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SHORT REPORT

Understanding the use of emergency department and urgent care services by diabetic patients of a Family Medicine Health Team: a retrospective observational study

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Aim: To understand the frequency, urgency, and rationale of emergency department and urgent care (ED/UC) use by diabetic patients of a Family Medicine Health Team (FHT). **Methods:** A retrospective, observational study with comparison control groups was conducted from 1 January 2013 to 31 December 2014. A total of 693 diabetic patients were compared with two, age-standardized non-diabetic groups: one with a higher disease burden based on International Classification of Diseases 9 diagnoses and the other from a randomized patient pool. **Findings:** The diabetic group utilized ED/UC services 1.25 and 1.92 times more often than the two control populations, consistent with that observed in other studies. Canadian Triage and Acuity Scale scores were essentially the same for the diabetic population. Only 3.1% of visits were for diabetic related emergencies, in contrast to the expected 23% by surveyed physicians of the FHT. Diabetic patient's sought treatment for cellulitis, wounds, abscesses, and infections more often than the control populations.

Key words: diabetes mellitus; emergency department; family health team

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Introduction

Multiple US studies have concluded that usage of emergency department (ED) services is significantly higher for individuals with diabetes. For instance, a commercial insurer population of over 800 000 in Ohio demonstrated a 1.7 times higher use of the emergency room by type 2 diabetic patients when controlling for age and sex (Laditka *et al.,* 2001). A prospective study of Medicare beneficiaries from 1994 to 1996 showed that diabetic patients were three times as likely to use the ED three or more times within a year (Krop *et al.,* 1999). Diabetic men in the US (aged 60–64) with heart failure as their primary diagnosis were seven times more likely to use the ED than those without diabetes (American Diabetes Association, 2008). For geriatric populations, a history of diabetes was identified as an independent risk factor that increased rate of return to the ED within six months of initial discharge (McCusker *et al.,* 2000).

Conversely, Egede (2004) suggested that the odds ratio of ED use was not statistically different for diabetic patients when confounding variables (eg, age, sex, race, education, income, and comorbidities) and a multivariate variate analysis was considered. Indeed, there remains some ambiguity on this topic in the literature.

In this study, diabetic patients of a large Family Medicine Health Team (FHT) in Kingston, Ontario were analyzed to help understand the frequency and rationale of use for local emergency department and urgent care (ED/UC) services. There is a push in Ontario for FHT's to facilitate more appropriate use of local emergency departments by

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high-risk populations (Rosser *et al.,* 2011). As such, it is the purpose of this study to shed light on potential reasons why diabetic patients of a multi-disciplinary health care team use the local ED/UC, and what primary care interventions may be appropriate to help reduce this resource usage when and where appropriate.

Methods

Family health team and local ED/UC services

The Queen's University Family Health Team (QFHT) is located in Kingston, Ontario and currently enrolls ~15 000 active patients. The team consists of 23 faculty physicians, 50 family medicine resident physicians, and 30 allied-health workers (including a pharmacist, social worker, dietician, and registered nurses). Local emergency departments and urgent care centers include Kingston General Hospital, Hotel Dieu Hospital, and Lennox and Addington Hospital.

Data collection

Patient data were extracted from the QFHT electronic medical record (EMR) and inserted into a secured Microsoft™ Excel™ spreadsheet. Patient confidentially was protected through the application of EMR demographic numbers.

Data collected during chart review by the single author included patient gender, age, number of International Classification of Diseases 9 (ICD9) diagnoses listed in the patient chart, A1c levels by month, and ED/UC visits by month. Canadian Triage and Acuity Scores (CTAS) and discharge diagnoses were recorded from emergency room records, which are automatically faxed from the local ED/UC centers and uploaded to the QFHT patient EMR. CTAS scores are used to triage patients presenting to an ED/UC center where they are assigned a level of 1–5 (corresponding to resuscitative, emergent, urgent, semi-urgent, and non-urgent priority, respectively).

A single diabetic test population and two control populations were created using the study flow diagram shown in Figure 1. Control population 1 was meant to represent an age-adjusted population of non-diabetic patients yet with a maximum amount of 'disease burden' as quantified by the number of ICD9 diagnoses on file. Control population 2 was a randomized age-adjusted population of non-diabetic patients. Because this second randomized control was intended to draw on the largest sample size possible ($n = 2021$), 271 patients from control population 1 were also found in control population 2.

