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Epidemiology and disease burden of complex wounds for inpatients in China: an observational study from Sichuan province

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ABSTRACT

Objectives: To investigate the period prevalence of complex wounds among the overall inpatients, and the impact of complex wounds on inpatient health expense and length of hospital stay.

Design: An observational study.

Setting: 6,056 health care institutions across Sichuan province in China.

Participants: This study included 4,033,763 people admitted to health care institutions during 1 September 2018 and 31 December 2018.

Results: The point prevalence of complex wounds was 4.07 per 1,000 among inpatients and 0.19 per 1,000 among residents in Sichuan. The most common complex wounds were pressure ulcers (1.47 per 1,000 among inpatients and 0.07 per 1,000 among residents in Sichuan). Older, male, Han ethnic groups and retired people were most likely to suffer from complex wounds. The median length of hospital stay was longer for those with complex wounds as their main condition of treatment compared with all-cause admissions in Sichuan (12 days compared with 7 days; $P<0.001$). The median cost of care for people with complex wounds was higher than for admission for any cause (6,500.18 CNY compared with 3,337.16 CNY; $P<0.001$). People with pressure ulcers had the longest length of stay, whilst people with ulcers related to diabetes incurred the highest costs.

Conclusions: Complex wounds, especially pressure ulcers, are common in Sichuan province and their presence is associated with significantly longer lengths of hospital stay and higher medical costs. Additionally, this study only included admitted inpatients during the sampling time period, hence the prevalence of complex wounds may be underestimated. The high prevalence rate and heavy direct and indirect disease burden of complex wounds indicate that health policies for early detection and prevention of complex wounds in elders are urgently needed.

Strengths and limitations of this study

• This geographically defined study is the first to report the prevalence and disease burden of complex wounds in inpatients in China.

• Both disease code (ICD-10) and disease diagnosis were used in this study to make sure that complex wounds were correctly identified and classified.

• As this was based on second-hand data, we were unable to identify the patients who may have had complex wounds that were not recorded in discharge records.

• This study only included admitted inpatients during the sampling time period, hence the prevalence of complex wounds may be underestimated.

INTRODUCTION

Complex wounds (wounds with superficial, partial or full-thickness skin loss healing by secondary intention), such as foot ulcers, legs ulcers, pressure ulcers, open trauma and surgical wounds, heal slowly and are complex to treat and care for:[1,2] they are often referred to as chronic wounds.[3] Complex wounds have been shown to adversely affect the health related quality of life of those affected as they are often painful and can become infected.[4,5] Complex wounds can lead to amputation,[6,7] which causes physical and mental harm, and severely affect productivity. Patients with complex wounds have a higher mortality than people without.[8,9] Management of complex wounds is costly, with crudely estimated annual costs of £3 billion in the UK, $2.85 billion in Australia and $25 billion in the USA.[10] In Europe it has been estimated that 2-4% of health care budgets are spent on wound management.[11]

Epidemiological estimates of complex wounds prevalence vary. It was estimated that 6.5 million patients have chronic wounds in the US and 1% of population would experience wounds problem in Denmark.[12,13] In 2003, Rodrigues et al conducted a cross sectional study which included 149 Canadian local community service centers, and found the point prevalence of chronic wounds (including pressure ulcer, venous ulcer, and diabetic foot wound) among home care patients was 1.4%.[14] Using health insurance data, Kristina et al showed that 1.04 % of insured German patients had chronic wounds (including diabetic foot ulcer, pressure ulcer, and leg ulcer), and 0.43 % of them had leg ulcer which was the most common wounds in 2012.[15] Recently, Hall and Gray have conducted community-based multiservice, cross sectional surveys in the UK, found that the point prevalence of complex wounds was 1.47 ‰ in Leeds and 1.64 ‰ in the north of England, and amongst the most frequent wound type was leg ulcer.[1,10] The same survey was carried out in Slovenia and found that the point prevalence of open surgical wounds was 0.38 ‰.[4]

Epidemiological research on complex wounds in China is limited. In 1998, Fu screened 30,000 hospitalized surgical patients in 15 Chinese hospitals for chronic dermal ulcers, and found that the incidence of wounds was from 1.5% to 3.0%, with trauma and infection being the main causes.[16] In 2008, similar surveys were conducted in 17 tertiary hospitals in 14 Chinese provinces, showing the prevalence of chronic wounds was 1.69 per 1,000 inpatients and the leading causes were diabetes and trauma in inpatients.[17] As both studies focused only on specific hospitals, the results may not allow inference on the point prevalence of complex wounds for inpatients national wide. Furthermore these data are now over a decade old and changing population demographics may result in changes in estimates. In this study, we systematically analyzed hospital discharge data from Sichuan province during the fourth quarter of calendar year 2018, aiming to investigate the period prevalence of complex wounds among the overall inpatients, and the impact of complex wounds on inpatient health expense and length of hospital stay (LOS).

CONTEXT

The Chinese healthcare system is characterized by a three-tier delivery system. The rural three tier system comprises village clinics, township health centers (THCs), and county hospitals; while the urban regions have community health centers/stations (CHCs), city hospitals including district hospitals, and municipal/regional hospitals. Additionally, the county and city hospitals are classified into three levels – primary, secondary and tertiary –

with supposedly increasing quality based on their clinical quality, service quality, management quality, medical safety, and clinical skills and research.[18] THCs and CHCs are called primary healthcare institutions which mainly provide primary care and public health services. Whilst primary healthcare institutions have a gatekeeping role to reduce people directly accessing specialist hospital services, patients can still go directly to higher level hospitals for medical services without attending THCs or CHCs first. Thus, in China, hospitals *de facto* provide both primary and specialist care; a significant difference from most health care systems in developed countries. When people are discharged from healthcare institutions (primary healthcare institution or hospital), their discharge records, containing demographic details together with data about their diagnoses and medical care costs, are completed by the Chief Physician (see Appendix, Table A1). These administrative data provide an opportunity to study the number of people with complex wounds in more detail. To ensure that data from all relevant people were considered we included discharge data from all patients from primary healthcare institutions (THCs/CHCs) and from (primary/secondary/tertiary) hospitals.

In China, over 95% of residents have Social Health Insurance (New Cooperative Medical Scheme for the rural population; Urban Resident Basic Medical Insurance for the unemployed urban people; Urban Employee Basic Medical Insurance for urban workers) which covers access to all primary healthcare institutions and public hospitals, and some private hospitals.[19] The inpatient costs for people with Social Health Insurance consisted of two parts—out-of-pocket payments and insurance reimbursement, while almost all the outpatient cost are out-of-pocket. Hence this study assumed that most, if not all, patients with complex wounds would get inpatient service, instead of outpatient service from healthcare institutions.

This study focused on Sichuan province. The results from Sichuan are likely to be applicable to much of China. Sichuan is the fifth largest and the third most populous province in China (83.41 million people recorded in 2018). The distribution of economic development is uneven, the geographic environment is varied, and the composition of the population is diverse. West Sichuan is sparsely populated, mountainous with poor economic development, and east Sichuan is densely populated, plain with well economic development, more health care institutions (see Figure A1 in Appendix). This is roughly consistent with the overall situation in China.[20,21]

METHODS

Study population and data source

Between 1 September 2018 and 31 December 2018, a total of 4,033,763 people were admitted to 6,056 health care institutions across Sichuan province. All were included in this retrospective, data-based study. Individual-level information was extracted from discharge records provided by the Health Information Centre of Sichuan Province. When performing data analysis, all healthcare institutions were categorized based on their situation at the time of data collection (i.e. in calendar year 2018).

