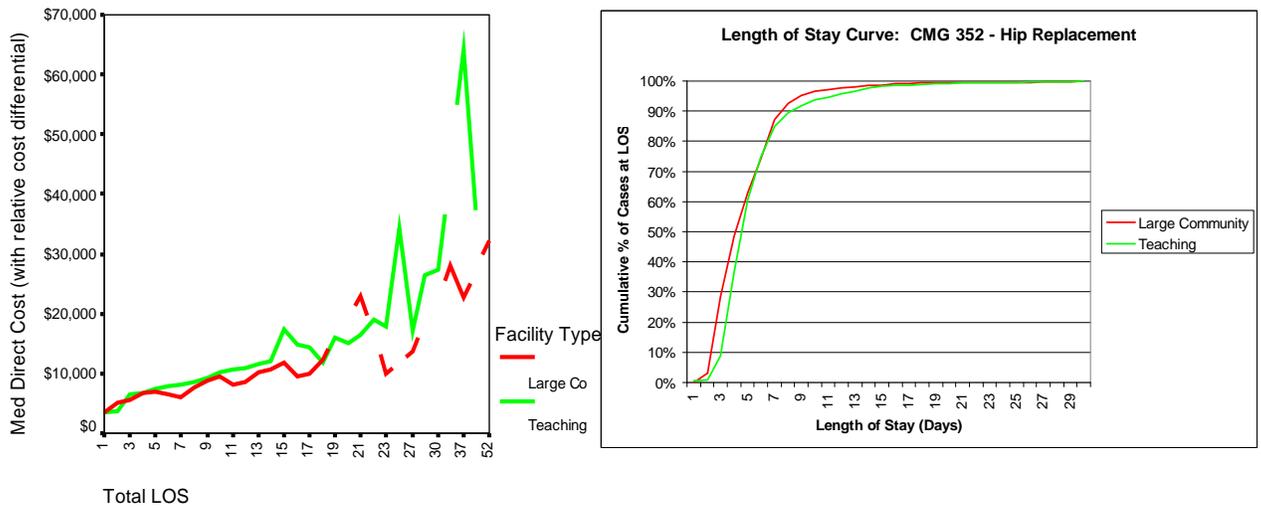


Exhibit 26: CMG 609 Vaginal Delivery with Complications



An analysis of the direct cost differential was then conducted across all CMGs (typical cases) to evaluate the impact of teaching at a cost centre level. CMGs were grouped into three clinical groupings (i.e., perinatal, surgical, medical) and the direct cost index for typical cases was calculated by functional centre for all CMGs. The direct cost index represents the ratio of average academic functional centre cost to average community functional centre cost. A regression analysis was conducted by functional grouping controlling for LOS. The results of the analysis are presented in the exhibit below. Within Inpatient Nursing, for example, the average Inpatient Nursing cost is approximately 8% higher among medical CMGs in academic organizations, 11% higher among perinatal CMGs and 25% higher among surgical CMGs (controlling for LOS). Results are not presented for Diagnostic Imaging as the model did not fit well for this cost centre. Interestingly, among medical and surgical CMGs the ICU average cost is 7-10% lower in academic organizations in comparison to community organizations. However, ICU average costs are substantially higher within the perinatal CMGs. This may be influenced by the extraordinarily high costs incurred in caring for very low birth weight neonates in academic organizations. The analysis of cost differential by cost centre indicates that the academic cost differential varies on clinical program and cost centre.

Exhibit 27: Average Cost Academic Cost Differential by Functional Centre and Clinical Grouping

Functional Group	Medical	Perinatal	Surgical
Inpatient Nursing	1.08	1.11	1.25
OR/PARR (incl DS)	1.26	0.38	1.20
ICU	0.90	6.48	0.93
Clinical Lab	1.34	1.83	1.73
Pharmacy/Drugs	1.35	0.98	1.49
Allied Health	1.75	2.24	1.49
Total	1.14	1.23	1.19

Summary of Conclusions:

The purpose of this analysis was to better understand the academic cost differential at a cost centre level. The analysis indicates that:

