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Ascertainment of self-harm at general hospitals in Hong Kong

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1. Introduction

Self-harm is a serious public health and social issue in many countries worldwide. Self-harm is defined as a harmful act performed on ones-self by a person who might, or might not, have an intent to take their own life (Palmer, 2007). Literature also identified that self-harm had a significant association with subsequent risk of suicide (Walker, 2003). The overall suicide rate increased over time after a self-harm episode by 1.7% after 5 years, 2.4% after 10 years, and 3.0% after 15 years (Zahl and Hawton, 2004).

In Hong Kong, a recent study identified the majority of self-harm patients attending emergency department (ED) were in the age groups of 15 –24 years and 25–39 years, accounting for two thirds of cases of self-harm from 1997 to 2003 (Yip et al., 2003). The rate of 6-month self-harm repetition was reported to be 16.7% (Yip et al., 2011). On the other hand, the suicide rate rose from 9.6 to 15 per 100,000 populations between 1981 and 2001, and was the sixth leading cause of death in HK. Within the same period, the total years of life lost due to suicide increased by 96% from 9900 years to 19,400 years (Yip et al., 2003). The hospital self-harm attendance can be identified from clinical notes in the ED records and from the Clinical Management System (CMS) in HK. However, the compliance of record keeping has not been investigated, considering most self-harm patients were admitted through ED. The accurate numbers of self-harm patients should be a priority for suicidal prevention; hence, there is a need to ascertain correctly identified episodes of self-harm at ED.

Capture and recapture methodology is a common approach to estimate populations and has been used since the 1940s (Tilling, 2001). This estimation method uses two databases with the assumption that there is no dependency between the two sources, and the method can give a 95 percent confidence level in the estimation. In the public hospitals in HK, the self-harm data from ED and ward records can be used to ascertain the number of the self-harm hospital admission as they are operated as two independent databases.

The study objective was to estimate the episodes of hospitalizations for self-harm and identify any factors associated with the ascertainment between ED and inpatient records.

2. Methodology

This was a retrospective observational study to estimate the number of episodes of hospitalizations for self-harm and identify the factors associated with self-harm coding in ED and inpatient records.

2.1. Setting

Data for self-harm was extracted from the records of three public hospitals in HK, the three hospitals cover more than 500,000 people living in Kowloon West. We extracted data from the hospitals to obtain a near complete picture of the ascertainment of self-harm admissions at hospitals to identify factors associated with the self-harm coding in ED and inpatient wards.

For ED attendance, an electronic record system is in place to process administrative and clinical information. For a self-harm patient, the identifier was the injury classification and poisoning type from the ED clinical notes. The data classification was not mutually exclusive as it depended on the method of self-harm. For subsequent reporting and data analysis, the identifiers were retrieved from a designated portal in the Clinical Management System of the HK Hospital Authority (HA).

For hospital admissions, the respective diagnosis was recorded in the electronic patient management system. For self-harm, the respective suicide E codes were assigned as a secondary diagnosis upon discharge. The ED and inpatient data can be downloaded from the system portal in spreadsheet format for retrospective analysis. Identification of self-harm cases existing in the both records can be obtained by matching the respective ED registration number and the inpatient registration number for each episode of hospital admission.

2.2. Data

The data set included patient demographics such as gender and age, and clinical data such as hospital registration number, hospital LOS, diagnosis, procedures and discharge outcome from the ED and inpatient records. Usually, the E code is assigned in the second diagnosis of respective patients. It can be used to identify cases of self-harm from the inpatient records. Each patient was given a base unique identifier for matching between both ED and inpatient records with common codes

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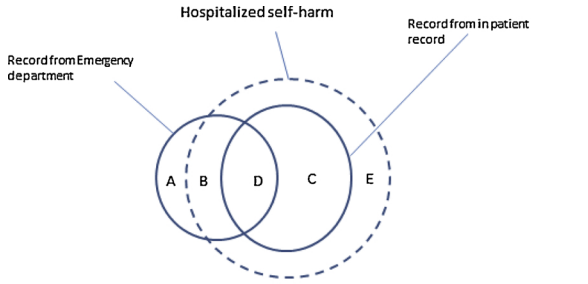
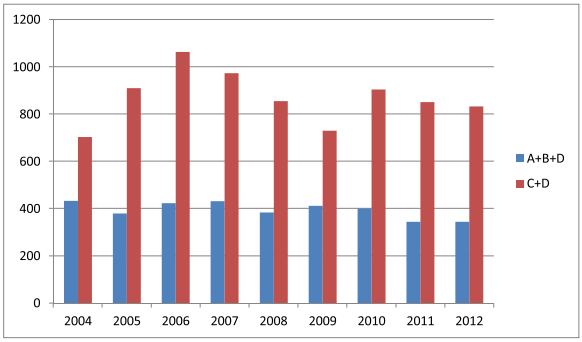


A: ED discharged directly (n= 832)
B: ED-Hospitalized but not found in the record of inpatient (n=868)
C: Found in the record of inpatient but not found in ED record (n=5,974)
D: Overlapping records found in both ED and inpatient records (n=1,851)
E: Unobserved hospitalized self-harm (n=3,145)

Fig. 1. Basic scheme of capture-recapture model for estimating hospitalized self-harm (2004–2012).
A:ED discharged directly (n = 832).
B:ED-Hospitalized but not found in the record of inpatient (n = 868).
C:Found in the record of inpatient but not found in ED record (n = 5974).
D:Overlapping records found in both ED and inpatient records (n = 1851).
E:Unobserved hospitalized self-harm (n = 3145).



A: ED discharged directly
B: ED-Hospitalized but not found in the record of inpatient
C: Found in the record of inpatient but not found in ED record
D: Overlapping records found in both ED and inpatient record

Fig. 2. Overall difference between ED identification and ward identification of self-harm (2004–2012).
A:ED discharged directly.
B:ED-Hospitalized but not found in the record of inpatient.
C:Found in the record of inpatient but not found in ED record.
D:Overlapping records found in both ED and inpatient records.

