Characteristics of individuals who frequently use emergency departments in Hong Kong: a region-based cohort study

Peter YT Ng *, CT Lui, CL Lau, HT Fung, CH Lai, LY Lee

A B S T R A C T

Introduction: This study analysed the characteristics and healthcare needs of emergency department (ED) users, and identified factors that contribute to frequent ED use.

Methods: Using the Clinical Data Analysis and Reporting System of the Hospital Authority, we identified all patients and visits to three EDs in the New Territories West Cluster from 1 April 2018 to 31 March 2019. Individuals with 4 to 9 ED visits and ≥10 ED visits were defined as frequent users (FUs) and high-intensity users (HIUs), respectively; they were compared with normal users (NUs, 1-3 visits) in terms of demographics, underlying disease, and outcomes. Visits by these users were also compared in terms of demographics, urgency, investigations performed, nature of complaint, and admission statistics.

Results: In total, FUs and HIUs constituted 9% of ED users but represented 27.2% of all visits. Compared with NUs, FUs and HIUs were older, more likely to have a payment exemption, and more likely to have underlying physical and mental health disorders. Compared with NUs, FUs were more likely to require ambulance services (17.9% vs 23.9%; P<0.001), be triaged as urgent or above (31.8% vs 38.1%; P<0.001), and require hospitalisation (28.5% vs 35.7%; P<0.001).

Conclusion: Individuals who frequently use EDs are more likely to be in poor health and require medical attention. Additional community- or ED-based support systems for discharge planning and support, along with reduced barriers to alternative sources of care, would improve health in these individuals and help reduce ED utilisation burden.

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[1] **PYT Ng ***, MB, ChB
[2] **CT Lui,** FHKAM (Emergency Medicine), FRCEM
[2] **CL Lau,** FHKAM (Emergency Medicine), FRCEM
[2] **HT Fung,** FHKAM (Emergency Medicine), FRCEM
[1] **CH Lai,** MRCSEd, FHKAM (Emergency Medicine)
[1] **LY Lee,** FHKAM (Emergency Medicine), FRCEM

[1] *Accident and Emergency Department, Tin Shui Wai Hospital, Hong Kong SAR, China*
[2] *Accident and Emergency Department, Tuen Mun Hospital, Hong Kong SAR, China*

* Corresponding author: pyt.ng@ha.org.hk

New knowledge added by this study

- Frequent users and high-intensity users constituted 9% of emergency department (ED) users but represented 27.2% of all ED visits.
- Frequent users had more underlying physical and mental health disorders; they were more likely to require timely medical care and hospitalisation.

Implications for clinical practice or policy

- Interventions targeting frequent users and high-intensity users could help reduce their ED visits.
- There are numerous potential interventions to reduce ED usage.

Introduction

Healthcare spending in Hong Kong continues to grow, as demonstrated by an 8.6% increase (to HK$69.7 billion [US$8.99 billion]) from fiscal year 2018 to fiscal year 2019.[1] According to internal statistics drawn from the Clinical Data Analysis and Reporting System of the Hospital Authority (HA), the annual number of emergency department (ED) visits in all public EDs in the New Territories West Cluster increased by 11.5% (to 410 707) between 2018-19 and 2019-20. Similar trends have been observed in many industrialised countries.[2] Moreover, the proportion of older adults (age ≥65 years) is projected to increase from 17.2% in 2019 to 25.1% in 2029.[3] The increasing demand for ED services may result in diminished quality of care and negative outcomes for vulnerable patients.

Frequent ED use is often regarded as a major component of ED utilisation burden. Substantial gaps remain in research concerning individuals who frequently use EDs in Hong Kong. Efforts to understand this population and the impacts of frequent use on ED utilisation burden are needed to identify interventions that can improve healthcare delivery, both in and out of the EDs.

This region-based study analysed individuals

頻繁使用香港急症室人士的特徵：以地區為基礎的前瞻性研究

伍有德、雷俊達、劉柱良、馮顯達、黎靖匡、李立業

引言：本研究分析公立醫院急症室求診者的特徵和醫療保健需求，並確定頻繁使用公立醫院急症服務的因素。

方法：本研究利用醫院管理局的臨床數據分析及報告系統，找出新界西醫院聯網三個公立急症室於2018年4月1日至2019年3月31日期間所有求診者及求診情況。我們將求診4至9次及≥10次者分別定義為頻繁使用者及高度使用者，並將他們與一般使用者（1-3次求診）在人口統計學、潛在疾病和病情方面比較。我們也比較這三組使用者的人口統計學、緊急情況、進行的檢查、呈現的症狀和體徵及住院統計數據。

結果：頻繁使用者和高度使用者佔急症室使用者的9%，但卻佔總求診次數27.2%。與一般使用者相比，頻繁使用者和高度使用者年齡較大，更可能享有醫療費用豁免，並且更可能有潛在的身體或心理健康問題。與一般使用者相比，頻繁使用者求診時更可能需要救護車服務（17.9% vs 23.9%；P<0.001），被分流為緊急或以上級別（31.8%vs38.1%；P<0.001），以及需要住院治療（28.5%vs35.7%；P<0.001）。

結論：頻繁使用急症室的人較大可能身體不佳且需要醫療照護。提供額外社區或急症室的出院規劃和支援系統，以及降低替代照護的門檻，有助改善頻繁使用急症室人士的健康狀況及減少急症室的使用負擔。

who frequently used public EDs and explored specific interventions that may reduce ED visits by these patients.