- Perinatal (typical) cases in academic organizations tend to cost approximately 23% more than cases in community hospitals (controlling for LOS):
 - Lower mean OR costs in academic organizations (may be result of procedures occurring more frequently on the unit in academic hospitals rather than in the OR)
 - Lower mean Pharmacy/Drug costs in academic organizations
 - Substantially higher mean costs in ICU and Allied Health.
- Surgical (typical) cases in academic organizations tend to cost on average 19% more than community hospitals (controlling for LOS):
 - Lower mean ICU costs in academic organizations
 - However, higher average costs in Clinical Laboratory, Pharmacy/Drugs, Allied Health, OR/PARR and Inpatient Nursing
- Medical (typical) cases in academic organizations tend to cost on average 14% more than community hospitals (controlling for LOS)
 - Lower mean ICU costs in academic organizations
 - Higher costs in Allied Health, Clinical Laboratory and Pharmacy/Drugs.

4.4 Summary and Conclusions:

The analysis presented in this section utilizes patient-level cost data to investigate the degree to which the academic differential is related to:

- Unmeasured severity in the patient grouper and/or
- Differences in care models and/or utilization patterns at the functional centre level.

The analysis suggests that the mean cost differential across typical cases is approximated at 12% but, that this varies by program, program type and functional centre. Some of this variation is related to differences within the same CMG that may be related to the absence of a severity and complexity adjustment. In the longer term, revisions to the CMG grouper could address this issue. CIHI may be already addressing some of the issues related to “heterogeneous” CMGs through their grouper re-development project. Commitment to this process should be articulated to ensure that the re-development progress is fast tracked. In the shorter turn, it is recommended that the Ministry of Health and the JPPC (Funding Committee) more accurately account for the teaching cost factors identified in funding and performance measurement tools.

Specific attention should be focused on the surgical CMGs as they are a major contributor to the cost differential. Again, refinement to the CMGs would improve the academic differential. Examples include:

- Looking at levels of invasiveness (as CIHI is proposing)
- Recognizing multiple interventions (plx only recognizes multiple comorbidities in general)
- Complexity may also interact more on the surgical side than on the medical side (certainly post admit).

The analysis by reference CMG indicated that even at the modal LOS there are substantial differences in cost structure across all hospitals. In addition, the regression results for the cost ratios indicated that medical/surgical/perinatal, and teaching all have independent effects. Unmeasured case mix (as proxied by typical 75th percentile length of stay) is also important. Further investigation should therefore focus on analyzing functional centre activity and costs by CMG by diagnosis/procedure code and by day of stay. This analysis should be undertaken to differentiate between differences in care plans and utilization differences.

Examination of outlier costs indicated that for a substantial number of CMGs ($n=103$) the direct cost differential between academic and community hospitals is at least two times. Given the “heterogeneity” of a large group of typical CMGs and the wide range in costs across outlier academic cases, it is recommended that further investigation of the influence of outlier cases on overall hospital costs be conducted.

5. CONCLUSIONS AND RECOMMENDED ACTIONS

The following are the key conclusions from the study:

- Academic hospitals represented by CAHO continue to train the vast majority of medical students (82%) and residents (90%) and fellows (99%). Residents and Fellows represent over 80% of medical trainee days and the proportion trained by CAHO hospitals has not changed significantly over the last four years. The proportion of undergraduate medical students being trained in non-CAHO hospitals has increased steadily over the last four years but this is reflecting the absorption of increasing demand for medical training by community hospitals as opposed to a shift in the burden of training from academic to community hospitals.
- Infrastructure and support expenses related to educating medical trainees are estimated at an average of \$42 per trainee day (\$23 for supplies and \$19 for other infrastructure and support). Based on this per day expense, the infrastructure and support costs represent an average of 1% to 1.5% of total operating costs for general academic hospitals and an estimated \$58 million in 2004/05 for all CAHO hospitals.
- Controlling for case mix, the average direct patient care cost differential between CAHO and non-CAHO hospitals is 12%. Higher length of stay explains a relatively small part of the cost differential although the differential widens with higher length stay and especially outlier cases. Unmeasured case mix effects (patients in academic hospitals requiring care beyond the ability of current case mix tools to measure) account for an additional cost differential of approximately 6%. As such, the total academic hospital cost differential controlling for case mix can be estimated as 18%.

