Mortality, admission rates and outpatient use among frequent users of emergency departments: a systematic review

Jessica Moe,[1] Scott Kirkland,[2] Maria B Ospina,[3] Sandy Campbell,[4] Rebecca Long,[2] Alan Davidson,[2] Patrick Duke,[2] Tomo Tamura,[2] Lisa Trahan,[5] Brian H Rowe[5]

▶ Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/emermed-2014-204496).

[1]RCPS Emergency Medicine Residency Program, Department of Emergency Medicine, University of Alberta, Edmonton, Alberta, Canada
[2]Emergency Medicine Research Group, University of Alberta, Edmonton, Alberta, Canada
[3]Respiratory Health Strategic Clinical Network, Alberta Health Services, Edmonton, Alberta, Canada
[4]J. W. Scott Health Sciences Library, 2K4.01 WC Mackenzie Health Sciences Centre, University of Alberta, Edmonton, Alberta, Canada
[5]Department of Emergency Medicine, University of Alberta Hospital, 1G1.42 Walter C. Mackenzie Centre, Edmonton, Alberta, Canada

Correspondence to
Dr Brian H Rowe, Department of Emergency Medicine, University of Alberta Hospital, 1G1.42 Walter C. Mackenzie Centre, 8440-112 Street NW, Edmonton, Alberta, Canada T6G 2B7; brian.rowe@ualberta.ca

Received 10 November 2014
Revised 18 February 2015
Accepted 22 February 2015
Published Online First 7 May 2015

ABSTRACT

Objective This systematic review examines whether frequent emergency department (ED) users experience higher mortality, hospital admissions and outpatient visits than non-frequent ED users.

Design We published an a priori study protocol in PROSPERO. Our search strategy combined terms for 'frequent users' and 'emergency department'. At least two independent reviewers screened, selected, assessed quality and extracted data. Third-party adjudication resolved conflicts. Results were synthesised based on median effect sizes.

Data sources We searched seven electronic databases with no limits and performed an extensive grey literature search.

Eligibility criteria for selecting studies We included observational analytical studies that focused on adult patients, had a comparison group of non-frequent ED users and reported deaths, admissions and/or outpatient outcomes.

Results The search strategy identified 4004 citations; 374 were screened by full text and 31 cohort and cross-sectional studies were included. Authors used many different definitions to describe frequent users; the overall quality of the included studies was moderate. Across seven studies examining mortality, frequent users had a median 2.2-fold increased odds of mortality compared with non-frequent users. Twenty-eight studies assessing hospital admissions found a median increased odds of admissions per visit at 1.16 and of admissions per patient at 2.58. Ten studies reported outpatient visits with a median 2.65-fold increased risk of having at least one outpatient encounter post-ED visit.

Conclusions Frequent ED users appear to experience higher mortality, hospital admissions and outpatient visits compared with non-frequent users, and may benefit from targeted interventions. Standardised definitions to facilitate comparable research are urgently needed.

Review registration number: PROSPERO (CRD42013005855).

INTRODUCTION

Recently, considerable attention has been given to pressures faced by emergency departments (EDs) in industrialised countries from increased patient volumes exceeding the capacity of departments to provide timely quality of care. A cross-sectional survey of 243 Canadian ED directors found that approximately 62% of Canadian EDs were at or overcapacity in 2005[1]; the crisis continues to draw attention and worsen.

Frequent ED users are a group of interest from a health services perspective, in part because of the presumption that they contribute substantially to ED crowding. Evidence from systematic reviews indicates that frequent users account for 4.5–8% of all ED patients and contribute to 21–28% of all ED visits.[2] Despite being a difficult group to study due to heterogeneity,[2] and inconsistent definitions,[3] there is consensus in the literature that frequent ED users tend to be sicker than occasional ED users.[2] Existing literature has suggested that frequent ED users may have chronic conditions associated with higher rates of hospitalisation, longer hospital length of stay and potentially increased mortality rates, though the evidence has varied across studies.[4–6]

Systematic reviews conducted to date on frequent ED users have explored their demographic characteristics, acuity level, access to health services[2] and the effectiveness of interventions aimed at reducing their number of ED visits.[7–9] None of these has examined mortality and health outcomes of frequent ED users compared with non-frequent users. This is a major shortcoming; determining whether frequent ED users have poorer outcomes or die more often is a first step in identifying at-risk patients in whom early interventions may improve outcomes. To our knowledge, there has been no systematic review focused on mortality and outcomes among frequent ED users. The objective of this systematic review is to compare mortality and health services outcomes between frequent versus non-frequent ED users.

METHODS

A study protocol was developed a priori to define the objectives, search strategy, eligibility criteria, outcomes of interest, the process for abstracting and synthesising information from eligible studies, and the methods for data analysis. The systematic review conforms to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.

Search strategy

Comprehensive searches of seven electronic databases (MEDLINE, EMBASE, CINAHL, SCOPUS, PsycInfo, Proquest Dissertations and Theses and BASE) were conducted from database inception to September 2013. The search strategy was designed by an information specialist (SC) and comprised both selected subject headings and keywords adapted to each database (see online supplementary

To cite: Moe J, Kirkland S, Ospina MB, *et al*. *Emerg Med J* 2016;**33**:230–236.

appendix 1). No limits were applied on the basis of date, language or publication status. Additionally, extensive grey literature searches were conducted including clinical trial registries, Web of Science, Google Scholar and hand searches of the most recent emergency medicine conference abstracts (2008–2013) in *Academic Emergency Medicine* and the *Canadian Journal of Emergency Medicine*. Reference lists of reviews and retrieved articles were checked for further potentially relevant studies.