(Fig. 1).

2.3. Analysis

A two-sample capture-recapture method was used to estimate the total number of hospitalizations for self-harm with an assumption that the cases would have same the chance of being selected in the two data sources. Assuming the case number in ED record was C1 + M and the case number from inpatient record was C2 + M, where M was the number of common cases identified within the two records, the asserted population would be estimated as $(N1) = \{(C1 + 1 \ *C2 + 1) / (M + 1)\} - 1$. The overall population (N) was then equal to N1 + C1 + C2 + M. In addition, the variance of N could be estimated by $Var(N) = (C1 + M) \times (C2 + M) \times C1 \times C2/M^3$, which facilitated the estimation at a 95% confidence interval (Fig. 2).

Multinomial logistic regression models were used to investigate factors that were associated with the use of self-harm codes in the ED records, ward discharge records, and both records. The reference category was hospitalizations coded as self-harm in both the ED and ward records. The factors associated with more chance of being recorded in ED and ward discharge systems was identified by odd ratios. The model classification accuracy, model fitting information (chi-square) and the measurement of effect size were then assessed. On the other hand, there was limitation that the potential underestimation of self-harm patients may affect type I/II error in light of multinomial regression.

3. Results

3.1. Capture history by year of incident

From 2004 to 2012, a total of 3551 episodes from ED and 7825 episodes from the inpatient records were identified from Hospital P (Hosp P), Hospital C (Hosp C), and Hospital Y (Hosp Y). Better training to healthcare professionals about self-harm and advancement in technology was considered as those factors that facilitates the data capture ad ED. Fig. 1 gives an illustration of the capture-recapture approach and the numbers in each mutually exclusive group. A total of 832 episodes of self-harm involving patients who had been treated and directly discharged from ED were excluded from the capture-recapture model. Of the remaining 2719 episodes, 1851 were hospitalized and 868 had missing discharge codes. Of the self-harm patients diagnosed in ED, 77% were admitted to hospital. The matching process identified a total of 1851 overlapping episodes, resulting in 8693 distinct registrations of hospitalized self-harm. The overlapping episodes only covered 52.13% and 23.66% of the A&E and inpatient data, respectively. In other words, the inpatient data missed 76% of self-harm cases that had been diagnosed in ED. Moreover, 7.63 out of every 10 episodes identified from inpatient data could not be captured by the ED attendance data. Table 1 shows the capture history by year of incidence. ED discharge episodes (column A) on their own accounted for 8.73% (Hosp C: 7.47%, Hosp P: 9.34%, Hosp Y: 9.19%) of all observed episodes, with a steady episodes from 2004 to 2012. The number of overlapping cases covered only 19.43% (Hosp C: 11.38%, Hosp P: 27.16%, Hosp Y: 17.32%) of the hospitalized self-harm cases.

Table 2 shows the capture history of incidence of hospitalized self-harm stratified by gender, age, and method of self-harm. There were 8693 (Hosp C: 2626, Hosp P: 3408, Hosp Y: 2659) distinct episodes of hospitalized self-harm with 1851 (Hosp C: 323, Hosp P: 1021, Hosp Y: 507) episodes overlapping in both datasets. ED overall (column B) accounted for 9.9% (Hosp C: 8.72%, Hosp P: 11.83%, Hosp Y: 8.88%) of the hospitalized cases. About 68.72% (Hosp C: 78.98%, Hosp P: 58.22%, Hosp Y: 72.06%) were captured only by inpatient admission (column C), whereas 21.29% (Hosp C: 12.3%, Hosp P: 29.96%, Hosp Y: 19.07%) were identified from both sources (column D). Female patients made up 49.47% of episodes of hospitalized self-harm. Most patients were adolescents or adults aged between 15 and 44 years (n = 5,812, 66.86%). Self-poisoning, either on its own or concurrent with self-injury, accounted for 91.9% (Hosp C: 90.71%, Hosp P: 91.77%, Hosp Y: 92.9%) of hospital admissions.

3.2. Capture history by gender, age, and method of self-harm

The capture history of hospitalized self-harm differed by gender, age and method of sel-harm (Table 2). The proportion captured by both data sources differed markedly between males (13.06%) and females (29.7%). Of the cases identified from both data sources, 80.40% (Hosp C: 81.7%, Hosp P: 80.5%, Hosp Y: 79.0%) of patients were younger than 55 years. Self-injury alone was found in 11.7% (Hosp C: 9.0%, Hosp P: 15.8%, Hosp Y: 10.3%) of cases, whereas drug overdose was found in 84.8% (Hosp C: 87.1%, Hosp P: 79.9%, Hosp Y: 87.5%). Self-poisoning was more likely to be captured as illustrated by inpatient data 80.6%, (Hosp C: 82.3%, Hosp P: 75.9%, Hosp Y: 83.4%) and ED data 45.62%, (Hosp C: 80.0%, Hosp P: 75.2%, Hosp Y: 83.1%).

3.3. Episode size and ascertainment rate

Table 3 shows the estimated episode size and corresponding

Table 1
Capture history by year of incidence.