A survey, designed to assess the understanding and attitudes of QFHT physicians in regards to utilization of the ED/UC by diabetic patients was circulated to members. A total of 32 respondents gave anonymous feedback by ranking their agreement or disagreement to three statement questions related to this topic (see Figure 4).

Two additional questions in the survey were asked requiring a numerical input. Question 1: 'In your experience/observation(s), by what approximate factor do you believe diabetic patients at QFHT (as a population mean) use emergency room/urgent care services (within a two-year period) compared to age-adjusted, non-diabetic patients with the same amount of morbidity [respondents given a range of 0.1 to 3.5]?' Question 2: 'Of the diabetic patients at QFHT, what total percentage of the time do you believe they access emergency department/urgent care services for true diabetic emergencies (hyperglycemia, DKA, HHS, hypoglycemia)?'

Data analysis

Data analysis relied on the standard statistical tools found in Microsoft™ Excel™ 2013 and Statistical Solutions, LLC. Demographic data, total number of ED/UC visits, and mean CTAS scores from 1 January 2013 to 31 December 2014 for each population were calculated and are shown in Table 1. In a sub-analysis of the test population only, weighted means and weighted standard deviations (σ_w) yielded the same results as normal means and normal standard deviations (σ) (data not shown), so where appropriate, the later statistical approach was used. Margin of error was calculated to the 95% confidence level. *T*-tests used two-tails and unequal variance of the test population against each control, with *P*-values listed.

Mean A1c levels, number of total ED/UC visits, and mean CTAS scores over a two-year period were calculated for each population in three-month increments. Margin of error for mean A1c and CTAS scores were again calculated to the 95% level. Data are presented in Figure 2. Trend lines for number of ED/UC visits over the two years were added to each population.

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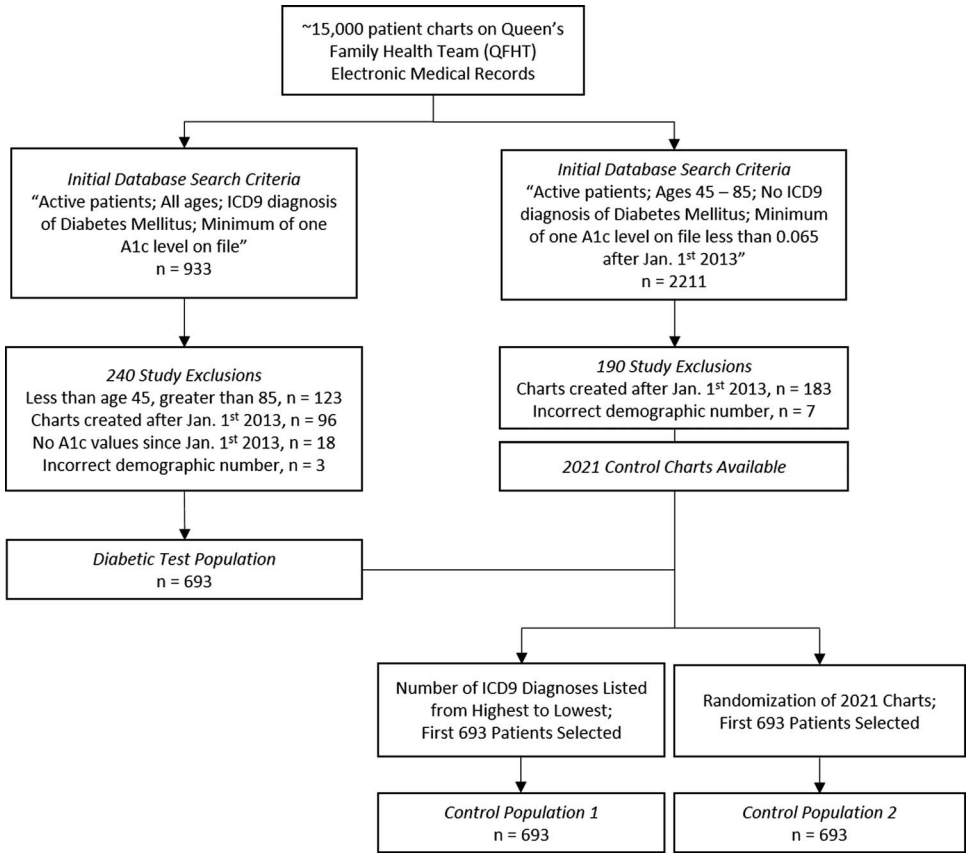