Inclusion and exclusion of studies

Studies were included if they were observational analytical studies (eg, prospective and retrospective cohort studies, case–control studies and cross-sectional studies) that compared adult (≥18 years) frequent versus non-frequent ED users. The definition of frequent ED users could be based on any parameters determined by study authors. Studies assessing frequent ED users with a specific disease were excluded, except for those examining frequent ED users with psychiatric disorders. The primary outcome of interest was mortality due to any cause, within any time frame or any duration of follow-up defined by study authors. Secondary outcomes were hospital admissions and outpatient visits. Experimental studies (ie, randomised controlled clinical trials, controlled clinical trials, before-and-after studies), editorials, review articles, case series and studies enrolling only paediatric populations were excluded. Data presented in graphs and figures were used only if numbers were described in the text or graph data. In cases of multiple publications reporting on the same data, only data from the main publication were extracted for the review.[10]

Two pairs of reviewers (JM, SK and LT, TT) independently screened titles and abstracts generated from the search strategies to identify potentially relevant articles. The full text of articles deemed relevant, and those whose abstracts and titles provided insufficient information were retrieved for closer inspection. For each of the included studies, two of three independent trained reviewers (JM, SK and TT) extracted information onto pretested data extraction forms and two reviewers checked for reliability (SK and MBO). Disagreements about study inclusion or exclusion were resolved by a third party (BHR or MBO). Authors were contacted for clarification of study methods or design, or to elaborate on ongoing research, where necessary.

Risk of bias assessment

Two of three independent reviewers (PD, RL and AD) assessed methodological quality of individual studies. Observational cohort studies were assessed using the Newcastle-Ottawa Scale (NOS), an eight-item instrument that evaluates the methods of participants' selection, comparability between cohorts and outcomes assessment.[11] The Cochrane Non-Randomized Studies Methods Group recommends the use of the NOS, and studies on their psychometric properties are in progress.[11] Overall, NOS quality scores range from 0 to 9 (0–4 points=poor quality; 5–7 points=moderate quality and 8–9 points=high quality). The methodological quality of cross-sectional studies was assessed with an eight-item tool developed by Loney *et al*[12] that evaluates the methods of sampling, sampling frame, sample size, outcome measurement, outcome assessment, response rate, statistical reporting and interpretation of results. Quality scores ranged from 0 to 8 (0–3 points=poor quality; 4–6 points=moderate quality and 7–8 points=high quality). An individual components approach based on the susceptibility to bias was adopted to report the results of the methodological quality assessment.[13] Disagreements were resolved by consensus or third-party adjudication (SK or MBO).

Data extraction and analysis

Two of the three independent trained reviewers (JM, SK and TT) extracted information from the included studies onto pretested data extraction forms and two reviewers checked it for reliability (SK and MBO). The following data were extracted from individual studies: country, publication year, setting, study design, demographic characteristics of participants, definitions of frequent ED users and outcomes ascertainment. Key details of included studies are presented in a summary of evidence table. Primary study authors were contacted to provide confirmation, clarification and/or expansion of information, when necessary. The main health outcomes extracted were death (at any time), hospital admission (defined as any reported admission to the hospital, based on the proportion of individual ED visits or patient-level data) and non-ED visit outpatient use (defined as outpatient encounters following ED visits).

Outcome data were extracted from the individual studies for the groups of frequent ED users and non-frequent users. ORs and 95% CIs were calculated with reference to a non-frequent users group for the proportion of patients within the groups with the outcome of interest. A value >1.0 in the OR indicated that the odds of having the outcome of interest were higher among frequent ED users compared with the reference group of non-frequent ED users.

Forest plots of individual study ORs were generated in Review Manager (RevMan, V.5.2; IMS, Nordic Cochrane Centre, Copenhagen, Denmark) to describe the results. Studies were ordered by effect size with the median effect size presented as a summary measure.[14] Substantial diversity in study designs, methodological quality and outcome reporting across studies precluded the pooling of data into a meta-analysis. Rather, a narrative synthesis of study results was undertaken.

RESULTS

Search results

The search strategy identified a total of 5980 citations. Removing duplicates resulted in 4004 citations overall. After screening of titles and abstracts, 374 articles were selected as potentially relevant, of which 31 articles satisfied the eligibility criteria for the review (see figure 1).[3 4 15–43] The primary reasons for the exclusion of 343 studies were as follows: (1) the study was not primary research (n=110); (2) the study did not provide a definition of frequent users (n=84); (3) the study did not assess the review's outcomes of interest (n=77); (4) the study did not use any of the study designs considered in the review (n=34); (5) the study was not conducted in ED settings (n=26); (6) the study did not target adult populations (n=6) and (7) the study was not retrieved (n=6). The complete list of excluded studies and reasons for exclusion is available upon request.