Year of Incident	A	(%)	B	(%)	C	(%)	Hospitalized self-harm D	(%)	Row total	% of total
Hosp C										
2004	28	(12.02)	46	(19.74)	126	(54.08)	33	(14.16)	233	(8.21)
2005	25	(8.83)	21	(7.42)	202	(71.38)	35	(12.37)	283	(9.97)
2006	17	(5.21)	17	(5.21)	248	(76.07)	44	(13.50)	326	(11.49)
2007	24	(7.59)	22	(6.96)	231	(73.10)	39	(12.34)	316	(11.13)
2008	25	(7.42)	34	(10.09)	242	(71.81)	36	(10.68)	337	(11.87)
2009	26	(10.32)	24	(9.52)	169	(67.06)	33	(13.10)	252	(8.88)
2010	23	(6.67)	24	(6.96)	259	(75.07)	39	(11.30)	345	(12.16)
2011	17	(4.87)	20	(5.73)	281	(80.52)	31	(8.88)	349	(12.30)
2012	27	(6.80)	21	(5.29)	316	(79.60)	33	(8.31)	397	(13.99)
Total	212	(7.47)	229	(8.07)	2074	(73.08)	323	(11.38)	2838	(100.00)
Hosp P										
2004	36	(8.28)	58	(13.33)	251	(57.70)	90	(20.69)	435	(11.57)
2005	24	(5.26)	26	(5.70)	304	(66.67)	102	(22.37)	456	(12.13)
2006	39	(7.93)	37	(7.52)	291	(59.15)	125	(25.41)	492	(13.09)
2007	38	(8.39)	40	(8.83)	237	(52.32)	138	(30.46)	453	(12.05)
2008	50	(13.48)	34	(9.16)	186	(50.13)	101	(27.22)	371	(9.87)
2009	37	(9.46)	67	(17.14)	166	(42.46)	121	(30.95)	391	(10.40)
2010	44	(10.50)	46	(10.98)	203	(48.45)	126	(30.07)	419	(11.15)
2011	39	(10.18)	46	(12.01)	181	(47.26)	117	(30.55)	383	(10.19)
2012	44	(12.26)	49	(13.65)	165	(45.96)	101	(28.13)	359	(9.55)
Total	351	(9.34)	403	(10.72)	1984	(52.78)	1021	(27.16)	3759	(100.00)
Hospit Y										
2004	34	(11.93)	48	(16.84)	143	(50.18)	60	(21.05)	285	(9.73)
2005	30	(9.49)	19	(6.01)	170	(53.80)	97	(30.70)	316	(10.79)
2006	28	(6.85)	25	(6.11)	265	(64.79)	91	(22.25)	409	(13.97)
2007	34	(8.74)	26	(6.68)	259	(66.58)	70	(17.99)	389	(13.29)
2008	34	(9.80)	23	(6.63)	243	(70.03)	47	(13.54)	347	(11.85)
2009	32	(10.67)	27	(9.00)	196	(65.33)	45	(15.00)	300	(10.25)
2010	28	(8.41)	27	(8.11)	235	(70.57)	43	(12.91)	333	(11.37)
2011	22	(7.64)	25	(8.68)	213	(73.96)	28	(9.72)	288	(9.84)
2012	27	(10.34)	16	(6.13)	192	(73.56)	26	(9.96)	261	(8.91)
Total	269	(9.19)	236	(8.06)	1916	(65.44)	507	(17.32)	2928	(100.00)
Grand Total	832	(8.73)	868	(9.11)	5974	(62.72)	1851	(19.43)	9525	(100.00)

ascertainment rate stratified by different covariates. For gender, the originally observed number of hospitalized episodes was almost distributed equally among males and females (Hosp C: 52.75% vs 47.25%; Hosp P: 45.9% vs 54.06%; Hosp Y: 53.28% vs 46.72%). The pattern remained the same after adjustment for errors in data entry (Hosp C: 55.29% vs 44.92%; Hosp P: 49.38% vs 51.78%; Hosp Y: 56.26% vs 44.43%). The resulting ascertainment rates after merging the two data sources captured 77.58% of hospitalizations among females, but only about 68.82% of male cases. The patient group between 25 to 34 years of age accounted for the most number of patients, the estimated total number was 3189 with 95% CI of 2,037-3,460 (Hosp C: 1107, 95% CI 562-1241; Hosp P: 1100, 95% CI 835-1158; Hosp Y: 982, 95% CI 650–1061), accounting for 26.94% (Hosp C: 27.03%, Hosp P: 26.25%, Hosp Y: 27.65%) of the total estimated number of hospitalized self-harm patients. The age distribution of the estimated number was quite similar to that of the observed cases. The ascertainment rates ranged from 62.88% to 83.13% for age groups 15–24, 25–34, 35–44, and 45–54 years. Episodes involving only self-poisoning were better captured than self-injury, as reflected by differences between ascertainment rates (Hosp C: 72.16% Vs 68.34%; Hosp P: 83.86% Vs 76.66%; Hosp Y: 79.62% Vs 71.78%). The estimated number by year covariate was fairly stable after adjusting for incompleteness. The annual count minimums (Hosp C: 349 in 2009; Hosp P: 384 in 2008; Hosp Y: 319 in 2009) and peaks (Hosp C: 571 in 2012; Hosp P: 561 in 2004; Hosp Y: 456 in 2011) are shown.

Table 4 demonstrates the capture-recapture model corrected only the under-reporting of self-harm cases that resulted in hospital admission. The 832 observed cases directly discharged from ED departments were redistributed to corresponding sub-groups. There was a distinct distribution of ED discharge cases compared with hospitalized episodes in terms of age, year of incidence, and method of self-harm. The largest patient groups were adolescents aged 15–24 years (Hosp C: 62, Hosp P: 102, Hosp Y: 78) and young adults aged 25–34 years (Hosp C: 64, Hosp P: 93, Hosp Y: 76), which also represented the largest age groups in the hospitalized cases. Both hospitalized patient and ED discharge patient records captured more poisoning cases (Hosp C: 190, 89.6%; Hosp P: 285, 81.2%; Hosp Y: 184, 52.4%). This probably was reflected by healthcare professionals being more aware of poisoning, or reflected that poisoned patients were more likely to be admitted.

3.4. Multinomial results of the category comparisons for self-harm being captured in clinical records

Table 5 reports the multinomial results of the category comparison of self-harm being captured in ED records, inpatient records, and existing in both records. A test of the model that considered only the constant was statistically significant (Chi-square, Hosp C: 223.85, $P < 0.001$; Hosp P: 477.82, $p < 0.001$; Hosp Y: 396.02, $p < 0.001$) indicated nine independent variables could distinguish self-harm being captured in ED or inpatient records from those being captured in both records. In addition, the models demonstrated a high classification accuracy (Hosp C: 80.5%, Hosp P: 61.9%, Hosp Y: 73.3%) while comparing the top 25% improved the estimated rate of classification accuracy (Hosp C: 80.6%, Hosp P: 55.3%, Hosp Y: 70.5%). The Nagelkerke pseudo-R2 (Hosp C: 0.252, Hosp P: 0.355, Hosp Y: 0.352) demonstrated the total variance was acceptable. There may be outliers that affect the Pseudo-R2, which included the human factors from patient and health care providers as it would directly affect the completeness of record during the continuum of hospital care. From the analysis, the statistical significant variables associated with a higher

Table 2
Capture history of incidence of hospitalized self-harm stratified by gender, age, and method of slef-harm.