Methods

Study setting and population

This multi-centre retrospective cohort study analysed ED visits from all acute care hospitals located within the New Territories West Cluster (serving a population of 1.14 million in 2018[3]). During the study period, only three EDs (in Tuen Mun Hospital, Pok Oi Hospital, and Tin Shui Wai Hospital[4]) provided acute emergency care in this region. All three EDs are public and managed by the HA, the statutory body that manages all public hospitals in Hong Kong. In the study region, individuals who called ambulances were typically taken to one of these three EDs.

The study population included all patients, regardless of age, who visited any of these three EDs during the fiscal year from 1 April 2018 to 31 March 2019. Patients without acceptable identification documents were excluded.

Definitions

Usage classes were defined according to the total number of ED visits by an individual patient to any of the 18 public EDs in Hong Kong[5] during the study period, using cut-off values commonly reported in the literature to facilitate comparison[6]: normal users (NUs) had ≤3 visits,[6] frequent users (FUs) had 4 to 9 visits,[6] and high-intensity users (HIUs) had ≥10 visits.[7]

Two additional groups were defined: non-ED users had no ED visits over a 12-month period, whereas superusers had very high numbers of ED visits (≥35 over a 12-month period, almost 1 visit every 10 days).

Data collection and analysis

Data were collected from the Clinical Data Analysis and Reporting System of the HA, a comprehensive electronic patient database that includes patient demographics, diagnoses, surgical records, ED visits, hospitalisation episodes, and radiological investigations from all public hospitals and most public clinics in Hong Kong. It allows episode-based and patient-based analyses according to user-defined criteria. For this study, multiple visits were linked using a unique record linkage number. Population demographic data were obtained from the 2016 Population By-census[8] and other official government statistics.[3,9]

Two dimensions of analysis were performed on the three classes NUs, FUs, and HIUs: patient-based and episode-based, in which patients and individual visits were the respective units of analysis.

Patient-based analysis

Demographic variables were assigned based on values reported at the index visit; they included age, ethnicity (Chinese/non-Chinese), sex (male/female), institutionalisation (residency in an old-age home or not), and ED payment status (exempt or not). In Hong Kong, identity card holders and residents aged <11 years are charged HK$180 (US$23.2) per ED visit. Civil servants and their family members, individuals receiving social security assistance from the government, and individuals in vulnerable groups (low income, chronically ill, and older adults with minimal income/assets) are exempt from the requirement to pay for ED visits. To evaluate ED utilisation trends, data were retrieved regarding utilisation in the 12-month period before the study.

In Hong Kong, all hospital admissions and ED visits (excluding patients who leave before consultation) are coded using an appropriate International Classification of Diseases, Ninth Revision (ICD-9) diagnosis recommended by the World Health Organization.[9] A list of diagnoses that represent chronic conditions with significant morbidity was compiled and classified into nine categories with reference to ICD-9 (online supplementary Appendix 1).[9] All in-patient procedures, except minor bedside and clinical procedures, are also appropriately coded and classified as minor, intermediate, major, or ultra-major[10]; they are then divided into elective and

emergency categories. These coding processes, and the processes described below, are routine procedures that undergo strict internal auditing for completeness and accuracy. This study analysed ICD-9 diagnosis codes, as well as major and ultra-major procedure records, from hospital and clinic encounters in the 5 years prior to the study period. The full list of major and ultra-major operations included in the current study is mostly based on the HA's List of Private Services.[10]

Deaths occurring in Hong Kong were retrieved from the Hong Kong Death Register. Two-year mortality was defined as death from any cause between 1 April 2018 and 31 March 2020.

Episode-based analysis

Variables in the episode-based analysis included age, ambulance utilisation, triage category (in descending order of urgency: critical, emergency, urgent, semi-urgent, and non-urgent), imaging performed in ED (plain radiography and computed tomography), and visit details (to be discussed below). Admission rates and median length of stay for admitted patients were calculated.

For each episode, the attending specialty, trauma status, and ICD-9 diagnosis or chief complaint were recorded by the attending emergency physician. The attending specialty was regarded as the specialty to which a patient's chief complaint belongs. Four main specialties (medicine and geriatrics, general surgery, orthopaedics, and paediatrics) were included in the data analysis. The ICD-9 diagnosis codes were grouped into musculoskeletal pain (eg, joint pain, cervicalgia, and lumbago) and minor infections (eg, acute upper respiratory tract infection). A full list of diagnoses within each of these two categories is included in online supplementary Appendix 2.[9]

Statistical analysis

Descriptive statistics were compiled for the demographic characteristics of non-ED users, NUs, FUs, and HIUs, with reference to data from the 2016 Population By-census.[8] Age-specific distributions of ED visits and numbers of ED visits per capita were analysed. In the patient-based analysis, demographic and clinical characteristics of NUs, FUs, and HIUs were compared by univariate analysis with appropriate statistical tests. The episode-based analysis compared age distribution, ambulance use, triage category, investigations performed, principal diagnosis during each ED visit, and admission statistics among NUs, FUs, and HIUs. The clinical and demographic characteristics of superusers were also analysed.