Study characteristics

Twenty-two retrospective cohort studies,[3 4 15–17 19–23 25–27 29 30 32–35 37–39] five prospective cohort studies[24 36 40 41 43] and four cross-sectional studies[18 28 31 42] provided data comparing health outcomes between frequent versus non-frequent ED users (see online supplementary table S1 for characteristics of included studies). The studies were published between 1990 and 2013 (median year of publication 2006; IQR: 2001 to 2011). Most of the studies (n=25) were published in peer-reviewed journals, and six were scientific conference abstracts. Authors of primary studies were mainly from the USA.[4 15–17 26 28 29 31–34 36 37 39 42] Other countries represented in this pool of studies were Canada,[3 19 22 23] the UK,[20 30 43] Australia,[21 27] Finland,[40 41] Ireland,[18 38] Sweden[24 25] and Portugal.[35]

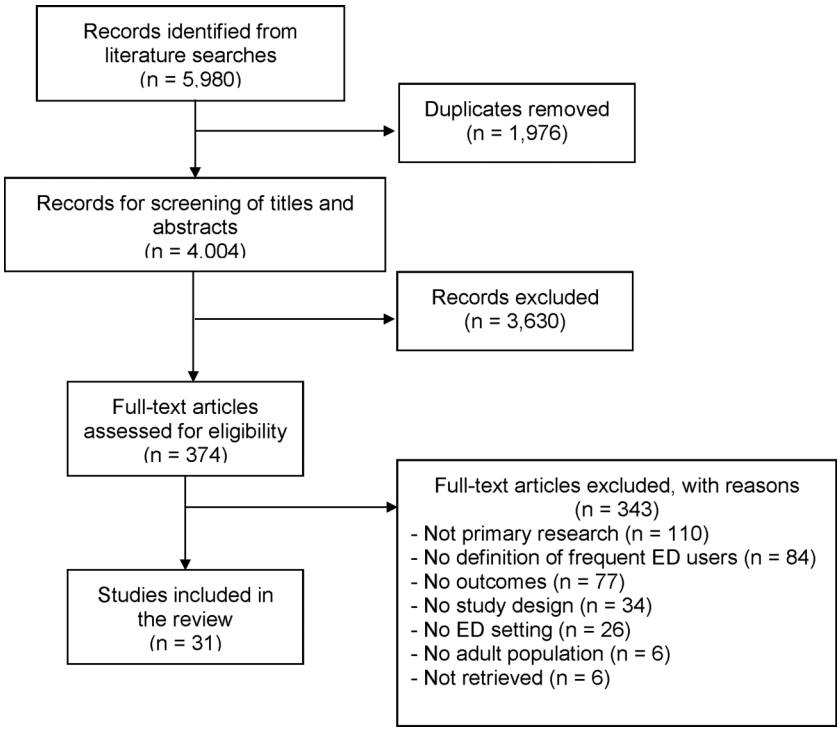

Figure 1 Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) study flow for the review. ED, emergency department.

The majority of studies were conducted in urban[15–18 23 26 27 29–34 36–42] or inner city/suburban EDs.[3 21 24 25 28 35 43] Three studies included ED data from larger (provincial/state) catchment areas,[4 19 22] whereas one study served both urban and rural areas.[20] Twelve studies were reportedly conducted in general EDs from academic centres,[16–18 21 23 29 31 32 34 36 39 42] and four studies were conducted in emergency psychiatric services.[26 37 40 41] Overall, studies included patients with all types of medical conditions; however, some studies restricted the inclusion to special populations of psychiatric patients,[26 37 40 41] substance users,[33] homeless patients[28] and individuals >65 years of age.[38 42]

Frequent ED users were defined in many ways in the studies, and in some instances, multiple definitions were used. The most common definition of frequent ED users considered patients who visited the ED four or more times in 1 year.[17 18 24–26 28 30 31 35 38] Other definitions considered patients with at least 2,[39] 3,[33 34 40 41] 5,[3 4 27 29 32] 6,[15 37] 7,[43] 10,[20 36] 12,[16 19] 15,[23] 18[22] or 20[39] ED visits in 1 year to be frequent ED users. Additional definitions of frequent ED users included two or more visits in 1 month,[31] four visits in 3 months[37] and >4 visits in 6 months.[42] Some studies used ranges of ED visits per year to define their study populations.[22 24 39] One study[39] defined frequent users if their number of ED visits was 2 standard deviation above the mean number of visits. One study[21] included the 500 most frequently presenting patients over 64 months rather than establishing a visit threshold.

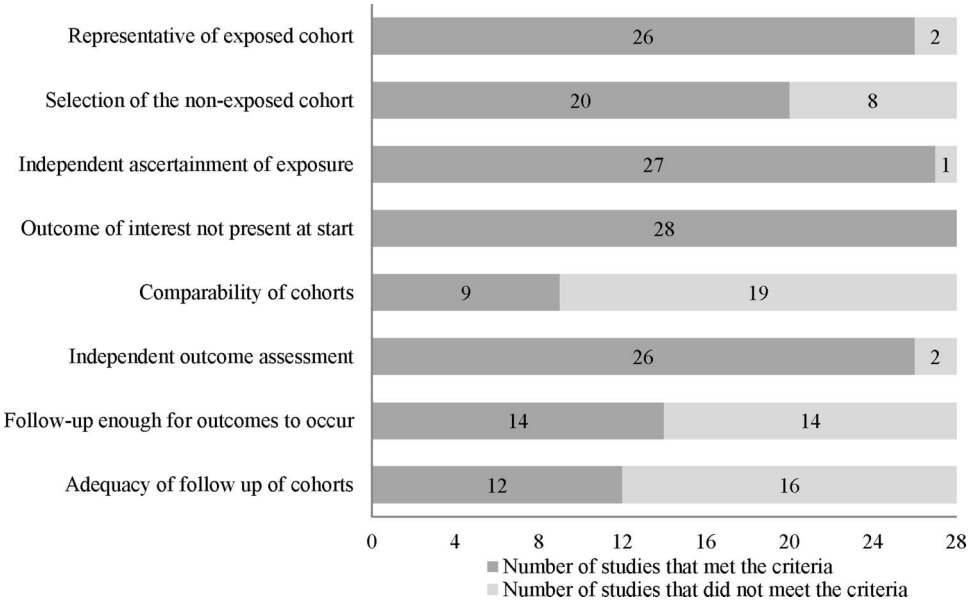

Figure 2 Methodological quality of cohort studies.