	Covariates	B	(%)	Hospitalized self-harm C	(%)	D	(%)	Row total	% of total
Hosp C									
	Total	229	(100.00)	2074	(100.00)	323	(100.00)	2626	(100.00)
	Gender								
	Female	152	(66.38)	844	(40.69)	216	(66.87)	1212	(46.15)
	Male	77	(33.62)	1230	(59.31)	107	(33.13)	1414	(53.85)
	Age Group								
	15-24	47	(20.52)	347	(16.73)	69	(21.36)	463	(17.63)
	25-34	73	(31.88)	529	(25.51)	94	(29.10)	696	(26.50)
	35-44	51	(22.27)	424	(20.44)	72	(22.29)	547	(20.83)
	45-54	32	(13.97)	395	(19.05)	46	(14.24)	473	(18.01)
	55-64	7	(3.06)	194	(9.35)	17	(5.26)	218	(8.30)
	65 +	19	(8.30)	185	(8.92)	25	(7.74)	229	(8.72)
	Method of self-harm								
	Injury	142	(62.01)	187	(9.02)	126	(39.01)	455	(17.33)
	Poisoning	73	(31.88)	1806	(87.08)	167	(51.70)	2046	(77.91)
	Both	14	(6.11)	81	(3.91)	30	(9.29)	125	(4.76)
Hosp P									
	Total	403	(100.00)	1984	(100.00)	1021	(100.00)	3408	(100.00)
	Gender								
	Female	259	(64.27)	881	(44.41)	713	(69.83)	1853	(54.37)
	Male	144	(35.73)	1103	(55.59)	308	(30.17)	1555	(45.63)
	Age Group								
	15-24	90	(22.33)	333	(16.78)	224	(21.94)	647	(18.98)
	25-34	100	(24.81)	535	(26.97)	258	(25.27)	893	(26.20)
	35-44	93	(23.08)	412	(20.77)	250	(24.49)	755	(22.15)
	45-54	54	(13.40)	318	(16.03)	150	(14.69)	522	(15.32)
	55-64	33	(8.19)	183	(9.22)	64	(6.27)	280	(8.22)
	65 +	33	(8.19)	203	(10.23)	75	(7.35)	311	(9.13)
	Method of self-harm								
	Injury	168	(41.69)	314	(15.83)	240	(23.51)	722	(21.19)
	Poisoning	211	(52.36)	1585	(79.89)	697	(68.27)	2493	(73.15)
	Both	24	(5.96)	85	(4.28)	84	(8.23)	193	(5.66)
Hosp Y									
	Total	236	(100.00)	1916	(100.00)	507	(100.00)	2659	(100.00)
	Gender								
	Female	157	(66.53)	730	(38.10)	348	(68.64)	1235	(46.45)
	Male	79	(33.47)	1186	(61.90)	159	(31.36)	1424	(53.55)
	Age Group								
	15-24	54	(22.88)	334	(17.43)	122	(24.06)	510	(19.18)
	25-34	85	(36.02)	479	(25.00)	155	(30.57)	719	(27.04)
	35-44	44	(18.64)	418	(21.82)	120	(23.67)	582	(21.89)
	45-54	27	(11.44)	282	(14.72)	57	(11.24)	366	(13.76)
	55-64	8	(3.39)	210	(10.96)	15	(2.96)	233	(8.76)
	65 +	18	(7.63)	193	(10.07)	38	(7.50)	249	(9.36)
	Method of self-harm								
	Injury	110	(46.61)	197	(10.28)	127	(25.05)	434	(16.32)
	Poisoning	112	(47.46)	1677	(87.53)	344	(67.85)	2133	(80.22)
	Both	14	(5.93)	42	(2.19)	36	(7.10)	92	(3.46)

chance of being captured in ED records at Hosp C were being non-critical upon arrival (OR 1.88, $P < 0.01$) and injury as the method of self-harm (OR 1.98, $P < 0.01$); at Hosp P were being non-critical upon arrival (OR1.33, $P = 0.05$), injury as the method of self-harm (OR 2.08, $P < 0.01$), admission on non-weekdays (OR 1.3, $P = 0.05$), and LOS at ED (OR 1, $P = 0.02$); and at Hosp Y were injury as the method of self-harm (OR 2.02, $P < 0.01$) and LOS at ED (OR 1.01, $P < 0.01$). The significant variables associated with lower chance of being captured only in ED were the admission time of day found at Hosp Y: Daytime from 07:00-15:00 (OR 0.67 $P = 0.01$) and Evening 16:00-23:00 (OR 0.74 $P = 0.04$). On the other hand, LOS at ED (Hosp C: OR 1, $P < 0.01$; Hosp P: OR 1, $P < 0.01$; Hosp Y: OR 1.01, $P < 0.01$) and LOS in hospital (Hosp C: OR 1, $P < 0.01$; Hosp P: OR 1.01, $P < 0.01$; Hosp Y: OR 1.01, $P < 0.01$) were the two significant variables associated with higher chance of being captured only in inpatient records when comparing with the chance of being captured in both ED and inpatient records. For consideration, the 27% underestimation of self-harm patients may be concerned as a limitation that affect type I/II error in the analysis.