Two models were used to identify independent predictors of FU and HIU statuses, compared with NU status and specific numbers of ED visits. Multinomial logistic regression was conducted, using the patient as the unit of analysis, to compare the FU and HIU groups with the reference group. Zero-truncated Poisson regression was performed to predict the independent association of each predictor with the number of ED visits. All bivariate predictors associated with the outcome ($P<0.1$) were entered into the model and used as categorical variables. Age-stratified subgroup analysis (≤17 years, 18-64 years, and ≥65 years) was performed to identify independent predictors of FU and HIU statuses in each age-group. $P<0.05$ was regarded as the threshold for statistical significance in all analyses. Zero-truncated Poisson regression was performed with R[11] with vector generalised linear and additive model.[12] All other statistical analyses were conducted using SPSS (Windows version 25.0; IBM Corp, Armonk [NY], United States).

Results

As shown in the Figure, the number of per capita ED visits was the highest in the youngest and oldest age-groups (0.66 for age 0-4 years and 1.02 for age ≥85 years); patients aged 10 to 54 years had a stable and low number of per capita ED visits (<0.3).

During the study period, 215 862 patients with valid identity documents accessed EDs in the study region; there were 371 915 visits in total (Table 1). Frequent users and HIUs constituted small percentages of the total number of patients (8.2% and 0.8%, respectively), but they represented larger percentages of visits (21.3% and 5.9%, respectively). The total number of ED visits by a single HIU ranged from 10 to 263.

Compared with NUs (median age, 47 years), FUs and HIUs were older (55 and 52 years, respectively). Frequent users and HIUs more often had underlying chronic illnesses, such as cardiac, respiratory, neurological, and gastrointestinal/hepatobiliary diseases. Mental health disorders and substance abuse were also much more prevalent among FUs and HIUs. Moreover, 23.5% and 59.0% of FUs and HIUs were FUs or HIUs in the previous year, implying habitual attendance behaviour. Frequent users and HIUs also had higher all-cause mortality rates, compared with NUs.

Reasons for ED visits differed among NUs, FUs, and HIUs (Table 2). Normal users were much more likely to visit the ED for an injury, whereas primary diagnoses related to musculoskeletal pain were more common in HIUs. Levels of urgency on presentation also differed among NUs, FUs, and HIUs. More visits by FUs were triaged as critical, emergency, or urgent (38.1%), compared with visits by NUs (31.8%). However, a lower percentage of visits by HIUs were triaged as urgent or above (28.6%), compared with visits by NUs; more HIUs attended EDs by calling an ambulance (HIUs: 21.2% vs NUs: 17.9%).

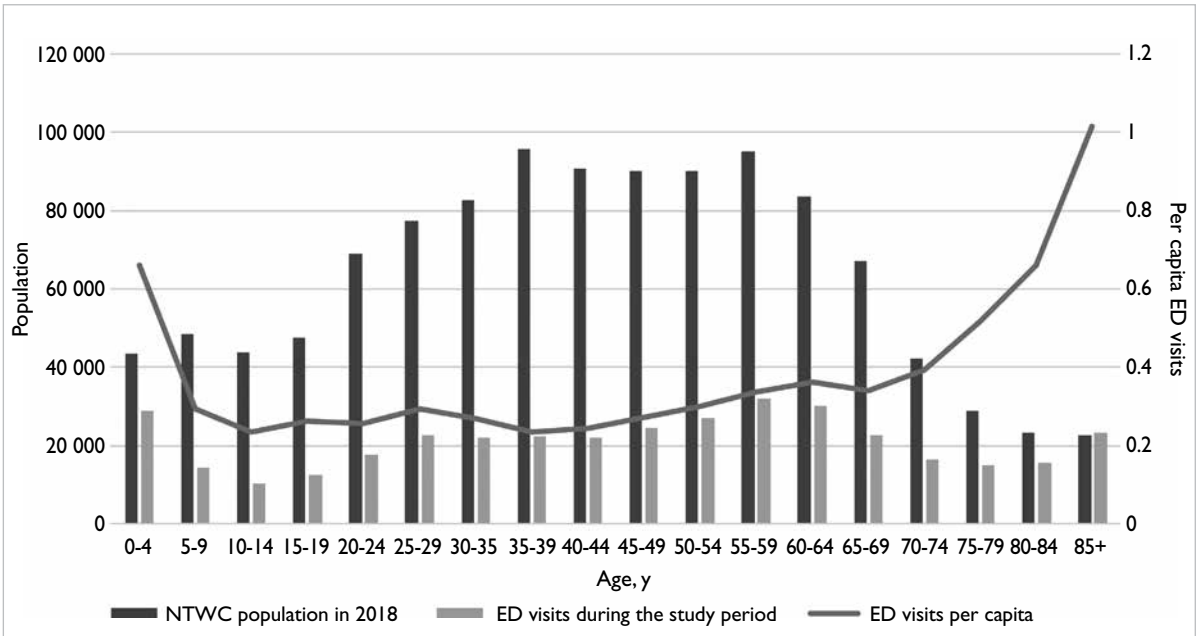

FIG. Age-stratified frequencies of emergency department visits (from 1 April 2018 to 31 March 2019) and emergency department visits per capita