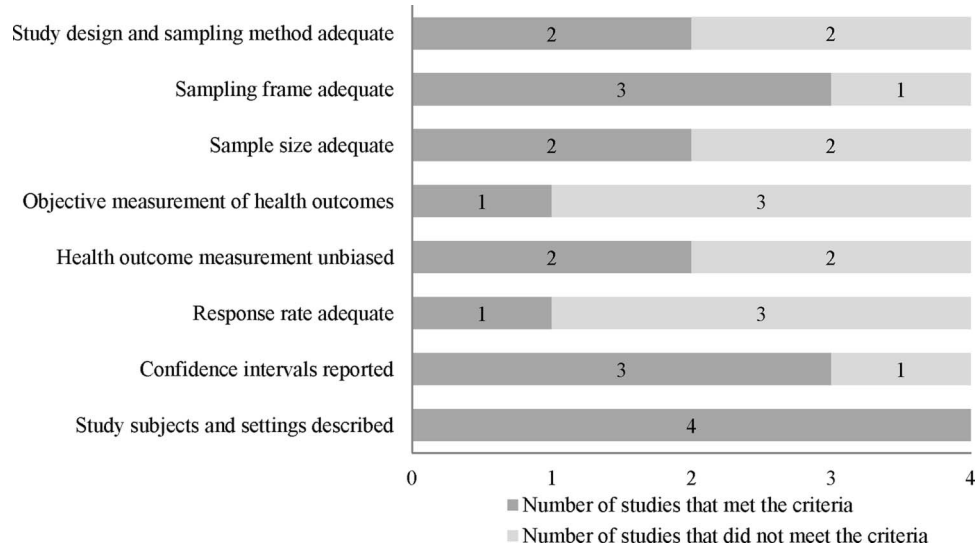

Figure 3 Methodological quality of cross-sectional studies.

Methodological quality of the studies

Overall, the 27 cohort studies were of moderate methodological quality (median NOS score 5.5; IQR 4 to 6). None of the cohort studies was of high methodological quality, and eight were of low methodological quality.[17 19 25 29 30 33 36 38] Figure 2 provides a summary of how cohort studies controlled for factors related with selection bias, validity of methods for ascertainment of exposure and outcome, and completeness of data at follow-up.

The four cross-sectional studies were of moderate methodological quality.[18 28 31 42] Figure 3 provides a summary of how well cross-sectional studies were able to address issues related with sampling methods, sample size, validity and blinding of outcome assessment, response rate and generalisability of study results.

Of six cohort studies reporting mortality, five were of moderate methodological quality[4 22 24 27 39] and one was of poor methodological quality.[36] The one cross-sectional study reporting mortality was of moderate methodological quality.[42] These assessments are summarised in table 1.

Mortality outcomes

Six cohort studies[4 22 24 27 36 39] compared mortality outcomes of frequent ED users versus non-frequent ED users. The odds of frequent ED users dying ranged from no difference (OR 1.02; 95% CI 0.77 to 1.42)[39] to three times higher (OR 3.11; 95% CI 2.75 to 3.52)[22] compared with non-frequent ED users (figure 4). The median effect size across studies was 2.2 (IQR 1.1 to 2.7). One cross-sectional study assessed the percentage of only those patients who died in the ED and did not find significant differences between frequent and non-frequent ED users.[42]

Table 1 Methodological quality of studies reporting mortality

Study	Study design	Quality score	Quality assessment
Doupe *et al*[22]	Retrospective cohort	NOS 6	Moderate
Fuda and Immekus[4]	Retrospective cohort	NOS 6	Moderate
Hansagi *et al*[24]	Prospective cohort	NOS 6	Moderate
Jelinek *et al*[27]	Retrospective cohort	NOS 6	Moderate
Oostema *et al*[36]	Prospective cohort	NOS 1	Poor
Ruger *et al*[39]	Retrospective cohort	NOS 6	Moderate
Wajnberg *et al*[42]	Cross-sectional	Loney 6	Moderate

NOS, Newcastle-Ottawa Scale.

Admission outcomes

All but three[18 19 33] included studies compared the proportion of hospital admissions between frequent ED users and non-frequent ED users.

Sixteen studies[3 4 15–17 20 21 23 26 27 29 30 32 35 37 39] reported admission outcomes based on the number of visits attributed to frequent or non-frequent users that resulted in hospital admission during the study period (ie, visit numbers as a denominator). Four of these studies were excluded from the forest plot (figure 5) as they did not report denominators (ie, number of visits) to calculate ORs for hospital admissions per visits in the two groups.[3 17 20 37] There was wide variability in the results. ORs ranged from lower risk of admission (OR 0.18; 95% CI 0.15 to 0.23)[23] to higher risk of admission (OR 3.38; 95% CI 2.89 to 3.95)[35] after visits made by frequent ED users compared with non-frequent ED users. The median effect size for studies assessing hospital admissions based on visits was 1.16 (IQR 0.94 to 1.63).