4. Discussion

4.1. Limitations of using clinical information for studying self-harm

In some countries, self-harm was identified as part of administrative data. It was also found to be under-recorded. In addition, some self-harm cases were misclassified as “unclassified” at ED (Horrocks et al., 2003; Bethell and Rhodes, 2009). However, our study indicated that the misclassified self-harm was not a major problem. The main reasons for under-recorded cases were miscoding, which was evident in our findings with 5974 (76.35%) admitted self-harm cases having no ED coding. Clinical information systems are mainly designed for the treatment and care process, it may not be sufficient to accurately capture epidemiological data on self-harm (Thomas et al., 2013). The under estimation of self-harm in ED might be due to time constraints in history taking instead of due to lack of awareness among emergency physicians. The reason why more self-harm patients are identified in ward may be due to the LOS in ward is much longer than in ED. The compliance of coding self-harm could be enhanced through regular

Table 3
The estimated episode size and corresponding ascertainment rate stratified by different covariates.

	Covariates	Observed Number (%) (B + C + D)		Estimated Number (%) (B + C + D + E)		Bootstrap 95% CI Upper Lower		Ascertainment Rate (%)
Hosp C								
	Total	2626	(100.0)	4096	(100.0)	4363	(2359.7)	(64.1)
	Gender							
	Female	1212	(46.2)	1806	(44.1)	1943	(1074.9)	(67.1)
	Male	1414	(53.8)	2299	(56.1)	2565	(1147.8)	(61.5)
	Age Group							
	15-24	463	(17.6)	699	(17.1)	793	(369.3)	(66.2)
	25-34	696	(26.5)	1107	(27.0)	1241	(562.0)	(62.9)
	35-44	547	(20.8)	847	(20.7)	961	(433.1)	(64.6)
	45-54	473	(18.0)	748	(18.3)	874	(346.5)	(63.3)
	55-64	218	(8.3)	298	(7.3)	365	(151.0)	(73.2)
	65+	229	(8.7)	370	(9.0)	453	(145.2)	(62.0)
	Year of incidence							
	2004	205	(7.8)	381	(9.3)	465	(121.1)	(53.9)
	2005	258	(9.8)	379	(9.3)	447	(190.1)	(68.0)
	2006	309	(11.8)	405	(9.9)	461	(252.8)	(76.3)
	2007	292	(11.1)	422	(10.3)	493	(221.3)	(69.1)
	2008	312	(11.9)	541	(13.2)	650	(202.3)	(57.7)
	2009	226	(8.6)	349	(8.5)	416	(158.7)	(64.8)
	2010	322	(12.3)	481	(11.8)	565	(238.5)	(66.9)
	2011	332	(12.6)	513	(12.5)	615	(230.0)	(64.7)
	2012	370	(14.1)	571	(13.9)	681	(259.9)	(64.8)
	Method of self-harm							
	Injury	455	(17.3)	666	(16.3)	730	(390.4)	(68.3)
	Poisoning	2046	(77.9)	2835	(69.2)	3060	(1821.2)	(72.2)
	Both	125	(4.8)	163	(4.0)	190	(98.3)	(76.8)
Hosp P								
	Total	3408	(100.0)	4191	(100.0)	4302	(3297.0)	(81.3)
	Gender							
	Female	1853	(54.4)	2173	(51.8)	2234	(1791.9)	(85.3)
	Male	1555	(45.6)	2071	(49.4)	2186	(1440.2)	(75.1)
	Age Group							
	15-24	647	(19.0)	781	(18.6)	823	(604.9)	(82.9)
	25-34	893	(26.2)	1100	(26.3)	1158	(835.0)	(81.2)
	35-44	755	(22.2)	908	(21.7)	954	(709.0)	(83.1)
	45-54	522	(15.3)	636	(15.2)	679	(479.2)	(82.0)
	55-64	280	(8.2)	374	(8.9)	419	(235.0)	(74.8)
	65+	311	(9.1)	400	(9.6)	442	(269.1)	(77.7)
	Year of incidence							
	2004	399	(11.7)	561	(13.4)	622	(337.8)	(71.2)
	2005	432	(12.7)	509	(12.2)	548	(394.0)	(84.8)
	2006	453	(13.3)	539	(12.9)	576	(415.7)	(84.0)
	2007	415	(12.2)	484	(11.5)	514	(384.9)	(85.8)
	2008	321	(9.4)	384	(9.2)	413	(291.2)	(83.7)
	2009	354	(10.4)	446	(10.6)	482	(318.4)	(79.4)
	2010	375	(11.0)	449	(10.7)	481	(343.5)	(83.5)
	2011	344	(10.1)	415	(9.9)	446	(313.2)	(82.9)
	2012	315	(9.2)	395	(9.4)	429	(280.8)	(79.7)
	Method of self-harm							
	Injury	722	(21.2)	942	(22.5)	999	(664.8)	(76.7)
	Poisoning	2493	(73.2)	2973	(70.9)	3061	(2404.5)	(83.9)
	Both	193	(5.7)	217	(5.2)	233	(177.7)	(88.8)
Hosp Y								
	Total	2659	(100.0)	3551	(100.0)	3705	(2504.6)	(74.9)
	Gender							
	Female	1235	(46.4)	1564	(44.1)	1639	(1159.9)	(78.9)
	Male	1424	(53.6)	2013	(56.7)	2181	(1256.4)	(70.7)
	Age Group							
	15-24	510	(19.2)	658	(18.5)	712	(455.3)	(77.5)
	25-34	719	(27.0)	982	(27.6)	1061	(639.8)	(73.2)
	35-44	582	(21.9)	735	(20.7)	795	(522.7)	(79.2)
	45-54	366	(13.8)	500	(14.1)	565	(300.7)	(73.3)
	55-64	233	(8.8)	345	(9.7)	435	(143.3)	(67.5)
	65+	249	(9.4)	340	(9.6)	394	(195.1)	(73.1)
	Year of incidence							
	2004	251	(9.4)	365	(10.3)	416	(200.6)	(68.7)
	2005	286	(10.8)	319	(9.0)	340	(265.8)	(89.6)
	2006	381	(14.3)	454	(12.8)	491	(344.3)	(84.0)
	2007	355	(13.4)	451	(12.7)	499	(307.2)	(78.7)
	2008	313	(11.8)	432	(12.2)	495	(250.3)	(72.5)
	2009	268	(10.1)	386	(10.9)	446	(207.9)	(69.5)
	2010	305	(11.5)	453	(12.7)	527	(230.6)	(67.4)
	2011	266	(10.0)	456	(12.8)	559	(163.1)	(58.3)