Abbreviations: ED = emergency department; NTWC = New Territories West Cluster

Multinomial logistic regression and zero-truncated Poisson regression showed similar independent predictors of FU and HIU statuses (Table 3). Payment exemption and number of visits in the prior year were the strongest predictors. Residency in an old-age home was a risk factor for FU status (adjusted odds ratio [OR]=1.131) but a protective factor for HIU status (adjusted OR=0.48). Non-Chinese ethnicity, pre-existing systemic diseases including cardiac, respiratory, gastrointestinal/hepatobiliary and renal, mental health disorders, and substance abuse were risk factors for frequent ED use. Age-stratified analysis (Table 4) showed similar predictors among the three groups. Respiratory diseases and gastrointestinal/hepatobiliary diseases were prevalent in paediatric FUs; neurological diseases and mental health disorders were prevalent in both paediatric FUs and paediatric HIUs. Non-Chinese ethnicity was a risk factor for FU and HIU statuses among patients aged <18 years (adjusted ORs=1.949 and 2.107, respectively), but it was not associated with ED use in older patients (age >64 years).

Superusers had particularly high prevalences of mental health disorders (26.9%) and gastrointestinal/hepatobiliary diseases (36.5%) [Table 5]. Many of their visits were less serious or complex, compared with visits by NUs, FUs, and HIUs. Only 9.4% of visits by superusers required the use of ambulance services. Most visits by superusers were triaged as semi-urgent or non-urgent (90.9%). Musculoskeletal pain and minor infections represented 54.3% of the principal diagnoses for superusers.

Discussion

Frequent emergency department utilisation and health needs

The characteristics of individuals who frequently use EDs in Hong Kong have not been extensively investigated. Frequent users and HIUs constituted 9% of all ED patients and represented 27.2% of all visits. Region-based studies in developed countries have revealed similar findings.[6,7,13-16] Although frequent ED use is often assumed to indicate inappropriate use, our data do not support this assumption. The health statuses and presentation conditions of FUs strongly suggest that these individuals have greater health needs than the rest of the population. Frequent users were more likely to have underlying illnesses, require ambulance services, have visits triaged as urgent or above, require hospital admission, and have a longer length of hospitalisation. In contrast, HIUs had visits triaged as less urgent, required less investigations, often attended for conditions (eg, musculoskeletal pain and minor infections) that could potentially be managed in primary care clinics, and had lower admission rates compared with both NUs and FUs. These trends were much more pronounced among superusers.

Improving healthcare delivery services and primary care

High percentages of visits involved musculoskeletal pain and minor infections, conditions that could potentially be managed in primary care clinics. Such visits could be related to a misunderstanding of ED

TABLE 1. Characteristics of emergency department patients by normal users, frequent users, and high-intensity users*

	Normal users	Frequent users	High-intensity users	Total	P value
No. of patients	196 493 (91.0%)	17 698 (8.2%)	1671 (0.8%)	215 862	
No. of visits	271 000 (72.9%)	79 069 (21.3%)	21 846 (5.9%)	371 915	
Sex					
Male	93 635 (90.7%)	8739 (8.5%)	914 (0.9%)	103 288	<0.001†
Female	102 858 (91.4%)	8959 (8.0%)	757 (0.7%)	112 574	
Age at index visit, y					
Median	47	55	52		<0.001‡
Interquartile range	26-52	30-73	37-68		
Ethnicity					
Chinese	166 757 (90.7%)	15 490 (8.4%)	1543 (0.8%)	183 790	<0.001†
Non-Chinese	10 938 (86.7%)	1568 (12.4%)	104 (0.8%)	12 610	
Unknown	18 798 (96.6%)	640 (3.3%)	24 (0.1%)	19 462	
Age distribution, y					
<18	31 846 (16.2%)	2637 (14.9%)	146 (8.7%)	34 629	<0.001†
18-40	53 868 (27.4%)	3769 (21.3%)	409 (24.5%)	58 046	
41-64	71 201 (36.2%)	5515 (31.2%)	617 (36.9%)	77 333	
≥65	39 578 (20.1%)	5777 (32.6%)	499 (29.9%)	45 854	
Payment exemption	46 864 (23.9%)	7881 (44.5%)	950 (56.9%)	55 695	<0.001†
Old-age home residents	3878 (2.0%)	1125 (6.4%)	72 (4.3%)	5075	<0.001†
ED visits in prior year					
0 (non-users)	125 364 (63.8%)	5374 (30.4%)	238 (14.2%)	130 976	<0.001†
1-3 (normal users)	63 810 (32.5%)	8166 (46.1%)	448 (26.8%)	72 424	
4-9 (frequent users)	7000 (3.6%)	3689 (20.8%)	571 (34.2%)	11 260	
10 (high-intensity users)	319 (0.2%)	469 (2.7%)	414 (24.8%)	1202	
Medical records in past 5 years§					
Cardiac diseases	9768 (5.0%)	2426 (13.7%)	325 (19.4%)	12519	<0.001†
Respiratory diseases	7437 (3.8%)	2029 (11.5%)	314 (18.8%)	9780	<0.001†
Gastrointestinal /hepatobiliary diseases	11965 (6.1%)	2407 (13.6%)	423 (25.3%)	14795	<0.001†
Endocrine diseases	2805 (1.4%)	646 (3.7%)	96 (5.7%)	3547	<0.001†
Renal diseases	2304 (1.2%)	754 (4.3%)	95 (5.7%)	3153	<0.001†
Neoplastic diseases	4256 (2.2%)	823 (4.7%)	67 (4.0%)	5146	<0.001†
Neurological diseases	7434 (3.8%)	1815 (10.3%)	219 (13.1%)	9468	<0.001†
Mental health disorders	9631 (4.9%)	1875 (10.6%)	362 (21.7%)	11 868	<0.001†
Substance abuse	1485 (0.8%)	318 (1.8%)	97 (5.8%)	1900	<0.001†
Elective operations‖	12 839 (6.5%)	2138 (12.1%)	245 (14.7%)	15 222	<0.001†
Emergency operations‖	5266 (2.7%)	865 (4.9%)	97 (5.8%)	6228	<0.001†
Death					
2-year mortality**	7008 (3.6%)	2152 (12.2%)	181 (10.8%)	9341	<0.001†