Figure 1 Study population flow diagram

The percentage of ED/UC visits grouped by clinical presentation were tabulated and presented in Figure 3 as a histogram. Specific diagnoses from all three populations as assigned by clinical presentation is presented in Supplementary Appendix. Survey results were tabulated and are shown in Figure 4.

Results

The mean age was similar between all three groups but the number of ICD9 diagnoses and A1c levels varied significantly between the test and control populations (Table 1). Based on the number of entered ICD9 diagnoses, control population 1 had greater disease burden than the diabetic population, helping to control for confounding factors related to this disease (Egede, 2004).

Compared with the control populations, diabetic patients utilized ED/UC services 1.25 ($n = 1063/871$) and 1.92 times ($n = 1063/548$) more respectively than control populations 1 and 2. As a range, diabetic patients utilized ED/UC services between 1.25 and 1.92 (mean of 1.58) more often than the two controls groups. Based on quantitative survey results, physicians at QFHT expected a factor difference of 1.75 [$n = 32$, margin of error 95% CI 0.248, (1.0–3.0), σ0.74], similar to that observed in this study.

There was no statistically significant difference in mean number of ED/UC visits per patient between the test population (1.53) and control population 1 (1.26) ($P = 0.08$), but there was a statistical difference compared with control population 2 (0.79) ($P < 0.001$).

CTAS scores had a statistically significant difference between the diabetic population and

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Table 1 Demographic data, total number of emergency department and urgent care (ED/UC) visits, and average Canadian Triage and Acuity Scale (CTAS) scores from 1 January 2013 to 31 December 2014 for the study populations

	Test population (n = 693)	Margin of error (95%)	Control population 1 (n = 693)	Margin of error (95%)	Control population 2 (n = 693)	Margin of error (95%)	*T*-test against control 1	*T*-test against control 2
Gender	337♀:356♂	–	422♀:251♂	–	407♀:286♂	–	–	–
Mean age (years)	64.6 [45–85] σ9.8	±0.7	66.0 [45–85] σ10.7	±0.8	63.1 [45–85] σ10.3	0.8	0.01	0.004
Mean no. of ICD9 D_x	6.2 [1–26] σ4.3	±0.3	7.7 [4–27] σ3.3	±0.3	3.9 [0–22] σ3.5	±0.3	<0.001	<0.001
Mean A1c	0.074 [0.048–0.15] σ0.014 (n = 2962)	±0.0005	0.057 [0.044–0.069] σ0.004 (n = 1003)	±0.0002	0.057 [0.044–0.076] σ0.003 (n = 918)	±0.0002	<0.001	<0.001
Total no. of ED/UC visits	1063	–	871	–	548	–	–	–
Mean no. of ED/UC visits per patient	1.53 [0–61] σ3.6	±0.2	1.26 [0–16] σ2.1	± 0.1	0.79 [0–13] σ1.5	±0.07	0.08	<0.001
Mean CTAS scores	3.3 [1–5] σ0.8	±0.05	3.2 [1–5] σ0.7	± 0.05	3.3 [1–5] σ0.7	±0.06	0.02	0.70

σ = standard deviation; [ ] = range; ICD9 = International Classification of Diseases 9.

control population 1, yet the later had a marginally lower (more urgent) mean score. No difference in mean CTAS score existed between the diabetic population and control population 2. The power to detect a mean difference of 1.0 in CTAS scores between the test population and control population 1 was 0.26 ($\beta = 0.74$, $\bar{u}_1 3.29$, $\bar{u}_2 3.22$, $\alpha 0.05$, $n = 693$, two-sided). The sample size needed for a desired power of 0.8 would have been $n = 3204$. The power between the test population and control population 2 could not be calculated as both had an identical mean ($\beta = 0.8$).