Fourteen studies compared proportions of frequent and non-frequent user patients who had any reported hospital admissions during the study period (ie, patient numbers as a denominator).[15 22 25 28 30–32 34 36 38 40–43] One of these studies was excluded from the forest plot (figure 6) as it did not report denominators for the group of non-frequent ED users.[15] The odds of frequent ED users being admitted ranged from half as likely (OR 0.57; 95% CI 0.48 to 0.69)[36] to 19 times as likely (OR 19.93; 95% CI 8.30 to 47.81)[43] compared with non-frequent ED users. The median effect size across studies was 2.58 (IQR 0.97 to 9.06).

Outpatient visits

Ten studies[18 19 22 25 26 28 33 40 41 43] compared outpatient visits after an ED visit between frequent and non-frequent users. All but one study examined the proportion of patients who had at least one outpatient visit after the index ED visit (figure 7).[26]

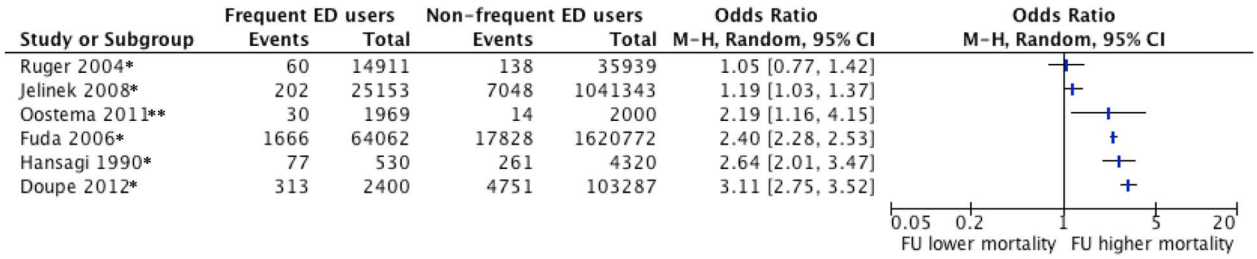

Figure 4 Mortality outcomes of frequent emergency department (ED) users versus non-frequent ED users. * indicates moderate quality; ** indicates poor quality. FU, follow-up; M–H, Mantel–Haenszel statistical testing.

All but two studies found that frequent ED users were more likely to have at least one outpatient encounter after an ED visit compared with non-frequent ED users.[28 40] The median effect size across the studies was 2.65 (IQR 1.47 to 6.29).

DISCUSSION

This systematic review has summarised the evidence from 31 observational studies on the mortality and health services outcomes of frequent compared with non-frequent ED users. Our results suggest that, despite heterogeneity, frequent users are a distinct and high-risk group. Based on the available evidence, frequent users appear to be at increased risk of death (median OR=2.2; IQR 1.1 to 2.7), admissions per visit (1.16; IQR 0.94 to 1.63), admissions per patient (2.58; IQR 0.97 to 9.06) and outpatient visits (2.65; IQR 1.47 to 6.29). The majority of studies examining frequent ED users have found that they consistently experience higher likelihoods of these important patient-oriented outcomes compared with non-frequent users (figures 4–7). A recent analysis of US National Health Interview Survey data corroborates our findings that frequent ED users are not simply inappropriate consumers of ED resources: ≥4 ED visits per year were associated with more outpatient visits, greater use of mental healthcare resources, poorer self-reported health status and higher prevalence of chronic disease.[44] Clearly, to view frequent users as merely a nuisance or drain on resources represents a narrow, biased and potentially dangerous view of this issue.[2] Our findings suggest that frequent ED users merit focused attention, continued research and implementation of interventions designed to meet their unmet needs from practitioners, health administrators and policymakers.

Frequent users of ED services represent a heterogeneous group of high-needs patients. Depending on the definition employed, they may include subgroups of patients with mental health and addiction issues, homelessness or unstable housing, chronic diseases (eg, heart failure, chronic obstructive pulmonary disease) and patients who make frequent visits with conditions that may require transient increased needs (eg, cellulitis/abscess treatment, missed diagnoses, complications). Appropriate interventions will depend on the needs of the targeted group; however, case management has been shown to be helpful in many cases.[7]

Significant heterogeneity in estimates of mortality, hospital admissions and outpatient visits across the studies precluded a formal pooling of individual study results into a single estimate. We used the median effect size as an alternative to synthesise the data from individual studies. This is an accepted approach in health system systematic reviews.[45] It is important to bear in mind that the median of effect sizes tends to yield results consistently favouring type II errors and lead to estimates that favour the null hypothesis of no difference.[14]

It is important, however, to describe some of the potential sources of heterogeneity that may have accounted for the differences in the outcome estimates across the studies included in this review. This systematic review highlights the marked inconsistency in the literature on the definitions of frequent ED users. The variability in the definitions and the characteristics of the populations included in the studies is substantial but unsurprising given that frequent users comprise a heterogeneous group including the elderly, patients with chronic diseases and mental health/addiction comorbidities. Another important source of heterogeneity is the composition of the samples, with some studies restricting their analysis to groups of patients with mental health problems or living in precarious conditions (ie, homeless). Our results likely capture institutional and regional variability in the makeup of frequent user groups studied. Differences in the methodological quality and reporting of the studies included in the review also limited the comparability of the studies. Estimating the differences in mortality and health services outcomes in this review was hampered by a number of