Abbreviation: ED = emergency department

* Data are shown as No. (%), unless otherwise specified

† Chi squared test

‡ Kruskal–Wallis test

§ For the full list of diagnosis codes, please refer to reference 9

‖ Includes only operations classified as major or ultra-major. For the full list of major or ultra-major operations, please refer to reference 10

** Defined as death from any cause within the period 1 April 2018 to 31 March 2020

TABLE 2. Total emergency department visits and characteristics of visits by normal users, frequent users, and high-intensity users during the study period*

	Normal users	Frequent users	High-intensity users	Total/P value
Total	271 000 (72.9%)	79 069 (21.3%)	21 846 (5.9%)	371 915
Age, y				
<18	43 585 (76.1%)	12 072 (21.1%)	1636 (2.9%)	57 293
18-64	168 575 (76.1%)	39 021 (17.6%)	13 987 (6.3%)	221 583
≥65	58 840 (63.2%)	27 976 (30.1%)	6223 (6.7%)	93 039
Ambulance use	48 641 (17.9%)	18 928 (23.9%)	4621 (21.2%)	<0.001†
Triage category‡				<0.001†
Critical/emergency	8480 (3.1%)	3065 (3.9%)	508 (2.3%)	
Urgent	77 835 (28.7%)	27 046 (34.2%)	5749 (26.3%)	
Semi-urgent/non-urgent	183 930 (67.9%)	48 791 (61.7%)	15 540 (71.1%)	
Imaging performed				
Plain radiography	137 178 (50.6%)	37995 (48.1%)	7627 (34.9%)	<0.001†
Computed tomography	20 173 (7.4%)	4820 (6.1%)	850 (3.9%)	<0.001†
Principal diagnosis				
Musculoskeletal pain–related§	24 094 (8.9%)	7231 (9.1%)	5216 (23.9%)	<0.001†
Minor infections‖	33 974 (12.5%)	12474 (15.8%)	2965 (13.6%)	<0.001†
Trauma-related	43 959 (16.2%)	6940 (8.8%)	2563 (11.7%)	<0.001†
Attending specialty				
Medicine and geriatrics	104 267 (38.5%)	37026 (46.8%)	9778 (44.8%)	<0.001†
Orthopaedics	58 543 (21.6%)	12950 (16.4%)	6660 (30.5%)	<0.001†
Surgery	36 796 (13.6%)	9767 (12.4%)	2038 (9.3%)	<0.001†
Paediatrics	28 176 (10.4%)	9368 (11.8%)	1338 (6.1%)	<0.001†
Admission statistics				
Episodes resulting in admission	77 180 (28.5%)	28230 (35.7%)	5583 (25.6%)	<0.001†
Length of stay per admission, d				
Median	2	3	3	<0.001**
Interquartile range	1-5	2-7	2-5	

* Data are shown as No. (%), unless otherwise specified
† Chi squared test
‡ Cases with missing triage category are not included
§ For the full list of musculoskeletal pain–related diagnoses, please refer to reference 9 and online supplementary Appendix 2
‖ Includes upper respiratory tract infection, urinary tract infection, gastroenteritis, and non-specific viral illness. For the full list of minor infection diagnoses, please refer to reference 9 and online supplementary Appendix 2
** Kruskal–Wallis test

function, a misperception of condition severity, or use of the ED as a substitute for unavailable forms of care. Policies to decrease ED utilisation burden should focus on improving healthcare delivery services and primary care; such policies are likely to benefit NUs with similar needs. Recent advances in information technology and the widespread use of smartphones offer many opportunities to improve information dissemination and increase accessibility to alternative sources of care.