Classification of cases

All people admitted with complex wounds or who developed one or more complex wounds during their stay were identified according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) (see Table 1) and the

corresponding diagnosis in discharge records. This included people with pressure ulcers of Stage 2 or above,[22] ulcers in people with diabetes, venous leg ulcers, non-healing surgical wounds and other ulcers (leg ulcers, upper limb ulcers, skin ulcers, gangrene, infection of amputation stump). We did not include people with open, traumatic wounds or burns in this study.

[Insert Table 1 about here]

Statistical analysis

All analyses were performed using statistical analysis system R-3.5.1. All point prevalence estimates were produced using the binomial proportion and are presented alongside 95% confidence intervals (CIs). The inpatient point prevalence of complex wounds was estimated using the number of people with at least one wound (the numerator) and all inpatients as denominator. To get a crude estimate of the point prevalence of complex wounds in community-based population, this study assumed that all people with one or more complex wounds received inpatient service from healthcare institutions and the point prevalence of complex wounds for community-based population was estimated using people living in Sichuan at present and with at least one complex wound (the numerator) and the population of Sichuan in 2018[23] as the denominator.

When estimating the direct disease burden (median of length of stay (LOS) and medical costs) of complex wounds, only people whose principal cause of hospitalization (principal diagnosis) was the complex wound were included. Wilcox rank sum test and Kruskal-Wallis rank sum test were used to test if LOS and expense were statistically different between groups. We also extracted data on people whose principal cause of hospitalization was not the complex wound but who were recorded as having a complex wounds of relevance in this study as a comorbidity (i.e. though the patient did have one or more complex wound, their main reason for admission was not the wound), and compared their LOS and inpatient costs with patients without complex wounds to determine the additional effect of complex wounds on LOS and inpatient costs. Multivariable linear regression was fitted to control for potentially confounding factors which were documented. Since the confounders are multilevel in our study, we constructed a two-level hierarchical linear model, where level 1 covariables included the patient's age, gender, occupation, social insurance program, whether or not surgery was required, and Charlson Index (a widely used tool to measure comorbid disease status; a higher score equals worse health condition) adjusting for non-complex wound related comorbidity;[24] level 2 covariables included health care institution level type (tertiary hospital, secondary hospital, primary hospital, unassigned hospital, primary health care institution and others) and ownership type (public or private). Healthcare institutions were included as a random effect to account for the within institution correlation for patients admitted in the same institution.

To avoid the impact of incorrect records on disease burden estimates, when analyzing the effect of complex wounds on LOS and inpatient expense, observations were selected based on the following criteria: 1) the length of stay was at least one day; 2) the per capita inpatient expense was more than 100 CNY. Thus, ultimately 4,026,725 records were used for multivariable disease burden analysis.

RESULTS

Prevalence of complex wounds

A total of 16,426 cases of patients with complex wounds was identified from the records of 4,033,763 patients during the fourth quarter of calendar year 2018. The point prevalence of complex wounds was 4.07 per 1,000 of inpatients (95% CI: 4.01 to 4.13) and 0.19 per 1,000 of the whole population in Sichuan province (95% CI: 0.19 to 0.20) (Table 2). It should be noted that this prevalence is likely underestimated as it is almost certain that not all patients with complex wounds had been admitted. Pressure ulcers were the most common complex wound with a point prevalence of 1.47 per 1,000 of inpatients (95% CI: 1.43 to 1.50) and 0.07 per 1,000 of the whole population (95% CI: 0.07 to 0.07).

[Insert Table 2 about here]

Table 3 shows the point prevalence estimates for all complex wounds by demographic characteristics. Most inpatients with complex wounds were aged between 60 and 79 years old. The prevalence of complex wounds amongst inpatients increased with age, and was lowest in patients younger than 10 and highest in patients over 90. Males had higher point prevalence estimate (5.05 per 1,000 with 95% CI 4.95 to 5.15) than females (3.19 per 1,000 with 95% CI 3.12 to 3.27). Prevalence was higher for Han (Chinese) than ethnic minorities at 4.17 per 1,000 (95% CI: 4.11 to 4.23) compared with 2.28 per 1,000 (95% CI: 2.08 to 2.49). Of the 16,426 patients with complex wounds, most were agricultural labors from rural areas, and the highest point prevalence estimate occurred in retired people with 10.24 per 1,000 (95% CI: 9.80 to 10.71). After adjusting for age, the prevalence of complex wounds was still significantly different by gender (likelihood ratio test: $P< 0.001$), ethnicity (likelihood ratio test: $P< 0.001$) and occupation (likelihood ratio test: $P< 0.001$).

[Insert table 3 and 4 about here]

Figure 1 shows the point prevalence estimates with 95% confidence intervals for individual complex wound types by demographic characteristics. Prevalence rates for individual wound types increased with age except for venous leg ulcers and non-healing surgical wounds whose highest rates occurred in 60-69 (0.50 per 1,000; 95% CI: 0.45 to 0.55) and 50-59 years old (1.45 per 1,000; 95% CI: 1.36 to 1.56) respectively. The highest point prevalence rates for pressure ulcers, diabetic ulcers and other ulcers were found in patients aged 90 years and over, which were 13.48 per 1,000 (95% CI: 12.30 to 14.78), 1.68 per 1,000 (95% CI: 1.30 to 2.18), 1.56 per 1,000 (95% CI: 1.19 to 2.05), respectively. Children younger than 10 were the least likely to have any complex wounds. Pressure ulcers are the most prevalent complex wound of those studied while venous leg ulcers are the least common, and females have much lower prevalence of all kinds of wounds than males. Prevalence rates for individual wound types were higher for Han (Chinese) than ethnic minorities except for non-healing surgical wounds. The prevalence for individual complex wound types are highly different in occupation groups. The highest prevalence for pressure ulcer (5.89 per 1,000; 95% CI: 5.56 to 6.25) and diabetic ulcer (2.56 per 1,000; 95% CI: 2.35 to 2.80) both occurred in retired patients. Venous leg ulcer, non-healing surgical wounds and other ulcer were most common in agricultural labourers (0.34 per

1,000; 95% CI: 0.31 to 0.36), office clerks (1.47 per 1,000; 95% CI: 1.26 to 1.73), and freelancers (0.78 per 1,000; 95% CI: 0.63 to 0.98), respectively.

[Insert Figure 1 about here]

Disease burden

Table 4 shows the central tendency and dispersion of per capita hospital LOS and medical costs for inpatients whose principal diagnosis was a complex wound. The median per capita LOS was 12 days (IQR: 7 to 22), which is significantly longer than the median per capita LOS for all inpatient in Sichuan (median: 7 days; IQR: 4 to 10; P<0.001). The median per capita medical cost for people with a complex wound was 6,500.18 CNY (IQR: 2,965.92 to 1,2975.23); nearly double the care costs of inpatients without complex wounds (median: 3,337.16; IQR: 1,759.02; 6,703.08; P<0.001). Patients with a principal diagnosis of pressure ulcer had the longest LOS (median: 20 days; IQR: 9 to 34). The median per capita LOS for patients whose principal diagnosis was diabetic ulcer, venous leg ulcer, surgical ulcer or other ulcer were 13 days (IQR: 7 to 22), 9 days (IQR: 7 to 14), 11 days (IQR: 7 to 20) and 13 days (IQR: 7 to 24) respectively (P<0.001). Diabetic ulcers costed the most among all types of complex wounds in this study, with a median per capita medical expense of 8,399.13 CNY (IQR: 3,435.24 to 16,267.55) followed by pressure ulcers (median: 8,039.12; IQR: 3,693.78 to 17,022.96) (P<0.001).