Figure 3 shows a histogram of clinical presentations for each group and box 1 highlights the increased frequency of ED/UC use by diabetic patients for treatment of cellulitis, abscesses, wounds, and infections (± use of IV antibiotics). The percentage ratio was 14.4:7.0:5.9% among the three groups, with diabetic patients visiting the ED/UC for such complaints 153 times (compared with 61 and 32 for populations 1 and 2). Box 2 in Figure 3 highlights a 3.1% frequency for diabetic emergencies (hyperglycemia, DKA, HHS, or hypoglycemia). This is in contrast to physician survey results which expected, on average, 23% of visits [n = 30, margin of error 95% CI 9.6%, (1–90%), σ27.8%] to be related to diabetic emergencies.

Figure 4 shows the attitudes of surveyed physicians at QFHT regarding their outlook of how diabetic patients utilize local ED/UC services. Physicians seemed to agree that diabetic patients at QFHT represent a unique 'at-risk' population more prone to overutilization of ED/UC services. They moderately agreed that extra attention and/or resources should be directed toward this population in order to help prevent inappropriate overutilization of this resource. However, there was only a neutral opinion that current primary care measures at QFHT were being used effectively to facilitate this goal.

Finally, an interesting secondary outcome of this study was that mean A1c levels appear to fluctuate seasonally, with a maximum mean of 0.075 (January–March 2013, n = 366, σ0.015) and a minimum mean of 0.072 (October–December 2013, n = 363, σ0.013) for the diabetic population (Figure 2). Seasonal variation in A1c has been observed previously by other authors (Higgins *et al.*, 2009). For instance, in a large study of US veterans, differences in A1c levels were on

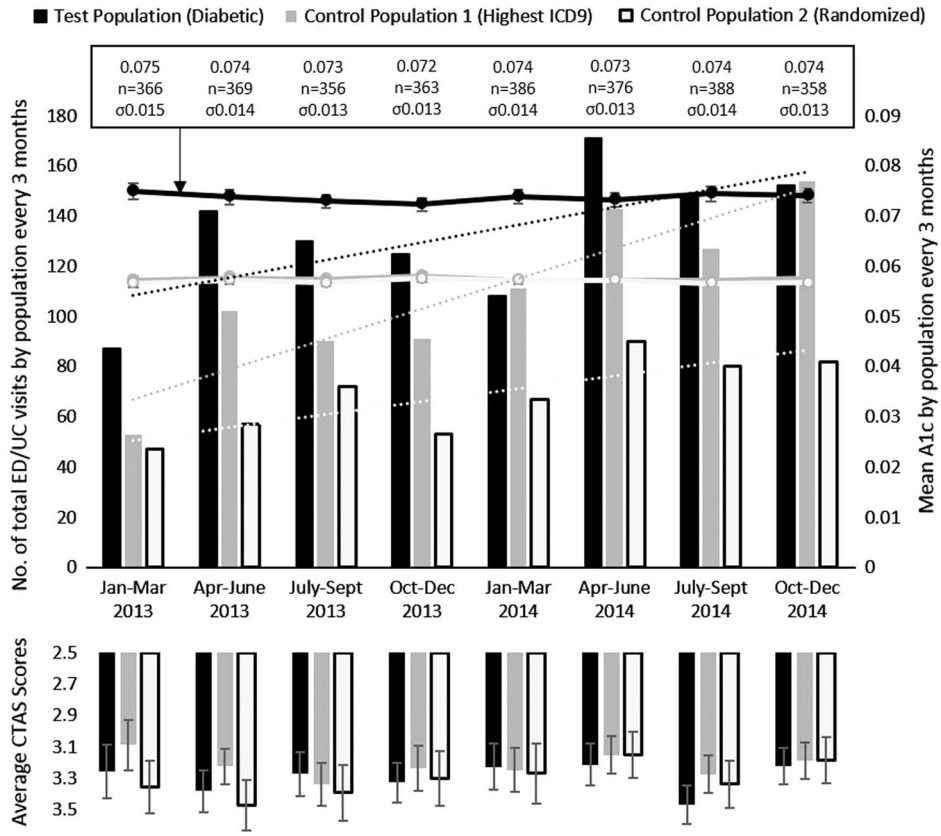

Figure 2 Number of emergency department and urgent care (ED/UC) visits (vertical bars), average A1c levels (horizontal solid lines), average Canadian Triage and Acuity Scale (CTAS) scores (bottom vertical bars), and ED/UC visit trends (dotted lines) in three-month increments by each population. Specific A1c means (black line) with *n*-values and standard deviations (σ) for the diabetic population is shown in the highlighted box