Upon reviewing the results of this study, the CAHO Council recommended the following actions in response:

- **Short Term Action:** The Ministry of Health and Long Term Care and the Joint Policy and Planning Committee's (JPPC) Funding Committee should be asked to more accurately and comprehensively account for the teaching cost factors identified in this study in the redevelopment of hospital funding and performance measurement tools.

- Longer Term Action: The Canadian Institute for Health Information (CIHI) should be asked to fast track the redevelopment of the Case Mix Grouping methodology. The objective would be to address the current gaps in the ability of the case mix grouping tools to accurately reflect patient care resource patterns typical of academic hospitals.

6. RECOMMENDATIONS FOR IMPROVING THE CAPABILITY TO MEASURE AND ASSESS CLINICAL EDUCATION IN ACADEMIC HOSPITALS

This study represents an initial attempt to identify and quantify the key factors that contribute to higher indirect (infrastructure and support) and direct patient care costs in academic versus non academic hospitals. This section identifies recommendations for improving the Ontario system's ability to accurately measure the cost impact of clinical education.

1. The methodology used in this study should be further refined. This includes refinement of the micro-costing methodology by standardizing the cost data collection process and including all academic hospitals. The validity of the case costing analysis would also be enhanced with the higher quality case cost data that will become available and more detailed reporting including cost by patient day and cost by expense type (fixed and variable).
2. A process should be implemented to report provincial nursing education activity similar to that for the medical trainee data. This should use standardized for required data elements which would include number of nurses and hours of training by year and diploma/degree/certificate type.
3. The infrastructure and support costing approach should be applied to nursing education, and then to diagnostic and therapeutic services. A similar micro-costing methodology to the one used for medical education in this study could be used.
4. In the longer term, a prospective, standardized data collection process should be developed to facilitate ongoing, reliable quantification of clinical education costs in academic and non academic hospitals. This could follow an annual survey method or incorporation into existing hospital financial and statistical reporting processes.

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Appendix 1: Academic Hospitals Interview Guide

Interview Guide: Development of Clinical Metrics in Ontario's Academic Hospitals

As part of assessing the costs associated with the academic mission of its hospital membership, CAHO has engaged consultants to research and quantify the investment of time and resources in the training of students. To allow us to gain a greater understanding of this investment, you have volunteered to participate in an interview given your knowledge of the logistics/processes of training students. For your review, we have included below a guide that will form the basis of discussion for your interview. The purpose of the interview is to obtain a better understanding of the requirements of students and the hospital in the training of all clinical disciplines (Medical, Nursing, Diagnostic, and Therapeutic). We require this information for every clinical program/department/discipline in your hospital that is directly involved in the training and/or logistical and administrative support of students.

We thank you in advance for your participation in this project.

Nursing, Diagnostic, and Therapeutic Trainees

Project Objective: To identify and define the hospital clinical placement requirements for nursing and diagnostic (Clinical Laboratory, Diagnostic Imaging, Electrodiagnosis, etc.) and therapeutic (Pharmacy, Respiratory Therapy, Radiation Oncology, Physiotherapy, Audiology, Social Work, etc.) areas including scope and duration. The questions below should be answered separately for each discipline trained by the hospital.

Trainee Discipline (e.g., Laboratory Medicine):

Hospital Program/Department Primarily Responsible for Training (e.g., Clinical Laboratory):

1. What are the training requirements (number of placement hours per weeks, number of clinical days)?

2. What program/department resources are required to support the clinical placements (e.g., number of professional FTEs, administrative and support staff, cost of supplies, etc.)? One way of thinking about that is to estimate the resources (FTEs and others) that would be reduced if teaching activity were to cease.

3. To what extent do the trainees provide direct patient care services? Are these services provided independently or always under the direct supervision? Do the students collect workload units when providing direct patient care?

4. What, if any, is the involvement of staff from other departments or programs required in the training, education, and administrative/logistical support of the students?

5. Are the students compensated in any way by the hospital (e.g., salaries, stipends, benefits, accommodation, expenses, etc.)?