[Insert Table 4 about here]

Table 5 shows the comorbidity of inpatients included in this study. People with complex wounds averagely have higher Charlson Index (more serious comorbidities) than people without at 1.87 compared with 0.82 (P <0.001). People with diabetic ulcers have the most serious comorbidities (Charlson Index: 3.08), followed by people with pressure ulcers (Charlson Index: 2.38), as compared with people having other complex wounds or without any complex wounds.

[Insert Table 5 about here]

For patients with a complex wound which was not considered the main cause of hospitalization, *ceteris paribus*, the LOS was on average 47.7% (exp(0.39)-1) longer than the LOS for patients without complex wounds (first column of Table 6); the inpatient medical cost was also 60.0% (exp(0.47)-1) higher on average (second column of Table 6). Compared with patients without complex wounds, the presence of a complex wound was associated with increased LOS and increased costs. After controlling for severity of comorbidities and other confounders, we found people with non-healing surgical wounds alongside another main reason for hospital admission had the longest LOS and highest costs: with a LOS 155.7% (exp(0.939)-1) higher and inpatient cost 124.8% (exp(0.81)-1) greater compared with those without complex wounds or with other types of complex wounds (pressure ulcers, venous leg ulcers or other ulcers) (the third and fourth column of Table 6).

[Insert Table 6 about here]

DISCUSSION

Complex wounds are a challenging public health problem.[25] In this study, we used three months of hospital discharge data from Sichuan province, China, and included all the healthcare institutions providing inpatient service in 2018. Our aim was to acquire more reliable estimates of the complex wound disease burden for inpatients. To identify patients with complex wounds more accurately, disease diagnosis and ICD-10 were used simultaneously.

This study discovered that the point prevalence of complex wounds among inpatients was 4.07 per 1,000, which is much higher than the earlier estimate from the 17 tertiary hospitals in China (1.69 per 1,000 inpatients).[17] Pressure ulcers were found to be the most common type of complex wound; similar to the result of an Irish study focusing on community care setting,[26] a two-week cross sectional survey in Leeds,[1] and Dutch study focusing on nursing homes.[5] Our point prevalence estimate of pressure ulcers among inpatients (1.47 per 1,000) is much lower than that of Indonesian inpatients (8.0%), and German inpatients (2.25%).[27,28] Assuming all patients with complex wounds got inpatient service from healthcare institutions, we have crudely estimated the point prevalence of complex wounds among community-based population in Sichuan (0.19 per 1,000). This rate is significantly lower than the estimates in previous studies which ranging from 0.04% to 1%.[25]

Many studies have previously shown that the prevalence of complex wounds is higher in older people[1,4,29], and our point prevalence rates of most complex wounds (including pressure ulcers, diabetic and other ulcers) are consistent with the highest rates occurring in age 90+ age group. It is worth noting that the highest rates of venous leg ulcers and non-healing surgical wounds occurred in age 60-69 and 50-59 groups respectively. For non-healing surgical wounds, this may due to the preference of conservative treatment for elderly population in China. For venous leg ulcers, the reason of this point prevalence peak in this age group requires further investigation.

This study also found that females have lower rates of complex wounds in China than males, which is consistent with previous study conducted in China and Slovenia,[4,16,17] but different from the UK[1,10] – which showed that females are more likely to suffer from complex wounds.[30] The difference may be partially explained by differences in occupational and lifestyle activities with heavy labor and activities such as smoking being more common in older men than women of the same age. Due to rapidly improving working environments and other risk factor related activities there may be a shift in these gender differences for wound point prevalence over subsequent generations. .

This study found that where complex wounds was the major reason for hospital admission people had a significantly longer hospital LOS and higher medical costs than for all-cause admission in Sichuan. This is the first investigation of this kind in China. For patients who were admitted to health care institutions mainly for pressure ulcer, the LOS was longer than other complex wounds. Pressure ulcers often occur in people with limited mobility due to physical or cognitive impairment, and people with pressure ulcers were more likely to have serious co-morbidities. The relatively poor psychological, behavioral and cognitive status of these patients may prolong the treatment period. The longest LOS may also partially explain why the median of per capita medical expense for those admitted with a pressure ulcer is higher

than for people being admitted for most other types of complex wounds. Among all the complex wound types in this study, people with diabetes and one or more ulcers incurred the most medical costs with a median per capita medical expense of 8,399.13 CNY. Again these were people commonly effected by a range of other co-morbidities and who also required the use of blood glucose controlling drugs. Considering that the average yearly disposable income of Sichuan province is 20,580 CNY, this is a significant economic pressure to these patients. Median medical costs show similar trends, while differences between median and average costs likely reflects different basic costs of them. We also found that LOS and costs for people with complex wounds for whom this was not their principal diagnosis were higher when compared with patients without complex wounds. These data provide us a scope for further in-depth investigation and a hint for designing better prevention and financial support system for patients in China.

Strengths and limitations

This geographically defined study is the first to report the prevalence of complex wounds in inpatients in China using data from all health care institutions providing inpatient services during the study period. It is also the first to quantify disease burden of complex wounds in China. Both disease code (ICD-10) and disease diagnosis were used to make sure that complex wounds were correctly identified and classified.

This study also had some limitations. The estimates of prevalence may be underestimated. When estimating the prevalence of complex wounds for inpatients, this study was unable to identify the patients who may have had complex wounds that were not recorded in discharge records. This is also the case for patients with certain other illnesses or systematic problems, which may contribute to increased medical costs due to their links to the wounds. The point prevalence of complex wounds for the whole population in Sichuan does not capture the information of people who may have complex wounds but receive care at outpatient sectors or/and do not receive inpatient care during the study period but are “self-treating”. Further research in this area could pay attention to this under-studied population.

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Contributors

ZL and JP conceived the idea and design for this study; ZL and QL were responsible for data analysis; JP, JD and NC contributed to data analysis; QL created the original draft of this manuscript. All authors contributed to the interpretation of the findings, critical version of the manuscript.

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Competing interest statement

The authors declare that they have no competing financial interests.

Patient consent for publication

Not required.

Patient and Public Involvement

No patient involved.

Provenance and peer review

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Data sharing statement

All data relevant to the study are included in the article or uploaded as supplementary information.

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Table 1. ICD-10 classification associated with complex wounds

Wound types	Identifying methods
Pressure ulcer	Code L89.-, excepting grade one pressure ulcer coded L89.000
Diabetic ulcer	1) code E10.504, E11.504, E14.501, E10.505, E11.505 2) code E11.502 with the corresponding diagnosis containing "gangrene" 3) E14.606, E11.601, E11.503, E10.503, BD54 excepting these whose Wagner classification is level zero. 1) or 2) or 3)
Venous leg ulcer	Code I83.0-, I83.2-
Non-healing surgical wound	1) code T81.3- 2) code T81.4- excepting biliary tract infection after surgery coded T81.404 3) code T81.8- excepting abdominal pain after surgery 1) or 2) or 3)
Other ulcer	Code L97.-, L98.4-, R02, T87.4-, T87.5-

Table 2. Wounds point prevalence estimates by wounds type

Wounds type	Frequency	Point prevalence per 1,000	95% CI
Inpatient point prevalence [a]			
All Wounds	16,426	4.07	(4.01, 4.13)
Pressure ulcers	5,915	1.47	(1.43, 1.50)
Diabetic ulcers	3,269	0.81	(0.78, 0.84)
Venous leg ulcers	1,139	0.28	(0.27 0.30)
Non-healing surgical wounds	4,090	1.01	(0.98, 1.05)
Other ulcer	2,013	0.50	(0.48, 0.52)
Point prevalence in community-based population [b]			
All Wounds	16,086	0.19	(0.19, 0.20)
Pressure ulcers	5,842	0.07	(0.07, 0.07)
Diabetic ulcers	3,230	0.04	(0.04, 0.04)
Venous leg ulcers	1,116	0.01	(0.01, 0.01)
Non-healing surgical wounds	3,936	0.05	(0.05, 0.05)
Other ulcers	1,962	0.02	(0.02, 0.03)

[a]. Using the total number of inpatient in Sichuan province during the fourth quarter of calendar year 2018 as denominator.