Effective policies targeting ethnic minorities

Our findings suggest disproportionate use of ED services by ethnic minorities. The number of Hong Kong residents of non-Chinese ethnicity rose by 70% over a 10-year period; they constituted 8% of the total population in 2016.[8] The Chinese literacy rate was <20% in some age-groups.[8] More frequent ED use may result from language barriers to access of care, limited knowledge of local healthcare alternatives, or cultural differences in health-seeking behaviour. Effective policy measures targeting these populations should promote an understanding of the local healthcare system through informative advertisements about alternative services offered; measures should also reduce language barriers (eg,

TABLE 3. Predictors of frequent user and high-intensity user statuses (with normal user status as reference) according to multinomial logistic regression and predictors of emergency department visit number according to zero-truncated Poisson regression

Independent variable	Multinomial logistic regression		ZTPR
	FU status Adjusted OR (95% CI)	HIU status Adjusted OR (95% CI)	IRR
Characteristic			
Age	1.003* (1.002-1.004)	1.003* (1-1.005)	1.001*
Sex (ref=male)	1.075* (1.04-1.112)	1.246* (1.119-1.386)	1.047*
Payment exemption	1.678* (1.618-1.74)	2.038* (1.821-2.28)	1.447*
Ethnicity (ref=non-Chinese)	1.782* (1.676-1.894)	1.111 (0.889-1.388)	1.387*
Residency in old-age homes	1.131* (1.041-1.229)	0.480* (0.365-0.63)	0.996
ED visits in previous year	1.409* (1.397-1.421)	1.655* (1.633-1.677)	1.048*
Medical records in past 5 years†			
Cardiac diseases	1.292* (1.217-1.371)	1.438* (1.224-1.69)	1.261*
Respiratory diseases	1.452* (1.368-1.541)	1.738* (1.498-2.016)	1.360*
Gastrointestinal/hepatobiliary diseases	1.334* (1.265-1.407)	1.622* (1.418-1.854)	1.398*
Endocrine diseases	1.120* (1.013-1.238)	1.197 (0.935-1.533)	1.054*
Renal diseases	1.527* (1.386-1.682)	1.432* (1.118-1.834)	1.238*
Neoplastic diseases	1.325* (1.216-1.445)	0.891 (0.677-1.172)	1.163*
Neurological diseases	1.216* (1.139-1.298)	1.190 (1-1.417)	1.217*
Mental health disorders	1.301* (1.225-1.381)	1.784* (1.541-2.066)	1.347*
Substance abuse	1.338* (1.167-1.535)	2.419* (1.846-3.169)	1.251*
Emergency operations‡	1.011 (0.931-1.098)	0.985 (0.78-1.244)	1.064*
Elective operations‡	1.110* (1.048-1.175)	1.195* (1.017-1.406)	1.083*

Abbreviations: CI = confidence interval; ED = emergency department; FU = frequent user; HIU = high-intensity user; IRR = incident risk ratio; OR = odds ratio; ZTPR = zero-truncated Poisson regression

* P<0.05

† For the full list of diagnosis codes, please refer to reference 9

‡ Include only operations classified as major or ultra-major. For the full list of major or ultra-major operations, please refer to reference 10

through translator services or the provision of online booking instructions in other languages).

Community-based interventions for frequent users

Frequent users constitute a sicker population requiring medical care that cannot be easily provided in primary care clinics. They need support to facilitate integration and maintenance in the community, which would reduce the need for emergency medical care at EDs. The burden placed on EDs may be reduced by developing new community-based support systems, such as enhanced coverage of community nursing services and extended service hours (eg, weekends and public holidays); dedicated multidisciplinary teams to provide rehabilitation services and caregiver training in the community; and centres for the provision of coordinated community services. Eligible geriatric patients could benefit from a holistic community geriatric care strategy triggered by an ED visit, with protocol-driven assessments in the ED to identify potentially reversible risk factors for subsequent deterioration and repeated ED visits. This strategy should include comprehensive geriatric assessment prior to ED discharge, focused on factors such as fall risk, delirium screening, and frailty assessment. In addition to physical assessments, psychosocial assessments and support may improve patient outcomes and minimise repeated ED visits. Pre-discharge care planning that empowers patients and family members to seek help from non-ED sources may also prevent repeated ED visits. Thus far, there remains uncertainty about the effectiveness of community-based interventions for people with multimorbidity because of the relatively small number of randomised controlled trials focused on this area of healthcare.[17]

Case management for patients with chronic diseases

Reformation of the chronic disease service model

TABLE 4. Age-stratified patient-based prediction of frequent user and high-intensity user statuses (with normal user status as reference) according to multinominal logistic regression