(*continued on next page*)

Table 3 (*continued*)

Covariates	Observed Number (%) (B + C + D)		Estimated Number (%) (B + C + D + E)		Bootstrap 95% CI Upper Lower		Ascertainment Rate (%)
2012	234	(8.8)	352	(9.9)	426	(160.2)	(66.4)
Method of self-harm							
Injury	434	(16.3)	605	(17.0)	660	(378.8)	(71.8)
Poisoning	2133	(80.2)	2679	(75.4)	2806	(2005.8)	(79.6)
Both	92	(3.5)	108	(3.1)	122	(78.8)	(84.9)

Table 4
The capture-recapture model corrected number of self-harm cases which resulted in hospital admission.

		A&E Discharged		Hospialized		Total Observed		Total Estimated	
	Covariates	(A)	(%)	(B + C + D)	(%)	(A + B + C + D)	(%)	(A + B + C + D + E)	(%)
Hosp C									
	Total	212	(100.00)	2626	(100.00)	2838	(100.00)	4308	(100.00)
	Gender								
	Female	129	(60.85)	1212	(46.15)	1341	(47.25)	1935	(44.92)
	Male	83	(39.15)	1414	(53.85)	1497	(52.75)	2382	(55.29)
	Age Group								
	15-24	62	(29.25)	463	(17.63)	525	(18.50)	761	(17.67)
	25-34	64	(30.19)	696	(26.50)	760	(26.78)	1171	(27.18)
	35-44	41	(19.34)	547	(20.83)	588	(20.72)	888	(20.62)
	45-54	17	(8.02)	473	(18.01)	490	(17.27)	765	(17.75)
	55-64	4	(1.89)	218	(8.30)	222	(7.82)	302	(7.01)
	65+	24	(11.32)	229	(8.72)	253	(8.91)	394	(9.14)
	Year of incidence								
	2004	28	(13.21)	205	(7.81)	233	(8.21)	409	(9.49)
	2005	25	(11.79)	258	(9.82)	283	(9.97)	404	(9.38)
	2006	17	(8.02)	309	(11.77)	326	(11.49)	422	(9.79)
	2007	24	(11.32)	292	(11.12)	316	(11.13)	446	(10.36)
	2008	25	(11.79)	312	(11.88)	337	(11.87)	566	(13.13)
	2009	26	(12.26)	226	(8.61)	252	(8.88)	375	(8.70)
	2010	23	(10.85)	322	(12.26)	345	(12.16)	504	(11.71)
	2011	17	(8.02)	332	(12.64)	349	(12.30)	530	(12.31)
	2012	27	(12.74)	370	(14.09)	397	(13.99)	598	(13.88)
	Method of self-harm								
	Injury	18	(8.49)	455	(17.33)	473	(16.67)	684	(15.87)
	Poisoning	190	(89.62)	2046	(77.91)	2236	(78.79)	3025	(70.23)
	Both	4	(1.89)	125	(4.76)	129	(4.55)	167	(3.87)
Hosp P									
	Total	351	(100.00)	3408	(100.00)	3759	(100.00)	4542	(100.00)
	Gender								
	Female	179	(51.00)	1853	(54.37)	2032	(54.06)	2352	(51.78)
	Male	172	(49.00)	1555	(45.63)	1727	(45.94)	2243	(49.38)
	Age Group								
	15-24	102	(29.06)	647	(18.98)	749	(19.93)	883	(19.44)
	25-34	93	(26.50)	893	(26.20)	986	(26.23)	1193	(26.27)
	35-44	67	(19.09)	755	(22.15)	822	(21.87)	975	(21.47)
	45-54	49	(13.96)	522	(15.32)	571	(15.19)	685	(15.09)
	55-64	12	(3.42)	280	(8.22)	292	(7.77)	386	(8.51)
	65+	28	(7.98)	311	(9.13)	339	(9.02)	428	(9.43)
	Year of incidence								
	2004	36	(10.26)	399	(11.71)	435	(11.57)	597	(13.14)
	2005	24	(6.84)	432	(12.68)	456	(12.13)	533	(11.75)
	2006	39	(11.11)	453	(13.29)	492	(13.09)	578	(12.73)
	2007	38	(10.83)	415	(12.18)	453	(12.05)	522	(11.49)
	2008	50	(14.25)	321	(9.42)	371	(9.87)	434	(9.55)
	2009	37	(10.54)	354	(10.39)	391	(10.40)	483	(10.63)
	2010	44	(12.54)	375	(11.00)	419	(11.15)	493	(10.86)
	2011	39	(11.11)	344	(10.09)	383	(10.19)	454	(10.00)
	2012	44	(12.54)	315	(9.24)	359	(9.55)	439	(9.67)
	Method of self-harm								
	Injury	65	(18.52)	722	(21.19)	787	(20.94)	1007	(22.17)
	Poisoning	285	(81.20)	2493	(73.15)	2778	(73.90)	3258	(71.73)
	Both	1	(0.28)	193	(5.66)	194	(5.16)	218	(4.81)
Hosp Y									
	Total	269	(100.00)	2659	(100.00)	2928	(100.00)	3820	(100.00)
	Gender								
	Female	133	(49.44)	1235	(46.45)	1368	(46.72)	1697	(44.43)
	Male	136	(50.56)	1424	(53.55)	1560	(53.28)	2149	(56.26)
	Age Group								
	15-24	78	(29.00)	510	(19.18)	588	(20.08)	736	(19.26)

(*continued on next page*)

Table 4 (*continued*)