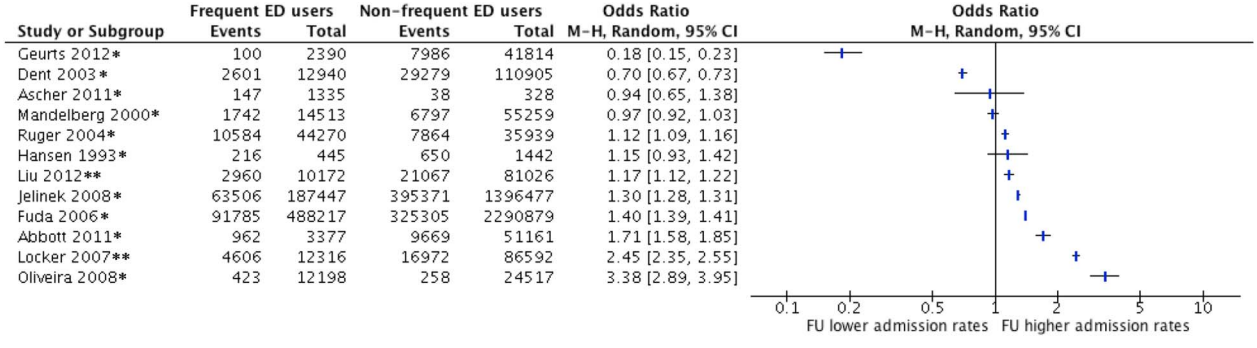

Figure 5 Hospital admissions (by visits) of frequent emergency department (ED) users versus non-frequent ED users. * indicates moderate quality; ** indicates poor quality. FU, follow-up; M–H, Mantel–Haenszel statistical testing.

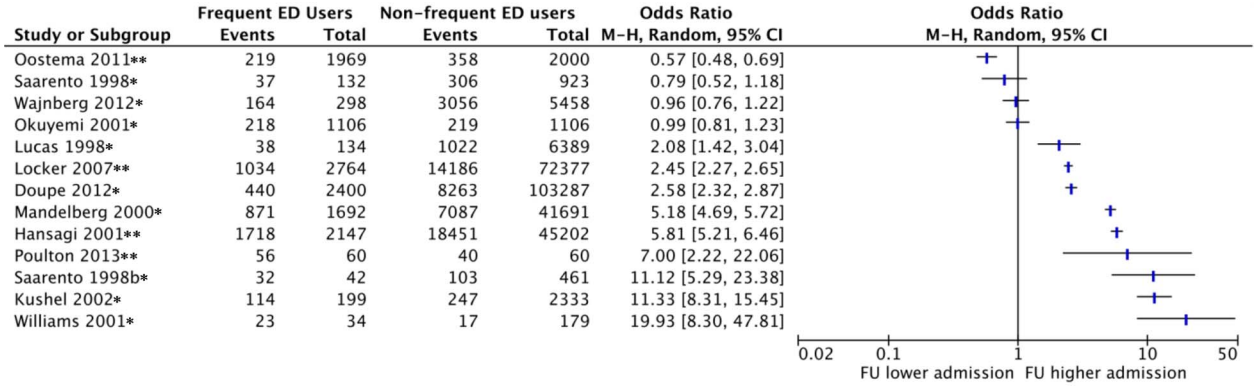

Figure 6 Hospital admissions (by proportion of patients) of frequent emergency department (ED) users versus non-frequent ED users. * indicates moderate quality; ** indicates poor quality. FU, follow-up; M–H, Mantel–Haenszel statistical testing.

methodological challenges, differences in case definitions and inherent bias in the study design of the individual studies. Our review is limited by unclear reporting of data and results in many of the included studies. For instance, data were sometimes reported as percentages rather than absolute numbers, and admission data were often unclear as to whether the denominator represented visits or patients. While authors were contacted to clarify results that were unclear, none responded. Therefore, we had to exclude several studies from our analyses based on an inability to confirm results. It is possible that these studies could have affected our median results.

One of the main strengths of this systematic review is the comprehensive search strategy that included multiple databases and grey literature sources. It is likely that the review has identified most of the scientific literature comparing mortality and health services outcomes of frequent users compared with non-frequent users; however, it is still possible that some studies were not identified in the searches. Similarly, we adopted a rigorous approach in the selection and quality appraisal of individual studies.

The current review helps consolidate current knowledge about mortality, admissions and outpatient outcomes among frequent ED users, and perhaps more importantly, it makes evident the inconsistent definition of frequent ED users in the scientific literature. As a first step, there is an urgent need to adopt standardised definitions for frequent ED use, as proposed elsewhere.[3] Developing a methodologically sound and comparable research agenda is a necessary first step to determining who frequent users are, the nature of their increased clinical risk and which subgroups of frequent users could benefit most from targeted interventions.

CONCLUSIONS

Frequent ED users are a vulnerable patient group; the majority of existing studies have found that they experience higher adverse outcomes (mortality, hospital admissions and outpatient visits) compared with non-frequent users. The heterogeneity in the literature on frequent users is striking; there is an urgent need to adopt standard definitions to allow comparable research and potentially generalisable recommendations. Future research should focus on identified subgroups (eg, mental health, chronic disease), interventions to reduce frequent visits and local frequent ED populations in order to understand site-specific needs and interventions.

Contributors JM conceptualised and drafted the protocol, screened abstracts and articles for inclusion, extracted data, analysed data and wrote the manuscript. SK screened abstracts and articles for inclusion, extracted data, analysed data, assessed study quality and edited the manuscript. MBO extracted data, analysed data, assessed study quality and wrote the manuscript. SCI developed and ran the search strategy. RL, AD and PD assessed the study quality. TT screened articles for inclusion and extracted data. LT screened abstracts for inclusion. BHR conceptualised the protocol, provided third-party adjudication for inclusion screening and quality assessment, and analysed data. All authors reviewed, edited and approved the final manuscript.