	0-17 y		18-64 y		≥65 y	
	FU status Adjusted OR (95% CI)	**HIU status Adjusted OR (95% CI)**	**FU status Adjusted OR (95% CI)**	**HIU status Adjusted OR (95% CI)**	**FU status Adjusted OR (95% CI)**	**HIU status Adjusted OR (95% CI)**
Characteristic						
Age	0.959* (0.95-0.968)	0.986 (0.949-1.025)	1.000 (0.998-1.002)	0.997 (0.991-1.002)	1.016* (1.012-1.02)	1.018* (1.006-1.031)
Sex (ref=male)	1.080 (0.986-1.182)	1.094 (0.753-1.588)	0.998 (0.953-1.045)	1.230 (1.072-1.41)	1.230* (1.158-1.306)	1.511* (1.233-1.852)
Payment exemption	1.864* (1.692-2.052)	2.823* (1.916-4.157)	1.708* (0.953-1.045)	2.043* (1.773-2.353)	1.361* (1.274-1.455)	1.928* (1.524-2.438)
Ethnicity (ref=non-Chinese)	1.949* (1.75-2.171)	2.107* (1.374-3.233)	1.679* (1.549-1.82)	0.937 (0.708-1.239)	0.944 (0.709-1.255)	0.614 (0.235-1.602)
Residency in old-age homes	<0.001 (<0.0001 to >10 000)	<0.001 (<0.0001 to >10 000)	1.073 (0.8-1.44)	0.354* (0.146-0.855)	1.120* (1.024-1.224)	0.532* (0.393-0.72)
ED visits in previous year	1.504* (1.47-1.538)	1.901* (1.812-1.994)	1.427* (1.411-1.443)	1.638* (1.611-1.666)	1.331* (1.312-1.351)	1.616* (1.576-1.657)
Medical records in past 5 years†						
Cardiac diseases	1.442 (0.956-2.174)	2.399 (0.816-7.054)	1.340* (1.196-1.501)	1.224 (0.923-1.623)	1.258* (1.173-1.35)	1.694* (1.371-2.094)
Respiratory diseases	1.270* (1.042-1.547)	1.467 (0.824-2.615)	1.579* (1.432-1.741)	1.877* (1.503-2.345)	1.395* (1.286-1.512)	1.661* (1.332-2.071)
Gastrointestinal/hepatobiliary diseases	1.364* (1.202-1.547)	1.369 (0.901-2.082)	1.361* (1.266-1.463)	1.624* (1.37-1.927)	1.217* (1.098-1.348)	1.628* (1.258-2.107)
Endocrine diseases	0.827 (0.505-1.356)	1.690 (0.5-5.713)	1.131 (0.957-1.337)	1.507* (1.054-2.156)	1.168* (1.029-1.327)	0.988 (0.688-1.419)
Renal diseases	0.792 (0.211-2.963)	<0.001 (<0.0001 to >10 000)	1.749* (1.49-2.053)	1.706* (1.157-2.516)	1.147* (1.292-1.644)	1.302 (0.94-1.804)
Neoplastic diseases	1.020 (0.226-4.591)	<0.001 (<0.0001 to >10 000)	1.556* (1.362-1.776)	0.815 (0.517-1.287)	1.189* (1.063-1.33)	0.935 (0.656-1.331)
Neurological diseases	2.038* (1.443-2.877)	2.925* (1.159-7.387)	1.264* (1.12-1.428)	1.489* (1.14-1.947)	1.150* (1.064-1.244)	1.005 (0.791-1.278)
Mental health disorders	1.958* (1.532-2.503)	2.732* (1.329-5.618)	1.360* (1.259-1.468)	1.751* (1.463-2.096)	1.201* (1.08-1.335)	1.567* (1.177-2.085)
Substance abuse	0.133 (0.006-3.074)	<0.001 (<0.0001 to >10 000)	1.430* (1.228-1.665)	2.522* (1.896-3.354)	1.094 (0.777-1.539)	1.086 (0.423-2.791)
Emergency operations‡	0.825 (0.507-1.343)	0.585 (0.12-2.849)	1.039 (0.92-1.173)	1.096 (0.799-1.504)	0.994 (0.887-1.114)	0.876 (0.613-1.251)
Elective operations‡	1.226 (0.866-1.734)	1.556 (0.538-4.499)	1.124* (1.025-1.232)	1.304* (1.023-1.663)	1.068 (0.992-1.149)	1.139 (0.908-1.427)

Abbreviations: CI = confidence interval; ED = emergency department; FU = frequent user; HIU = high-intensity user; OR = odds ratio

* P<0.05

† For the full list of diagnosis codes, please refer to reference 9

‡ Include only operations classified as major or ultra-major. For the full list of major or ultra-major operations, please refer to reference 10

may improve quality of care and reduce repeated ED visits. Patient-based care, rather than disease-based care, may be beneficial. Patients with multimorbidity (especially older adults) receive medical treatment through multiple specialty or subspecialty clinics, which can result in fragmented and duplicative care. It is not uncommon for patients with chronic diseases to attend the ED for minor problems and questions about their chronic diseases because they cannot find an alternative source of medical advice. Case management helps improve outcomes in some chronic diseases.[18] Efforts to strengthen the abilities of primary care clinics to function as 'case managers' for patients with chronic diseases may improve quality of care and reduce the number of ED visits.