	A&E Discharged		Hospialized		Total Observed		Total Estimated	
Covariates	(A)	(%)	(B + C + D)	(%)	(A + B + C + D)	(%)	(A + B + C + D + E)	(%)
25-34	76	(28.25)	719	(27.04)	795	(27.15)	1058	(27.69)
35-44	50	(18.59)	582	(21.89)	632	(21.58)	785	(20.56)
45-54	26	(9.67)	366	(13.76)	392	(13.39)	526	(13.76)
55-64	17	(6.32)	233	(8.76)	250	(8.54)	362	(9.48)
65+	22	(8.18)	249	(9.36)	271	(9.26)	362	(9.49)
Year of incidence								
2004	34	(12.64)	251	(9.44)	285	(9.73)	399	(10.46)
2005	30	(11.15)	286	(10.76)	316	(10.79)	349	(9.14)
2006	28	(10.41)	381	(14.33)	409	(13.97)	482	(12.61)
2007	34	(12.64)	355	(13.35)	389	(13.29)	485	(12.70)
2008	34	(12.64)	(313.00)	(11.77)	347	(11.85)	466	(12.20)
2009	32	(11.90)	268	(10.08)	300	(10.25)	418	(10.93)
2010	28	(10.41)	305	(11.47)	333	(11.37)	481	(12.58)
2011	22	(8.18)	266	(10.00)	288	(9.84)	478	(12.52)
2012	27	(10.04)	234	(8.80)	261	(8.91)	379	(9.93)
Method of self-harm								
Injury	82	(30.48)	434	(16.32)	516	(17.62)	687	(17.97)
Poisoning	184	(68.40)	2133	(80.22)	2317	(79.13)	2863	(74.95)
Both	3	(1.12)	92	(3.46)	95	(3.24)	111	-(2.91)

system audit and feedback provide as a regular agenda in department meeting and education activities. It could be made on the basis of standard, practice and audit approach. Additional resources were suggested to enhance the collection of required information for self-harm in epidemiological study. In addition, it is necessary to ascertain the burden of self-harm for subsequent prevention planning. More detailed information like the ideation, social history, and family interaction is needed for discharge planning and subsequent prevention strategies. Prospective collection of information should be considered to provide more reliable information on the prevalence and characteristics of self-harm in HK.

4.2. Usefulness of capture-recapture approach in the study of self-harm in HK

Capture-recapture techniques have been used to estimate the incidence of many diseases and health-related problems (Tilling, 2001; Morrison and Stone, 2000). The approach makes two assumptions of a closed population and equal probability of being identified in the 1st and 2nd capture. (LaPorte et al., 1995). It can enhance compliance while minimizing effort, with the potential to estimate the incidence with lower costs (Roberts and Scragg, 1994), and to compensate for missing records of self-harm. This method was feasible to ascertain self-harm from the two separate databases (ED and inpatient record) in HA. On the other hand, a standalone registry was proposed to capture the self-harm as the first resource for the capture-recapture methodology. By reducing the time gap of recording self-harm, the proposed registry can fulfill the required assumption of a closed population.

4.3. Point of ascertainment for self-harm in HK

This study documented low case finding sensitivity of 22.9% in ED. This highlighted the problem of missing self-harm detection at ED level in the three public hospitals. The main reason was that self-harm patients attending ED might be unwilling to disclose the self-harm event to the triage nurse or the ED physicians. For a reliable point of ascertainment of self-harm, ED might not be appropriate as it faced the problem of record completeness. Our findings suggest merging cases from AEIS and E codes in order to enhance completeness for a higher case finding sensitivity for the estimation of self-harm.

4.4. Proposed surveillance system for self-harm

Our study identified under-recording of self-harm in the existing databases. For completeness and for a more accurate estimation of the burden of self-harm, a standalone registry was proposed to collect self-harm information. The estimation bias may be reduced by a designated system for capturing self-harm information. In addition, more detailed information could be available for designing prevention strategies for subsequent suicides. Although there is no perfect registry with zero missing cases, a standalone surveillance system with a designated processes for data collection will definitely help to reduce the missing rate. Besides helping to develop evidenced based prevention strategies, it could be used for measuring the incidence or prevalence for studying epidemiological characteristics (Tilling, 2001; Hayati and Kamarul, 2008), and would facilitate partnerships between community agencies for targeted prevention (Cheng et al., 2014).

4.5. Limitations

Our study had limitations in that there was a positive dependency between ED and inpatient records, which might have lead to a degree of underestimation in the self-harm population. It is recommended that the impact of this would be less severe by merging dataset from the ED record and inpatient database to estimate the burden of self-harm. Although the estimation of the ascertainment may not be perfect, it has been identified that under-recording of self-harm could be close to 27%, highlighting the need for action.

5. Conclusions

The ED data for the estimation of the self-harm burden was found to be insufficient, which was related to the patient's willingness to disclose the self-harm event. The design of the clinical documentation, busy clinical environment, and focus of clinical practice in critical cases were also found to be negative factors. Although the merging of ED records with inpatient records could increase the case finding sensitivity from 22.9% to 66%, some important information would still be missing. The design of clinical documentation was mainly for facilitating the treatment and care process. The busy clinical environment with high attendance situation might not facilitate the collection of more detailed information on self-harm. Therefore, a designated information collection process is necessary to support a standalone self-harm registry to collect the required information for measuring the incidence or

Table 5
Results of the multinomial logistic regression of self-harm records being captured.