6. Do the colleges or universities that the trainees are enrolled in, provide any financial support to your hospital for the placements (e.g., stipends)? If so, what is the current amount paid per student placement?

7. Are students from this discipline also trained in community hospitals? If so, how do the training requirements differ for academic versus community hospitals?

8. What data elements should be collected on an ongoing basis to support analysis of teaching activity for the discipline?

9. What process should be implemented for the collection of this data (e.g., responsibility, time frames, submission process)?

Medical Trainees

Project Objective: To define the medical trainee program requirements for each type of training and to assign relative value units reflecting the differential impact on hospital resources to each of the medical trainee categories/levels of education.

	Undergraduate (U1-U4)	Post-graduate (P1-P8)	Clinical Fellow (excl. Clinical Associates)
1. What are the training requirements (number of placement hours per week, number of clinical days, call on-site)?			
2. Do the training requirements differ for academic versus community hospitals?			

	Undergraduate (U1-U4)	Post-graduate (P1-P8)	Clinical Fellow (exld. Clinical Associates)
3. What program/department resources are required to support the clinical placements (e.g., number of professional FTEs, administrative and support staff, cost of supplies, etc.)? One way of thinking about that is to estimate the resources (FTEs and others) that would be reduced if teaching activity were to cease.			
4. What, if any, involvement of other hospital departments or programs in the training, education, and administrative/ logistical support of medical students?			
5. To what extent do the trainees provide direct patient care services? Are these services provided independently or always under the direct supervision?			
6. Is medical training more resource intensive on some specialties (e.g. family medicine)?			

Appendix 2: List of CAHO Hospitals As Identified for the Analysis

Master Number	Hospital Name
651	Royal Ottawa Health Care Group
674	St Joseph's Hamilton
692	Hotel Dieu - Kingston
693	Kingston General
695	Providence CCC-St Mary's (Kingston)
714	St Joseph's - London
751	Children's Hospital of Eastern Ontario (Ottawa)
827	Toronto Baycrest
837	Hospital For Sick Children
842	Toronto Mount Sinai
852	Toronto St. Michael's and Casey House
856	Royal Ottawa Health Care Group
935	Thunder Bay Regional
936	London Health Sciences
939	Bloorview MacMillan
942	Hamilton Health Sciences Corp
947	Toronto University Health Network
948	Centre For Addiction and Mental Health
953	Toronto Sunnybrook & Women's College
956	Toronto Rehabilitation Institute
958	The Ottawa Hospital
959	Sudbury Hopital Regional De Sudbury
961	Ottawa Heart Institute

Appendix 3: Infrastructure and Support Microcosting Survey

As part of assessing the costs associated with the academic mission, CAHO has engaged consultants to research the investment of time and hospital resources in the training of medical trainees. To allow us to gain a greater understanding of this investment, you have volunteered to participate in a micro-costing survey given your knowledge of the logistics/process of training students.

The purpose of this survey is to estimate, using case examples, the direct hospital costs associated with the training of medical trainees at all levels. The objective of the study is to define the medical trainee program requirements for each type of training and to assign relative value units (RVU) reflecting the differential impact on hospital resources to each of the medical trainee categories/levels of education (undergraduate, post-graduate and graduate).

We thank you in advance for your participation in this project.

- 1) Provide the average number of days spent by each student/resident in the hospital per academic year (Sept through August). For example, if U1 students spend 1.5 days per week at the hospital for 36 weeks in their first year (Sept through May), then the total days would be 54.

Days:

Undergraduate (U1)	_____
Undergraduate (U2)	_____
Clinical Clerks (U3)	_____
Clinical Clerk (U4)	_____

- 2) In your opinion, rank in ascending order (1-4) the various types of medical student categories in terms of the largest consumers of hospital expenses (e.g., heat, hydro, hospital staff, supplies and sundry) per student (e.g., a ranking of 1 is assigned to the medical student category utilizing the most hospital expenses per student).