[b]. Using inpatients who were living in Sichuan at present and have at least one wounds we defined as the numerator and the population of Sichuan in 2018 as the denominator.

Table 3. Inpatient wounds point prevalence estimates by demographic characteristics

Variable	Patients with wounds	Total patients	Point prevalence per 1,000 [a]	95% CI
Age group [b]				
0-9	95	423,706	0.22	(0.18, 0.27)
10-19	171	98,270	1.74	(1.50, 2.02)
20-29	462	293,458	1.57	(1.44, 1.72)
30-39	584	281,722	2.07	(1.91, 2.25)
40-49	1,569	480,648	3.26	(3.12, 3.43)
50-59	2,489	571,865	4.35	(4.19, 4.53)
60-69	3,763	835,686	4.50	(4.36, 4.65)
70-79	3,885	715,667	5.43	(5.26, 5.60)
80-89	2,825	299,432	9.44	(9.10, 9.79)
90+	583	33,309	17.50	(16.15, 18.97)
Gender				
Male	9,676	1,916,399	5.05	(4.95, 5.15)
Female	6,746	2,114,331	3.19	(3.12, 3.27)
Missing	4	3,033	1.32	(0.51, 3.39)
Ethnic Group				
Minority	471	206,921	2.28	(2.08, 2.49)
Han	15,955	3,826,844	4.17	(4.11, 4.23)
Occupation				
Civil servants & active army	88	20,341	4.33	(3.51, 5.33)
Professionals & technical	96	33,195	2.89	(2.37, 3.53)
Office clerk & manager	347	103,284	3.36	(3.03, 3.73)
Worker	356	82,198	4.33	(3.91, 4.80)
Agricultural labourer	6,284	1,816,499	3.46	(3.38, 3.55)
Student	133	103,659	1.28	(1.08, 1.52)
Freelancer	427	98,469	4.34	(3.95, 4.77)
Self-employed	63	19,021	3.31	(2.59, 4.24)
Unemployed	491	124,972	3.93	(3.60, 4.29)
Retired	1,934	188,829	10.24	(9.80, 10.71)
Others	6,207	1,443,296	4.30	(4.20, 4.41)

[a]. Using the total number of inpatient people in Sichuan province during the fourth quarter of calendar year 2018.

[b]. Continuous variable was transferred to 10-year age categories manually.

Table 4. Disease burden of complex wounds

Wounds type	Frequency [a]	LOS (days) [b]		Per capita inpatient cost (CNY) [b]	
		Mean± SD	Median (IQR)	Mean± SD	Median (IQR)
All wounds	5,048	18± 22	12 (7; 22)	11,347.54± 16,715.62	6,500.18 (2,965.92; 1,2975.23)
Pressure ulcers	583	31± 41	20 (9; 34)	15,852.69± 23,630.01	8,039.12 (3,693.78; 17,022.99)
Diabetic ulcers	843	18± 23	13 (7; 22)	13,528.74± 17,966.84	8,399.13 (3,435.24; 16,267.55)
Venous leg ulcers	903	12± 8	9 (7; 14)	8,865.53± 6,866.72	7,496.02 (4,063.37; 11,388.46)
Non-healing surgical wounds	1,639	16± 17	11 (7; 20)	10,071.35± 15,240.53	4,954.22 (2,316.53; 10,774.30)
Other ulcers	1,080	18± 19	13 (7; 24)	11,225.03± 18,425.64	6,152.69 (3,011.88; 13,719.34)

[a] Only patient whose principal cause of hospitalization was the complex wound were included in this table.

[b] mean with standard deviation (SD) and median with inter-quantile range (IQR) were presented.

Table 5. Comorbidities of people with complex wounds

Group	Charlson Index	
	Mean±SD	Median (IQR)
Patients without complex wounds	0.82±1.29	0 (0;1)
Patients with complex wounds	1.87±1.93	1 (0;3)
Pressure ulcers	2.38±1.86	2 (1;3)
Diabetic ulcers	3.08±1.97	3 (1;4)
Venous leg ulcers	0.51±1.03	0 (0;1)
Non-healing surgical wounds	0.91±1.46	0 (0;2)
Other ulcers	1.17±1.58	1 (0;2)

Table 6. Two-level hierarchical model results

Explaining variables	*Dependent variable*			
	log(LOS)	log(expense)	log(LOS)	log(expense)
	(1)	(2)	(3)	(4)
Complex wounds (*vs NO*)	0.39***	0.47***		
	(0.01)	(0.01)		
Wounds type (vs patients without complex wounds)				
Pressure ulcers			0.23***	0.48***
			(0.01)	(0.01)
Diabetic ulcers			0.18***	0.19***
			(0.01)	(0.01)
Venous leg ulcers			0.27***	0.14**
			(0.04)	(0.04)
Non-healing surgical wounds			0.94***	0.81***
			(0.01)	(0.01)
Other ulcers			0.38***	0.33***
			(0.02)	(0.02)
Observations [a]	4,021,677	4,021,677	4,021,677	4,021,677

Note: Cells contain coefficient (and standard error). *p <0.05, **p<0.01, ***p<0.001. All models had adjusted for patient's age (continuous, years), gender (male, female or missing), occupation (11 categories: Civil Servants & active army, professionals & technical, office clerk & manager, worker, agricultural labourer, student, freelancer, self-employed, unemployed, retired, others), social insurance program (four categories: Urban Employee Basic Medical Insurance, Urban Resident Basic Medical Insurance, New Rural Cooperative System), whether or not surgery was required (yes or no), Charlson Index (continuous, adjusting for comorbidity), health care institution level (six categories: primary hospitals, secondary hospitals, tertiary hospitals, unassigned hospitals, primary health care sectors, other providers) and ownership type (public or private). The full results were displayed in table A2 in appendix.

a. Only patients whose principal cause of hospitalization was not complex wound were selected to fit the two-level hierarchical models.