		B				C			
		Log-odds	Sig.	Odds Ratio	95% Confidence Inrerval for the Odds Ratio	Log-odds	Sig.	Odds Ratio	95% Confidence Inrerval for the Odds Ratio
Hosp C									
	Sex(Male)								
	Female	0.02	0.93	1.02	0.70–1.49	−1.04	0.14	0.35	0.27–0.47
	Age (65+)								
	15–24	−0.23	0.56	0.80	0.37–1.71	−0.36	0.30	0.70	0.39–1.25
	25–34	0.08	0.82	1.09	0.52–2.26	−0.31	0.28	0.74	0.42–1.28
	35–44	0.06	0.87	1.06	0.51–2.24	−0.29	0.29	0.75	0.43–1.32
	45–54	0.18	0.65	1.20	0.54 –2.66	−0.06	0.30	0.94	0.52–1.70
	55–64	−0.50	0.37	0.61	0.20 –1.81	0.08	0.37	1.08	0.52 - 2.23
	Condition on arrival (Critical)								
	Non critical	0.63	0.00	1.88	1.25 –2.85	1.38	0.16	3.97	2.88–5.48
	Patient mobility (ambulatory)								
	Non ambulatory	−0.17	0.47	0.85	0.54 –1.33	−0.07	0.19	0.94	0.65–1.36
	Method of self-harm (Poisoning)								
	Both	0.03	0.93	1.03	0.50 –2.11	−3.91	0.45	0.02	0.01–0.05
	Injury	0.68	0.00	1.98	1.32 –2.96	−2.46	0.17	0.09	0.06–0.12
	Admission day of week (weekdays)								
	Non weekdays	−0.15	0.45	0.86	0.59 –1.27	−0.04	0.15	0.96	0.72–1.29
	Admission time of day (Night 00-06)								
	Day 07-15	−0.36	0.14	0.70	0.44 –1.13	−0.13	0.18	0.88	0.62 –1.25
	Evening 16-23	−0.03	0.90	0.97	0.64 –1.49	0.03	0.17	1.04	0.74 –1.45
	Length of stay at ED	0.00	0.11	1.00	1.00 –1.01	0.00	0.00	1.00	1.00 –1.01
	Length of stay in Hospital	−0.02	0.21	0.98	0.94 –1.01	0.00	0.01	1.00	0.99 –1.01
Hosp P									
	Sex(Male)								
	Female	−0.11	0.39	0.90	0.70 –1.15	−0.98	0.09	0.37	0.31 –0.45
	Age (65+)								
	15–24	−0.12	0.64	0.89	0.54 –1.46	−0.60	0.18	0.55	0.38 –0.79
	25–34	−0.08	0.76	0.93	0.57 –1.51	−0.29	0.18	0.75	0.53 –1.06
	35–44	−0.09	0.74	0.92	0.56 - 1.50	−0.45	0.18	0.64	0.45 –0.90
	45–54	−0.05	0.85	0.95	0.56 –1.61	−0.16	0.19	0.85	0.59 - 1.23
	55–64	0.24	0.44	1.27	0.70 –2.31	−0.10	0.22	0.91	0.59 –1.39
	Condition on arrival (Critical)								
	Non critical	0.28	0.05	1.33	1.01 –1.75	1.32	0.10	3.73	3.08 –4.53
	Patient mobility (ambulatory)								
	Non ambulatory	−0.23	0.15	0.80	0.59 –1.09	0.11	0.12	1.12	0.89 –1.41
	Method of self-harm (Poisoning)								
	Both	−0.02	0.92	0.98	0.60 –1.58	−3.30	0.44	0.04	0.02 –0.09
	Injury	0.73	0.00	2.08	1.59 –2.72	−1.13	0.11	0.32	0.26 –0.40
	Admission day of week (weekdays)								
	Non weekdays	0.26	0.05	1.30	1.01 –1.68	0.03	0.10	1.03	0.85 –1.25
	Admission time of day (Night 00-06)								
	Day 07–15	0.11	0.50	1.11	0.82 –1.51	−0.16	0.11	0.85	0.68 –1.06
	Evening 16–23	−0.03	0.86	0.97	0.72 - 1.32	−0.09	0.11	0.91	0.74 - 1.13
	Length of stay at ED	0.00	0.02	1.00	1.00 –1.00	0.00	0.00	1.00	1.00 –1.00
	Length of stay in Hospital	0.00	0.70	1.00	0.99 –1.01	0.01	0.00	1.01	1.00 –1.01
Hosp Y									
	Sex(Male)								
	Female	0.06	0.73	1.06	0.75 –1.50	−1.01	0.12	0.37	0.29 –0.46
	Age (65+)								
	15–24	−0.07	0.83	0.93	0.47 –1.85	−0.30	0.24	0.74	0.46 –1.20
	25–34	0.22	0.51	1.25	0.64 –2.43	−0.13	0.24	0.88	0.55 –1.39
	35–44	−0.10	0.78	0.91	0.45 –1.82	−0.15	0.24	0.86	0.54 –1.38
	45–54	0.18	0.63	1.20	0.57 –2.55	0.13	0.26	1.14	0.68 –1.91
	55–64	0.21	0.70	1.23	0.43 –3.53	0.78	0.35	2.19	1.10 –4.36
	Condition on arrival (Critical)								
	Non critical	0.15	0.54	1.16	0.72 –1.87	1.67	0.18	5.29	3.73–7.51
	Patient mobility (ambulatory)								
	Non ambulatory	−0.06	0.82	0.94	0.57 –1.55	0.25	0.20	1.29	0.87 –1.90
	Method of self-harm (Poisoning)								
	Both	0.13	0.70	1.14	0.59 –2.21	−4.25	0.63	0.01	0.00 –0.05
	Injury	0.70	0.00	2.02	1.34 –3.03	−2.38	0.18	0.09	0.07 –0.13

(*continued on next page*)

Table 5 (*continued*)

	B				C			
	Log-odds	Sig.	Odds Ratio	95% Confidence Inrerval for the Odds Ratio	Log-odds	Sig.	Odds Ratio	95% Confidence Inrerval for the Odds Ratio
Admission day of week (weekdays)								
Non weekdays	−0.01	0.98	1.00	0.71 –1.40	−0.09	0.12	0.91	0.72 –1.16
Admission time of day (Night 00-06)								
Day 07–15	−0.40	0.01	0.67	0.50 –0.90	−0.40	0.15	0.67	0.50 –0.90
Evening 16–23	−0.30	0.04	0.74	0.56 –0.98	−0.30	0.14	0.74	0.56 –0.98
Length of stay at ED	0.01	0.00	1.01	1.00 –1.01	0.01	0.00	1.01	1.00 –1.01
Length of stay in Hospital	−0.01	0.71	0.99	0.95 –1.04	0.01	0.01	1.01	0.99 –1.02

prevalence, and for planning effective prevention strategies.

Conflict of interest

None.

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