Rank (1-4):

Undergraduate (U1 and U2)	_____
Clinical Clerks (U3 and U4)	_____
Residents (R1-R8)	_____
Fellows	_____

- 3) Please identify the total square metres/footage of the following areas and provide your best estimate of the percentage use of those areas by medical trainees in 2005/06:

	Square Metres/ Footage	Percent Use by Medical Trainees
Auditoriums/Lecture Halls	_____	_____
Dedicated Medical Trainee	_____	_____
Classrooms	_____	_____
Tele-health rooms	_____	_____
Conference rooms	_____	_____
Other rooms (e.g., mail boxes)	_____	_____
Audiovisual office and storage	_____	_____
Library	_____	_____
Dedicated Computer Rooms	_____	_____
On-call/Duty rooms	_____	_____
Student bathrooms	_____	_____
Lockers	_____	_____
Other (<i>please specify</i>):	_____	_____
_____	_____	_____
Other (<i>please specify</i>):	_____	_____
_____	_____	_____

- 4) Please identify the total cleanable square metres/footage of your organization for 2005/06. Total cleanable square metres/footage is defined as *the total area inside exterior walls, excluding major mechanical rooms (and penthouses)*. The area should correspond to the area maintained by the housekeeping functional centre. If the department earns a recovery for cleaning areas for others, those areas should not be included. Note: parking garages should be excluded.

_____ **square metres/feet**

- 5) For the following cost centres, please identify the total budgeted expenses (net of external recoveries) for 2005/06:

	Budgeted 2005/06 Total Expense
Housekeeping	\$ _____
Plant administration	\$ _____
Plant operations	\$ _____
Plant security	\$ _____
Plant maintenance	\$ _____

- 6) Please identify the total budgeted expenses in the Medical Education Office by expense category below. Include revenues/recoveries received to off-set these costs. In addition, identify your best estimate of the percentage of time dedicated to medical education (and if possible by medical trained category)

	Budgeted 2005/06 Total Expense	Budgeted 2005/06 Off-Setting Revenue/Recovery	Percentage of Resources Dedicated to Medical Education				
			Total	Under-graduate (U1 and U2)	Clinical Clerks (U3 and U4)	Residents (R1-R8)	Fellows
Medical Director	\$	\$	%	%	%	%	%
Director	\$	\$	%	%	%	%	%
Coordinator	\$	\$	%	%	%	%	%
Assistant	\$	\$	%	%	%	%	%
Laundry and Linen	\$	\$					
Pager	\$	\$					
Photocopying	\$	\$					
Supplies & Sundry	\$	\$	%	%	%	%	%
Other (please specify):	\$	\$	%	%	%	%	%
Other (please specify):	\$	\$	%	%	%	%	%
Other (please specify):	\$	\$	%	%	%	%	%

- 7) Please identify any other physician or other hospital staff salaries/stipends (not already identified in question 6) that are involved in medical education **who are paid through hospital operations**. Include revenues/recoveries received to off-set these costs.

	Budgeted 2005/06 Salary/Stipend Expense	Budgeted 2005/06 Off-Setting Revenue/Recovery
Physicians	\$	\$
Other (please specify):	\$	\$
Other (please specify):	\$	\$

8) Please identify fellow salaries and other support **paid through hospital operations**:

	Budgeted 2005/06 Salary and Other Support
Fellows	\$ _____
Other (<i>please specify</i>): _____	\$ _____

9) Please identify budgeted expenditures (net of external recoveries) for the following cost centres. In addition, estimate the percentage of the resource dedicated to medical education.

	Budgeted 2005/06 Expenditures	Percentage of Resources Dedicated to Medical Education
Library	\$ _____	_____ %
Audio visual	\$ _____	_____ %
Information technology	\$ _____	_____ %
Occupational health and safety	\$ _____	_____ %
Human resources	\$ _____	_____ %
Other (<i>please specify</i>): _____	\$ _____	_____ %
Other (<i>please specify</i>): _____	\$ _____	_____ %

10) Please identify the average cost for the following items:

	Average Unit Cost (2005/06)
Cost per gown	\$ _____
Costs per glove	\$ _____
Cost per lab coat	\$ _____
Cost per scrub (top and bottom)	\$ _____
Cost per ID badge	\$ _____

Thank you very much for taking the time to complete this survey.