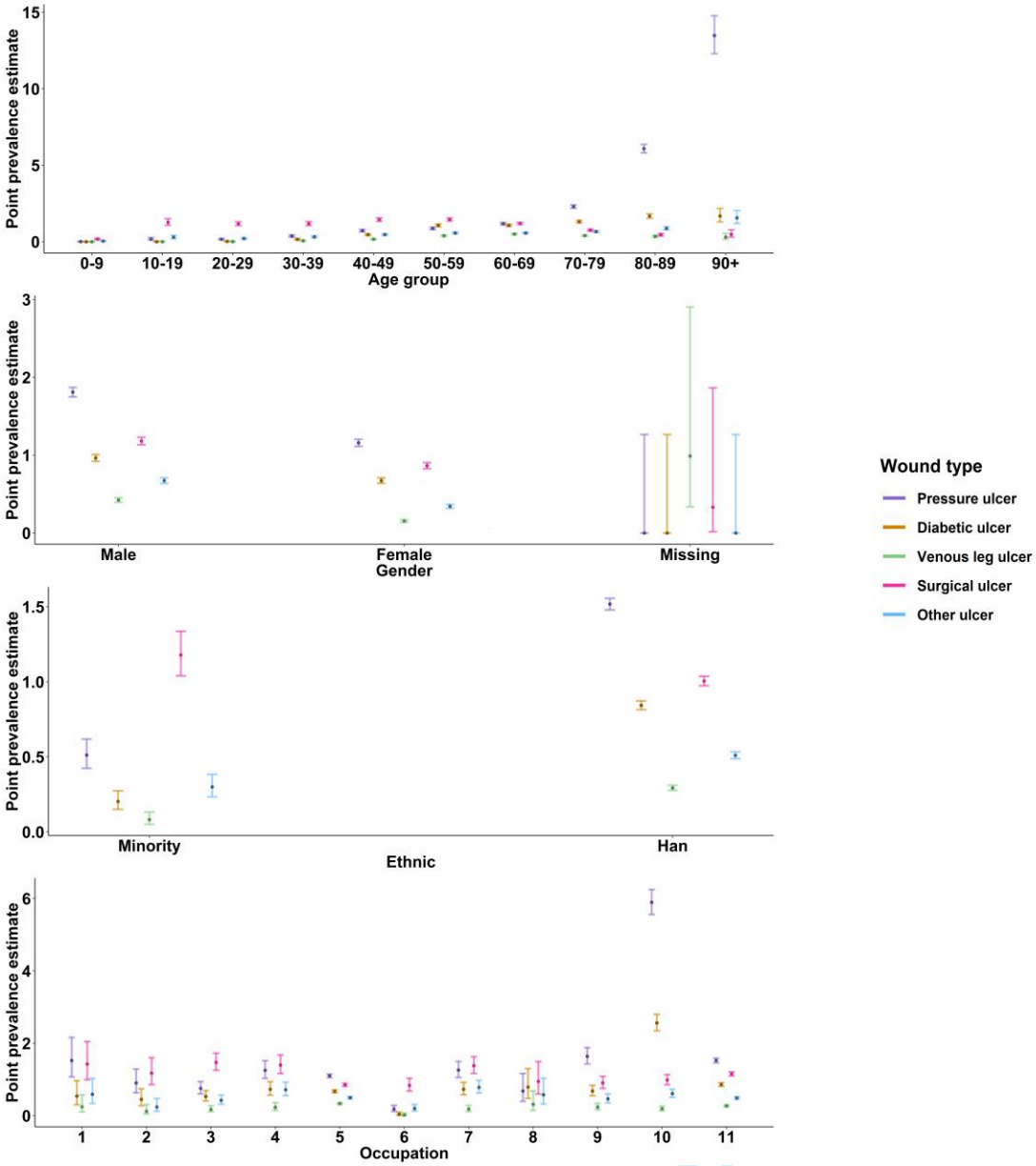

Figure 1. Inpatient wounds point prevalence estimates by wound types and demographic characteristics

Note: Point estimates with 95% confidence intervals were displayed in this figure. Occupation 1: Civil Servants and active army; 2: Professionals and technical; 3: Office clerk and manager; 4: Worker; 5: Farmer; 6: Student; 7: Freelancer; 8: Self-employed; 9: Unemployed; 10: Retired; 11: Others. Exact data was showed in table A1 in appendix.

APPENDIX

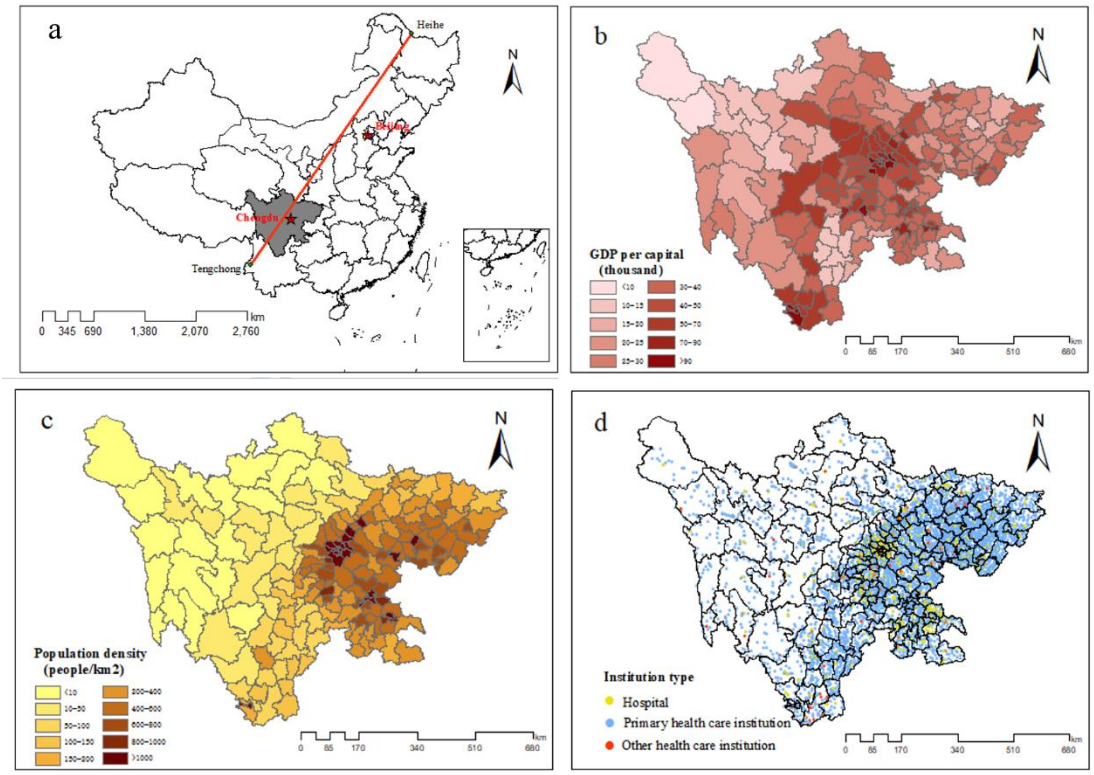

Figure A1. Characters of Sichuan province.

(a) Geographic position of Sichuan; (b) Per capital GDP among counties in 2017; (c) Population density among counties in 2017; (d) Distribution of health care institutions in 2018.

Table A1. Ghost table for discharge data

Home page of inpatient record

Year _____

Name of Hospital_____ (Organization code: □□□□□□□□ – □)

Number of Health Card: Hospitalization count: Patient's identification number:

Name _____ **Gender** □ 1.M 2. F **Birthday**_____ **Age**_____
Nationality _____ **Neonatal birth weight**_____g **Neonatal admission weight**_____g
Birthplace _____ **Native place**_____ **Ethnic group** _____
ID number_____ **Occupation**_____ **Marital status** _____
Present address _____ **Tel**_____**Post code**_____
Registered address_____**Post code**_____
Work address_____**Office Tel**_____**Post code**_____
Contact person _____ **Relationship** _____ **Address**_____**Tel**_____
Admission type □ 1. emergency 2. outpatient clinic
3.Referred from other institutions and its name is_____ 9. others
Admission time_____year____month____day____hour___minute
Hospital department_____ **Inpatient ward number**_____ **The department the patient transferred to is**_____
Discharge time_____year____month____day____hour___minute
Diagnosis in outpatient (emergency) department_____ **ICD-10**_____
Health status at admission □1. critically ill 2. acute 3. ordinary
Diagnosis at admission_____ **ICD-10**_____ **Date of making the principal diagnosis**_____
Whether the patient was critically ill during hospitalization □ 1.yes 2.no

Diagnosis on Discharge	ICD-10	Disease status at admission (DSA)	Disease status on discharge (DSD)
Principal diagnosis:			
Other diagnosis:			

DSA: 1.yes 2.clinically undetermined 3.unclear 4.no **DSD:** 1.cured 2.improved 3.not cured 4.deceased 5.others