Funding The following study sponsors provided financial compensation for various study investigators: the Emergency Strategic Clinical Network (Alberta Health Services; SK, MBO, RL, AD, PD, TT and BHR), the Emergency Medicine Research Group (SK, TT and AD), Alberta Innovates Health Solutions Summer Studentship Award (Edmonton, AB; PD) and Tier I Canada Research Chair in Evidence-based Emergency Medicine from the Canadian Institutes of Health Research (CIHR) through the Government of Canada (Ottawa, ON; BHR). All authors are independent from funders. This paper is a registered PROSPERO review. Details of the protocol for this systematic review were registered on PROSPERO and can be accessed at http://www.crd.york.ac.uk/PROSPERO/

Competing interests All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available upon request from the

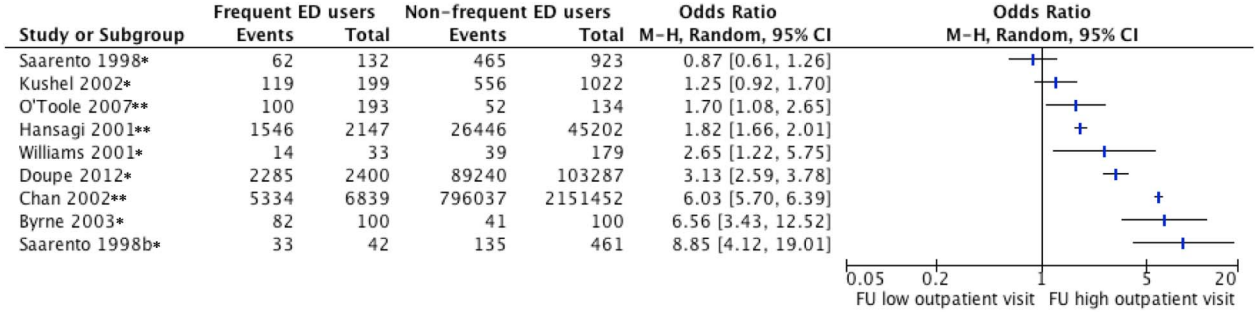

Figure 7 Outpatient visits (by proportion of patients) of frequent emergency department (ED) users versus non-frequent ED users. * indicates moderate quality; ** indicates poor quality. FU, follow-up; M–H, Mantel–Haenszel statistical testing.