average 0.0022 higher in winter months (January–April) compared with summer months (July–October) (Tseng *et al*., 2005). This study would remind the clinician that seasonal factors are thought to potentially impact mean A1c levels, although the clinical significance of such small differences seen here is unknown.

Discussion

This paper explored the use of ED/UC services by diabetic patients of a FHT and determined that they were 1.25 and 1.92 (mean of 1.58) times more likely to access these services. These results are consistent with that observed in other studies and that expected by surveyed physicians of QFHT. CTAS scores were slightly less urgent for diabetic patients who required a higher need for treatment of cellulitis, wounds, abscesses, infections, and IV antibiotics. Only 3.1% of visits were for diabetic related emergencies in contrast to the expected 23% by surveyed physicians.

There are well-known economic and personal costs associated with diabetic-related emergencies. Leese *et al.* (2003) showed that incidence rates for severe hypoglycemia requiring emergency treatment are as high as 11.5 and 11.8 events per 100 patient-years for type 1 and 2 insulin-dependent diabetic patients, respectively. However, in comparison with all other presenting complaints, patients in this study accessed ED/UC services a

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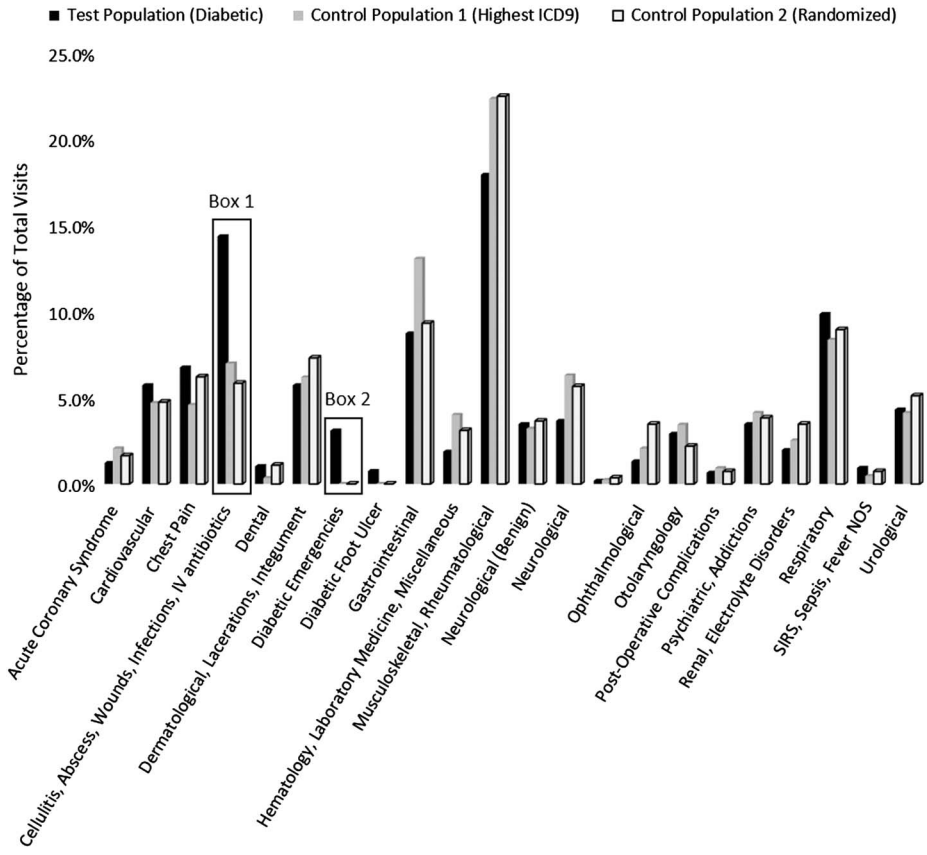
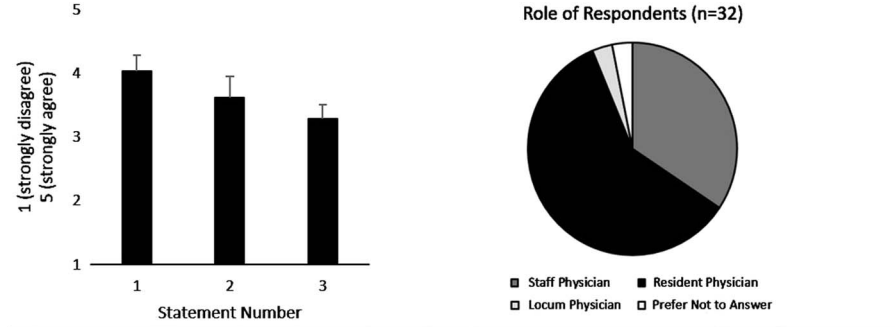