Cause of injury/poisoning_____**ICD-10**_____

pathological diagnosis: _____**ICD-10**_____**Pathological examination number**_____

TNM stage: □1.I 2.II 3.III 4.IV

drug allergy □1.no 2.yes, and the allergic drug is: _____ **Autopsy of deceased patient** □ 1.yes 2.no

Blood type □ 1. A 2.B 3.O 4.AB 5.unclear 6. unchecked
Rh □1. negative 2. positive 3. unclear 4. unchecked

Follow up clinic □ 1.yes 2.no **Follow-up period** _____

Section director's name_____ **Chief doctor**_____ **Attending doctor**_____ **Visiting staff**_____
Resident doctor _____**Primary nurse**_____ **Refresher doctor**_____**Intern**_____ **coder**_____

The quality of medical record □ 1. high 2.medium 3.low **Quality control doctors**_____
Quality control nurses_____ **Date of making quality control**_____

Prophylactic use of antimicrobial drugs for primary surgical incision □ 1.yes 2.no
Duration(hours): _____ **Drug combination □1.yes 2.no**

Surgery code	time	level	Name of the operation	Operating Doctor			Wound healing grade	anesthesia	Anesthesiologists
				Operator	Assistant 1	Assistant II			
							/		
							/		
							/		
							/		
							/		
							/		
							/		
							/		

Clinical pathway management □1.yes 2.no **Complete clinical pathway** □1.yes 2.no, and the reason is_____
Variation □ 1.yes 2.no; the reason is: _____

Discharge type □
1 Discharge on doctor's orders
2.Be referred to a superior hospital, and its name is_____
3.Be referred to primary health institution(THC/CHC), and its name is_____
4.Leave hospital without medical advice 5.dead 9.others

Does she/he has the plan to be readmitted within 31 days □ 1.no 2.yes, and the reason is_____

How long did the craniocerebral injury patient remain in a coma:
Before admission, she/he was in coma for _____minutes
After admission, she/he was in coma for_____minutes

Whether the patient was readmitted for the same disease □1.yes 2.no
How long has it been since the last discharge? _____days

Inpatient expense (yuan): Total expense_____ (out-of-pocket payment: ___others: _____)
1. Comprehensive medical services:
(1) General medical service expense: _____ (2) General treatment expense: _____
(3) Nursing expense: _____ (4) Other expense: _____
2.Diagnosis: (5) Pathological diagnosis: _____ (6) laboratory diagnosis: _____
(7) Imaging diagnosis: _____ (8) Clinical diagnosis: _____
3.Treatment: (9) Non-surgical treatment: _____ (Clinical physiotherapy: _____)
(10) Surgical treatment expense: _____ (Anesthetic expense: _____ Operation: _____)
4.Recovery: (11) Recovery expense: _____
5.Traditional Chinese treatment: (12) Traditional Chinese treatment expense: _____
6.Western medicine: (13) Western medicine expense: _____ (Antimicrobial expense: _____)
7. Traditional Chinese medicine (TCM):
(14) Proprietary Chinese medicine expense_____ (15) Chinese herbal medicine expense: _____
8. Blood and blood products: (16) Blood expense: _____ (17) Albumin products: _____
(18) Globulin products: ____ (19) Hemagglutinin sub products: ____ (20) Subclass of cytokines: _____
9. Consumable materials: (21) Disposable medical materials for inspection: _____
(22) Disposable medical materials for treatment: _____
(23) Disposable medical materials for surgery: _____
10.Others: (24) Other expense: _____

Table A2. Full results of two-level hierarchical models

Explaining variables	*Dependent variable*			
	log(LOS)	log(expense)	log(LOS)	log(expense)
	(1)	(2)	(3)	(4)
Wounds	0.390***	0.472***		
	(0.006)	(0.006)		
Wounds type (vs patients without complex wounds)				
Pressure ulcers			0.233***	0.484***
			(0.009)	(0.009)
Diabetic ulcers			0.183***	0.194***
			(0.014)	(0.013)
Venous leg ulcers			0.268***	0.137**
			(0.044)	(0.042)
Non-healing surgical wounds			0.939***	0.807***
			(0.013)	(0.013)
Other ulcers			0.380***	0.333***
			(0.020)	(0.019)
Age (year)	0.003***	0.008***	0.003***	0.008***
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Gender (vs male)				
Female	-0.061***	-0.056***	-0.061***	-0.056***
	(0.001)	(0.001)	(0.001)	(0.001)
Missing	-0.055***	-0.061***	-0.055***	-0.061***
	(0.015)	(0.014)	(0.015)	(0.014)
Charlson Index	0.075***	0.116***	0.075***	0.116***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Social insurance program (vs UEBMI) [a]				
URBMI	-0.059***	-0.036***	-0.059***	-0.036***
	(0.001)	(0.001)	(0.001)	(0.001)
NRCMS	-0.078***	-0.036***	-0.078***	-0.036***
	(0.002)	(0.002)	(0.002)	(0.002)
Others	-0.127***	-0.078***	-0.127***	-0.078***
	(0.001)	(0.001)	(0.001)	(0.001)
Occupation (vs Civil Servants & active army) [b]				
Professionals & technical	-0.055***	-0.031***	-0.055***	-0.031***
	(0.006)	(0.006)	(0.006)	(0.006)

Office clerk & manager	-0.057***	-0.024***	-0.057***	-0.024***
	(0.005)	(0.005)	(0.005)	(0.005)
Worker	0.013*	0.050***	0.013*	0.050***
	(0.005)	(0.005)	(0.005)	(0.005)
Agricultural labor	-0.006	0.050***	-0.006	0.050***
	(0.005)	(0.005)	(0.005)	(0.005)
Student	-0.051***	-0.100***	-0.050***	-0.100***
	(0.005)	(0.005)	(0.005)	(0.005)
Freelancer	-0.057***	-0.001	-0.057***	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Self-employed	-0.051***	-0.017*	-0.051***	-0.017*
	(0.007)	(0.007)	(0.007)	(0.007)
Unemployed	-0.048***	-0.014**	-0.048***	-0.014**
	(0.005)	(0.005)	(0.005)	(0.005)
Retired	0.062***	0.030***	0.062***	0.030***
	(0.005)	(0.005)	(0.005)	(0.005)
Others	0.004	0.021***	0.005	0.021***
	(0.005)	(0.005)	(0.005)	(0.005)
Whether or not surgery was required (vs No)				
Surgery (Yes)	0.127***	0.714***	0.126***	0.714***
	(0.001)	(0.001)	(0.001)	(0.001)
Health care institution levels (vs primary hospital)				
Secondary hospital	0.067	0.443***	0.067	0.443***
	(0.035)	(0.043)	(0.035)	(0.043)
Tertiary hospital	-0.190***	0.681***	-0.190***	0.681***
	(0.049)	(0.061)	(0.049)	(0.061)
Unassigned hospital	0.055	0.168***	0.055	0.168***
	(0.028)	(0.035)	(0.028)	(0.035)
Primary healthcare sector	-0.456***	-0.825***	-0.456***	-0.825***
	(0.036)	(0.045)	(0.036)	(0.045)
Other providers	-0.548***	0.014	-0.547***	0.014
	(0.048)	(0.059)	(0.048)	(0.059)
Ownership type (vs private)				
Public	0.222***	-0.041	0.222***	-0.041
	(0.027)	(0.034)	(0.027)	(0.034)

Missing	0.171*	-0.325***	0.172*	-0.325***
	(0.067)	(0.083)	(0.067)	(0.083)
Constant	1.848***	7.337***	1.848***	7.337***
	(0.025)	(0.031)	(0.025)	(0.031)
Observations	4,021,677	4,021,677	4,021,677	4,021,677

Note: Cells contain coefficient (and standard error). *p <0.05, **p<0.01, ***p<0.001.