corresponding author). For the submitted work, no authors have relationships with companies that might have an interest in the submitted work in the previous three years; BHR and MBS are employed by the provincial health authority in Alberta (Alberta Health Services) with accountability for ED overcrowding. Their spouses, partners or children do not have financial relationships that may be relevant to the submitted work. (4) JM was the lead author of one of the included studies (Moe *et al*[3]); however, she was not involved in selection, data extraction or assessment of methodological quality of this study. No other authors have any non-financial interests that may be relevant to the submitted work.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Bond K, Ospina MB, Blitz S, *et al*. Frequency, determinants and impact of overcrowding in emergency departments in Canada: a national survey. *Healthc Q* 2007;10:32–40.
2 LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. *Ann Emerg Med* 2010;56:42–8.
3 Moe J, Bailey AL, Oland R, *et al*. Defining, quantifying, and characterizing adult frequent users of a suburban Canadian emergency department. *CJEM* 2013;15:214–26.
4 Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: a statewide analysis. *Ann Emerg Med* 2006;48:9–16.
5 Salazar A, Bardes I, Juan A, *et al*. High mortality rates from medical problems of frequent emergency department users at a university hospital tertiary care centre. *Eur J Emerg Med* 2005;12:2–5.
6 Gunnarsdottir OS, Rafnsson V. Risk of suicide and fatal drug poisoning after discharge from the emergency department: A nested case-control study. *Emerg Med J* 2010;27:93–6.
7 Althaus F, Paroz S, Hugli O, *et al*. Effectiveness of interventions targeting frequent users of emergency departments: a systematic review. *Ann Emerg Med* 2011;58:41–52.
8 Sorbye SW, Fismen S, Gutteberg TJ, *et al*. HPV mRNA testing in triage of women with ASC-US cytology may reduce the time for CIN2+diagnosis compared with repeat cytology. *Curr Pharm Des* 2013;19:1401–5.
9 Okin RL, Boccellari A, Azocar F, *et al*. The effects of clinical case management on hospital service use among ED frequent users. *Am J Emerg Med* 2000;18:603–8.
10 Huston P, Moher D. Redundancy, disaggregation, and the integrity of medical research. *Lancet* 1996;347:1024–6.
11 Wells GA, Shea B, O'Connell D, *et al*. *The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses [Internet]*. Ottawa: University of Ottawa (cited 20 August 2014). http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
12 Loney PL, Chambers LW, Bennett KJ, *et al*. Critical appraisal of the health research literature: prevalence or incidence of a health problem. *Chronic Dis Can* 1998;19:170–6.
13 Juni P, Witschi A, Bloch R, *et al*. The hazards of scoring the quality of clinical trials for meta-analysis. *JAMA* 1999;282:1054–60.
14 Kraemer HC, Gavin A. A nonparametric technique for meta-analysis effect size calculation. *Psychol Bull* 1982;91:404–12.
15 Abbott J, Wright J, Madrid S. "Frequent flyers:" characteristics of emergency department patients with 6 or more visits in a single year. *Ann Emerg Med* 2011;58:S297.
16 Ascher J, Swor R. Assessing the costs and clinical characteristics associated with frequent emergency department users in a suburban emergency department. *Ann Emerg Med* 2011;58:S233.
17 Buhumaid R, Riley J, Blanchard J. A comparison of frequent and infrequent emergency department users among patients with a psychiatric diagnosis. *Acad Emerg Med* 2012;19:S357.
18 Byrne M, Murphy AW, Plunkett PK, *et al*. Frequent attenders to an emergency department: a study of primary health care use, medical profile, and psychosocial characteristics. *Ann Emerg Med* 2003;41:309–18.
19 Chan BT, Ovens HJ. Frequent users of emergency departments. Do they also use family physicians' services? *Can Fam Physician* 2002;48:1654–60.
20 Dent A, Hunter G, Webster AP. The impact of frequent attenders on a UK emergency department. *Eur J Emerg Med* 2010;17:332–6.
21 Dent AW, Phillips GA, Chenhall AJ, *et al*. The heaviest repeat users of an inner city emergency department are not general practice patients. *Emerg Med* 2003;15:322–9.
22 Doupe MB, Palatnick W, Day S, *et al*. Frequent users of emergency departments: developing standard definitions and defining prominent risk factors. *Ann Emerg Med* 2012;60:24–32.
23 Geurts J, Palatnick W, Strome T, *et al*. Frequent users of an inner-city emergency department. *CJEM* 2012;14:303–13.
24 Hansagi H, Allebeck P, Edhag O, *et al*. Frequency of emergency department attendances as a predictor of mortality: nine-year follow-up of a population-based cohort. *J Public Health Med* 1990;12:39–44.
25 Hansagi H, Olsson M, Sjöberg S, *et al*. Frequent use of the hospital emergency department is indicative of high use of other health care services. *Ann Emerg Med* 2001;37:561–7.
26 Hansen TE, Elliott KD. Frequent psychiatric visitors to a Veterans Affairs medical center emergency care unit. *Hosp Community Psychiatry* 1993;44:372–5.
27 Jelinek GA, Jiwa M, Gibson NP, *et al*. Frequent attenders at emergency departments: a linked-data population study of adult patients. *Med J Aust* 2008;189:552–6.
28 Kushel MB, Perry S, Bangsberg D, *et al*. Emergency department use among the homeless and marginally housed: results from a community-based study. *Am J Public Health* 2002;92:778–84.
29 Liu SW, Nagurney JT, Chang Y, *et al*. Frequent users of the emergency department: Do they make visits that can be addressed in a primary care setting? *Ann Emerg Med* 2012;60:S155.
30 Locker TE, Baston S, Mason SM, *et al*. Defining frequent use of an urban emergency department. *Emerg Med J* 2007;24:398–401.
31 Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. *Ann Emerg Med* 1998;32:563–8.
32 Mandelberg JH, Kuhn RE, Kohn MA. Epidemiologic analysis of an urban, public emergency department's frequent users. *Acad Emerg Med* 2000;7:637–46.
33 O'Toole TP, Pollini R, Gray P, *et al*. Factors identifying high-frequency and low-frequency health service utilization among substance-using adults. *J Subst Abuse Treat* 2007;33:51–9.
34 Okuyemi KS, Frey B. Describing and predicting frequent users of an emergency department. *J Assoc Acad Minor Phys* 2001;12:119–23.
35 Oliveira A. Hyperusers and emergency. *Acta Med Port* 2008;21:553–8.
36 Oostema J, Troost J, Schurr K, *et al*. High and low frequency emergency department users: a comparative analysis of morbidity, diagnostic testing, and health care costs. *Ann Emerg Med* 2011;58:S225.
37 Pasic J, Russo J, Roy-Byrne P. High utilizers of psychiatric emergency services. *Psychiatr Serv* 2005;56:678–84.
38 Poulton M, Foley MP, Robinson D, *et al*. Clinical characteristics and rates of psychosocial problems and alcohol abuse in frequent attenders aged over 65 to an inner city emergency department. *Ir J Med Sci* 2013;182:S296.
39 Ruger JP, Richter CJ, Spitznagel EL, *et al*. Analysis of costs, length of stay, and utilization of emergency department services by frequent users: implications for health policy. *Acad Emerg Med* 2004;11:1311–17.
40 Saarento O, Kastrup M, Hansson L. The Nordic comparative study on sectorized psychiatry: characteristics of repeat users of emergency outpatient services in two Nordic psychiatric services. A 1-year follow-up study. *Eur Psychiatry* 1998;13:35–40.
41 Saarento O, Hakko H, Joukamaa M. Repeated use of psychiatric emergency out-patient services among new patients: a 3-year follow-up study. *Acta Psychiatr Scand* 1998;98:276–82.
42 Wajnberg A, Hwang U, Torres L, *et al*. Characteristics of frequent geriatric users of an urban emergency department. *J Emerg Med* 2012;43:376–81.
43 Williams ERL, Guthrie E, Mackway Jones K, *et al*. Psychiatric status, somatisation, and health care utilization of frequent attenders at the emergency department: a comparison with routine attenders. *J Psychosom Res* 2001;50:161–7.
44 Vinton DT, Capp R, Rooks SP, *et al*. Frequent users of US emergency departments: characteristics and opportunities for intervention. *Emerg Med J* 2014;31:526–32.
45 Effective Practice and Organisation of Care (EPOC). *EPOC resources for review authors*. Oslo: Norwegian Knowledge Centre for the Health Services Effective Practice; 2013 [cited 1 October 2014]. http://epocoslo.cochrane.org/epoc-specific-resources-review-authors