TABLE 5. Demographic and clinical characteristics of superusers and their emergency department visits*

	No. (%)
Characteristic	
Total No. of patients	52 (100%)
Age, y	
Mean	47.4
Standard deviation	16.4
Sex	
Male	31 (59.6%)
Female	21 (40.4%)
Payment exemption	22 (42.3%)
Ethnicity, Chinese	47 (90.4%)
Residency in old-age homes	0
Medical records in past 5 years†	
Cardiac diseases	7 (13.5%)
Respiratory diseases	8 (15.4%)
Gastrointestinal/hepatobiliary diseases	19 (36.5%)
Endocrine diseases	3 (5.8%)
Renal diseases	1 (1.9%)
Neoplastic diseases	1 (1.9%)
Neurological diseases	5 (9.6%)
Mental health disorders	14 (26.9%)
Substance abuse	4 (7.7%)
Emergency operations‡	2 (3.8%)
Elective operations‡	5 (9.6%)
Episode-based analysis	
Total episodes	2758 (100%)
Ambulance use	258 (9.4%)
Triage category§	
Critical/emergency	9 (0.3%)
Urgent	229 (8.3%)
Semi-urgent/non-urgent	2507 (90.9%)
Five most common principal diagnoses	
Lumbago	466 (16.9%)
Cervicalgia	291 (10.6%)
Acute upper respiratory infection	208 (7.5%)
Abdominal pain, unspecified site	155 (5.6%)
Joint pain–ankle	154 (5.6%)
Principal diagnosis	
Musculoskeletal pain–related‖	1220 (44.2%)
Minor infections**	278 (10.1%)
Imaging	
Plain radiography	377 (13.7%)
Computed tomography	32 (1.2%)
Admission statistics	
Hospital admission	217 (7.9%)
Total episodic length of stay, d	703
Mean length of stay, d ± standard deviation	3.2 ± 5.7

* Data are shown as No. (%), unless otherwise specified
† For the full list of diagnosis codes, please refer to reference 9
‡ Include only operations classified as major or ultra-major. For the full list of major or ultra-major operations, please refer to reference 10
§ Cases with missing triage category are not included
‖ For the full list of musculoskeletal pain–related diagnoses, please refer to reference 9 and online supplementary Appendix 2
** Includes upper respiratory tract infection, urinary tract infection, gastroenteritis, and non-specific viral illness. For the full list of minor infection diagnoses, please refer to reference 9 and online supplementary Appendix 2

Mental health disorders and substance abuse

In this study, mental health disorders and substance abuse were significant predictors of frequent ED use. A previous work indicated that one in seven Hong Kong residents aged 16 to 75 years has anxiety, depression, or another common mood disorder.[19] The HA is the main specialist service provider for patients with mental health disorders. It provides in-patient facilities, day hospitals, specialist out-patient clinics, and community outreach services. The HA is experiencing increased demand for specialist mental health services,[20] which may be causing patients to use EDs instead. Emergency department visits and readmissions for psychiatric problems may be reduced by reforming the current service model to expand community psychiatric services, with a focus on personalised care for psychiatric patients and their caregivers through a case management approach that facilitates community re-integration and strengthens recovery. Enhanced screening to identify early features of mental health disorders may allow earlier detection and treatment, thereby reducing ED utilisation. Patients and caregivers should receive education about health-seeking behaviours during instances of acute deterioration (eg, using a 24-hour psychiatric advisory hotline or undergoing urgent assessment at a psychiatric specialist out-patient clinic), rather than simply using the ED as a safety net.

Limitations

This study was limited to the three EDs in the New Territories West Cluster. Its findings may not be generalisable to other regions in Hong Kong with different demographics, health-seeking behaviours, and socio-economic statuses. Also, this study only investigated ED visits within a specific time period and did not consider past or future periods. Thus, it may have underestimated ED visits for patients who were born or died during the study period.

By reviewing diagnosis codes, we were able to include many visits and patients in the analysis; however, we could not analyse individual charts. Although coding is a routine component of hospital procedures, codes are only required for the current condition or presenting problem. Generally, coding is not mandatory for appointments at out-patient clinics. This difference in coding information may have led to underestimation of patient comorbidities. To mitigate this possibility, we examined all diagnosis codes from the past 5 years to acquire a more complete representation of underlying comorbidities.

Because this study excluded patients without valid identification documents, homeless persons may have been underrepresented. These individuals potentially have a heavier disease burden and a disproportionate share of frequent visits. The study

may also have excluded visitors to Hong Kong and individuals who do not have residency status.

Conclusion

Frequent users and HIUs are a small but diverse population that represents a substantial proportion of annual ED visits. Demographic factors, economic considerations, and medical conditions all contribute to increased numbers of ED visits. Our data suggest that there are many opportunities for improvement via streamlining and enhancement of healthcare delivery to reduce ED utilisation.

Author contributions

Concept or design: PYT Ng, CT Lui.
Acquisition of data: PYT Ng, CT Lui.
Analysis or interpretation of data: PYT Ng, CT Lui.
Drafting of the manuscript: PYT Ng, CT Lui.
Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

This research was approved by the New Territories West Cluster Research Ethics Committee of Hospital Authority, Hong Kong (Ref No.: NTWC/REC/19081). Informed patient consent was waived by the Committee due to the retrospective nature of the study.

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