[a]. UEBMI (Urban Employee Basic Medical Insurance); URBMI (Urban Resident Basic Medical Insurance); NRCMS (New Rural Cooperative System).

[b]. Occupations with too small a sample were merged with similar occupations.

Table A3. Inpatient wounds point prevalence estimates by wound types and demographic characteristics

Variable	Pressure ulcers		Diabetic ulcers		Venous leg ulcers		Non-healing surgical wounds		Other ulcers	
	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)
Age group										
0-9	4	0.009 (0.004, 0.024)	0	0.000 (0.000, 0.009)	0	0.000 (0.000, 0.009)	73	0.172 (0.137, 0.217)	18	0.042 (0.027, 0.067)
10-19	17	0.173 (0.108, 0.277)	0	0.000 (0.000, 0.039)	0	0.000 (0.000, 0.039)	125	1.272 (1.068, 1.515)	29	0.295 (0.205, 0.424)
20-29	48	0.164 (0.123, 0.217)	7	0.024 (0.012, 0.049)	2	0.007 (0.002, 0.025)	344	1.172 (1.055, 1.303)	61	0.208 (0.162, 0.267)
30-39	104	0.369 (0.305, 0.447)	43	0.153 (0.113, 0.206)	17	0.060 (0.038, 0.097)	331	1.175 (1.055, 1.308)	89	0.316 (0.257, 0.389)
40-49	347	0.722 (0.650, 0.802)	221	0.460 (0.403, 0.525)	81	0.169 (0.136, 0.209)	695	1.446 (1.342, 1.557)	225	0.468 (0.411, 0.533)
50-59	498	0.871 (0.798, 0.951)	611	1.068 (0.987, 1.157)	223	0.390 (0.342, 0.445)	831	1.453 (1.358, 1.555)	326	0.570 (0.511, 0.635)
60-69	983	1.176 (1.105, 1.252)	891	1.066 (0.998, 1.138)	415	0.497 (0.451, 0.547)	997	1.193 (1.121, 1.269)	477	0.571 (0.522, 0.624)
70-79	1,643	2.296 (2.188, 2.409)	939	1.312 (1.231, 1.399)	287	0.401 (0.357, 0.45)	542	0.757 (0.696, 0.824)	474	0.662 (0.605, 0.725)
80-89	1,822	6.085 (5.813, 6.370)	501	1.673 (1.533, 1.826)	104	0.347 (0.287, 0.421)	136	0.454 (0.384, 0.537)	262	0.875 (0.775, 0.987)

90+	449	13.480 (12.296, 14.776)	56	1.681 (1.295, 2.182)	10	0.300 (0.163, 0.553)	16	0.480 (0.296, 0.780)	52	1.561 (1.191, 2.046)
Gender										
Male	3,466	1.809 (1.749, 1.870)	1,848	0.964 (0.921, 1.009)	810	0.423 (0.395, 0.453)	2,263	1.181 (1.133, 1.230)	1,289	0.673 (0.637, 0.710)
Female	2,449	1.158 (1.113, 1.205)	1,421	0.672 (0.638, 0.708)	326	0.154 (0.138, 0.172)	1,826	0.864 (0.825, 0.904)	724	0.342 (0.318, 0.368)
Missing	0	0.000 (0.000, 1.265)	0	0.000 (0.000, 1.265)	3	0.989 (0.336, 2.904)	1	0.330 (0.017, 1.865)	0	0.000 (0.000, 1.265)
Ethnic group										
Minority	106	0.512 (0.424, 0.619)	42	0.203 (0.150, 0.274)	17	0.082 (0.051, 0.132)	244	1.179 (1.040, 1.337)	62	0.300 (0.234, 0.384)
Han	5,809	1.518 (1.479, 1.557)	3,227	0.843 (0.815, 0.873)	1,12 2	0.293 (0.277, 0.311)	3,846	1.005 (0.974, 1.037)	1,951	0.510 (0.488, 0.533)
Occupation										
Civil Servants & active army	31	1.524 (1.074, 2.162)	11	0.541 (0.302, 0.968)	5	0.246 (0.105, 0.575)	29	1.426 (0.993, 2.047)	12	0.590 (0.338, 1.031)
Professionals & technical	30	0.904 (0.633, 1.290)	15	0.452 (0.274, 0.745)	4	0.121 (0.047, 0.310)	39	1.175 (0.86, 1.606)	8	0.241 (0.122, 0.476)
Office clerk & manager	78	0.755 (0.605, 0.942)	55	0.533 (0.409, 0.693)	18	0.174 (0.11, 0.275)	152	1.472 (1.256, 1.725)	44	0.426 (0.317, 0.572)
Worker	103	1.253 (1.033, 1.519)	60	0.730 (0.567, 0.939)	19	0.231 (0.148, 0.361)	115	1.399 (1.166, 1.679)	59	0.718 (0.557, 0.926)
Agricultural labor	1,999	1.100 (1.053, 1.150)	1,226	0.675 (0.638, 0.714)	608	0.335 (0.309, 0.362)	1,549	0.853 (0.811, 0.896)	902	0.497 (0.465, 0.53)

Student	19	0.183 (0.117, 0.286)	4	0.039 (0.015, 0.099)	2	0.019 (0.005, 0.07)	87	0.839 (0.681, 1.035)	21	0.203 (0.133, 0.31)
Freelancer	124	1.259 (1.056, 1.501)	72	0.731 (0.581, 0.921)	18	0.183 (0.116, 0.289)	136	1.381 (1.168, 1.633)	77	0.782 (0.626, 0.977)
Self-employed	13	0.683 (0.399, 1.169)	15	0.789 (0.478, 1.301)	6	0.315 (0.145, 0.688)	18	0.946 (0.599, 1.495)	11	0.578 (0.323, 1.035)
Unemployed	205	1.640 (1.431, 1.881)	85	0.680 (0.550, 0.841)	30	0.240 (0.168, 0.343)	113	0.904 (0.752, 1.087)	58	0.464 (0.359, 0.600)
Retired	1,113	5.894 (5.559, 6.250)	484	2.563 (2.345, 2.802)	36	0.191 (0.138, 0.264)	186	0.985 (0.853, 1.137)	115	0.609 (0.507, 0.731)
Others	2,200	1.524 (1.462, 1.589)	1,242	0.861 (0.814, 0.910)	393	0.272 (0.247, 0.301)	1,666	1.154 (1.100, 1.211)	706	0.489 (0.454, 0.527)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Yes
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Yes
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Yes
Objectives	3	State specific objectives, including any prespecified hypotheses Yes
Methods		
Study design	4	Present key elements of study design early in the paper Yes
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Yes
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants Yes
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Yes
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Yes
Bias	9	Describe any efforts to address potential sources of bias Yes
Study size	10	Explain how the study size was arrived at Yes
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Yes
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Yes
		(*b*) Describe any methods used to examine subgroups and interactions Yes
		(*c*) Explain how missing data were addressed Yes
		(*d*) If applicable, describe analytical methods taking account of sampling strategy NA
		(*e*) Describe any sensitivity analyses NA
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Yes
		(b) Give reasons for non-participation at each stage NA
		(c) Consider use of a flow diagram NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Yes
		(b) Indicate number of participants with missing data for each variable of interest Yes
Outcome data	15*	Report numbers of outcome events or summary measures Yes
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Yes

		(*b*) Report category boundaries when continuous variables were categorized Yes
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Yes
Discussion		
Key results	18	Summarise key results with reference to study objectives Yes
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Yes
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Yes
Generalisability	21	Discuss the generalisability (external validity) of the study results Yes
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Yes

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Epidemiology and disease burden of complex wounds for inpatients in China: an observational study from Sichuan province

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ABSTRACT

Objectives: To investigate the period prevalence of complex wounds among the overall inpatients, and the impact of complex wounds on inpatient health expense and length of hospital stay.