Figure 3 Percentage of emergency department and urgent care visits grouped by clinical presentation



Statement 1: Diabetic patients are a unique 'at-risk' population and should receive extra attention and resources within any primary care setting.
Statement 2: Diabetic patients, as a population, are more likely to use emergency department / urgent care services compared to non-diabetic, age- and morbidity adjusted patients.
Statement 3: Current primary care measures are used effectively at QFHT in reducing the frequency of which diabetic patients use local emergency department / urgent care services.

Figure 4 Survey responses where respondents were asked to read the following statements and rank their agreement or disagreement

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relatively minimal amount of time for diabetic-related emergencies (3.1%). This seems to contrast 'popular belief' among surveyed physicians and may seem counterintuitive when the risks of diabetic emergencies are known to be so serious and prevalent on a population-wide level.

Furthermore, CTAS scores among all three groups in this study were similar, suggesting that diabetic patients on average, may not necessarily use the ED/UC for more urgent/life-threatening complaints. This is not surprising given that Goyder *et al.* (1997) already concluded that even though diabetic patients make more trips to the emergency department in the United Kingdom, the proportion actually requiring admission was similar to that of non-diabetic patients. As such, the results here are meant to reinforce the idea that there are other reasons diabetic patients visit the ED/UC, often unrelated to emergencies attributed to the underlying disease itself.

Diabetic patients in this study required treatment for cellulitis, abscesses, wounds, infections and IV antibiotics disproportionately more frequently than their non-diabetic counterparts. This is also not surprising given the well-known link between diabetes and infection (Calvet and Yoshikawa, 2001). As such, primary care providers may wish to pay particular attention to wound care management and/or signs of developing cellulitis for their diabetic patients. Perhaps early treatment with oral antibiotics and/or facilitating timely wound care may help decrease ED/UC usage by this population. More research would be needed.

Limitations

Limitations of this study included the presence of only one author being involved in data collection and analysis, inconsistent application of ICD9 diagnostic codes in patient charts among QFHT physicians, and the absence of additional confounding data that could have been used in multivariate analysis. Significant power limitations were also identified in regards to analysis of CTAS scores. Given the small differences in CTAS means among the populations, and whether or not a mean difference <1.0 has actual clinical significance, a larger sample size is required in future studies to adequately power a reanalysis of such triage scores.

Conclusion

Diabetic patients accessed ED/UC services a greater amount than the control populations over the study period. Despite perceptions by surveyed physicians, the vast majority of visits were not for diabetic-related emergencies. There was also little difference in urgency of presentation at triage. Diabetic patients required a higher need for treatment of cellulitis, wounds, abscesses, infections, and IV antibiotics. Primary care providers may want to specifically focus on infectious disease management and prevention in diabetic patients to potentially reduce their overall usage of ED/UC services. Future research on such interventions would be required.

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Conflicts of Interest

The author has no disclosure(s) or conflict of interest to declare.

Ethical Standards

Research Study, FMED-407-15, File Number 6014572, Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board-Delegated Review.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1463423616000396

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