Design: An observational study.

Setting: 6,056 health care institutions across Sichuan province in China.

Participants: This study included 4,033,763 people admitted to health care institutions during 1 September 2018 and 31 December 2018.

Results: The point prevalence of complex wounds was 4.07 per 1,000 among inpatients in Sichuan. The most common complex wounds were pressure ulcers (1.47 per 1,000 among inpatients). Older, male, Han ethnic groups and retired people were most likely to suffer from complex wounds. The median length of hospital stay was longer for those with complex wounds as their main condition of treatment compared with all-cause admissions in Sichuan (12 days compared with 7 days; $P<0.001$). The median cost of care for people with complex wounds was higher than for admission for any cause (6,500.18 CNY compared with 3,337.16 CNY; $P<0.001$). People with pressure ulcers had the longest length of stay, whilst people with ulcers related to diabetes incurred the highest costs.

Conclusions: Complex wounds, especially pressure ulcers, are common in Sichuan province and their presence is associated with significantly longer lengths of hospital stay and higher medical costs. Additionally, this study only included admitted inpatients during the sampling time period, hence the prevalence of complex wounds may be underestimated. The high prevalence rate and heavy direct and indirect disease burden of complex wounds indicate that health policies for early detection and prevention of complex wounds in elders are urgently needed.

Strengths and limitations of this study

• This geographically defined study is the first to report the prevalence and disease burden of complex wounds in inpatients in China.

• Both disease code (ICD-10) and disease diagnosis were used in this study to make sure that complex wounds were correctly identified and classified.

• As this was based on second-hand data, we were unable to identify the patients who may have had complex wounds that were not recorded in discharge records.

• This study only included admitted inpatients during the sampling time period, hence the prevalence of complex wounds may be underestimated.

INTRODUCTION

Complex wounds (wounds with superficial, partial or full-thickness skin loss healing by secondary intention), such as foot ulcers, legs ulcers, pressure ulcers, open trauma and surgical wounds, heal slowly and are complex to treat and care for:[1,2] They are often referred to as chronic wounds.[3] Complex wounds have been shown to adversely affect the health related quality of life of those affected as they are often painful and can become infected.[4,5] Complex wounds can lead to amputation,[6,7] which causes physical and mental harm, and severely affect productivity. Patients with complex wounds have a higher mortality than people without.[8,9] Management of complex wounds is costly, with crudely estimated annual costs of £3 billion in the UK, $2.85 billion in Australia and $25 billion in the USA.[10] In Europe it has been estimated that 2-4% of health care budgets are spent on wound management.[11]

Epidemiological estimates of complex wounds prevalence vary. It was estimated that 6.5 million patients have chronic wounds in the US and 1% of population would experience wounds problem in Denmark.[12,13] In 2003, Rodrigues et al conducted a cross sectional study which included 149 Canadian local community service centers, and found the point prevalence of chronic wounds (including pressure ulcer, venous ulcer, and diabetic foot wound) among home care patients was 1.4%.[14] Using health insurance data, Kristina et al showed that 1.04 % of insured German patients had chronic wounds (including diabetic foot ulcer, pressure ulcer, and leg ulcer), and 0.43 % of them had leg ulcer which was the most common wound in 2012.[15] Recently, Hall and Gray have conducted community-based multiservice, cross sectional surveys in the UK, found that the point prevalence of complex wounds was 1.47 ‰ in Leeds and 1.64 ‰ in the north of England, and amongst the most frequent wound type was leg ulcer.[1,10] The same survey was carried out in Slovenia and found that the point prevalence of open surgical wounds was 0.38 ‰.[4]

Epidemiological research on complex wounds in China is limited. In 1998, Fu screened 30,000 hospitalized surgical patients in 15 Chinese hospitals for chronic dermal ulcers, and found that the incidence of wounds was from 1.5% to 3.0%, with trauma and infection being the main causes.[16] In 2008, similar surveys were conducted in 17 tertiary hospitals in 14 Chinese provinces, showing the prevalence of chronic wounds was 1.69 per 1,000 inpatients and the leading causes were diabetes and trauma in inpatients.[17] As both studies focused only on specific hospitals, the results may not allow inference on the point prevalence of complex wounds for inpatients national wide. Furthermore these data are now over a decade old and changing population demographics may result in changes in estimates. In this study, we systematically analyzed hospital discharge data from Sichuan province during the fourth quarter of calendar year 2018, aiming to investigate the period prevalence of complex wounds among the overall inpatients, and the impact of complex wounds on inpatient health expense and length of hospital stay (LOS).

CONTEXT

The Chinese healthcare system is characterized by a three-tier delivery system. The rural three tier system comprises village clinics, township health centers (THCs), and county hospitals; while the urban regions have community health centers/stations (CHCs), city hospitals including district hospitals, and municipal/regional hospitals. Additionally, the county and city hospitals are classified into three levels – primary, secondary and tertiary –

with supposedly increasing quality based on their clinical quality, service quality, management quality, medical safety, and clinical skills and research.[18] THCs and CHCs are called primary healthcare institutions which mainly provide primary care and public health services. Whilst primary healthcare institutions have a gatekeeping role to reduce people directly accessing specialist hospital services, patients can still go directly to higher level hospitals for medical services without attending THCs or CHCs first. Thus, in China, hospitals *de facto* provide both primary and specialist care; a significant difference from most health care systems in developed countries. When people are discharged from healthcare institutions (primary healthcare institution or hospital), their discharge records, containing demographic details together with data about their diagnoses and medical care costs, are completed by the Chief Physician (see Appendix, Table A1). These administrative data provide an opportunity to study the number of people with complex wounds in more detail. To ensure that data from all relevant people were considered we included discharge data from all patients from primary healthcare institutions (THCs/CHCs) and from (primary/secondary/tertiary) hospitals.

In China, over 95% of residents have Social Health Insurance (New Cooperative Medical Scheme for the rural population; Urban Resident Basic Medical Insurance for the unemployed urban people; Urban Employee Basic Medical Insurance for urban workers) which covers access to all primary healthcare institutions and public hospitals, and some private hospitals.[19] The inpatient costs for people with Social Health Insurance consisted of two parts—out-of-pocket payments and insurance reimbursement, while almost all the outpatient cost are out-of-pocket. Hence this study assumed that most, if not all, patients with complex wounds would get inpatient service, instead of outpatient service from healthcare institutions.

This study focused on Sichuan province. The results from Sichuan are likely to be applicable to much of China. Sichuan is the fifth largest and the third most populous province in China (83.41 million people recorded in 2018). The distribution of economic development is uneven, the geographic environment is varied, and the composition of the population is diverse. West Sichuan is sparsely populated, mountainous with poor economic development, and east Sichuan is densely populated, plain with well economic development, more health care institutions (see Figure A1 in Appendix). This is roughly consistent with the overall situation in China.[20,21]

METHODS

Study population and data source

Between 1 September 2018 and 31 December 2018, a total of 4,033,763 people were admitted to 6,056 health care institutions across Sichuan province. All were included in this retrospective, data-based study. Individual-level information was extracted from discharge records provided by the Health Information Centre of Sichuan Province. When performing data analysis, all healthcare institutions were categorized based on their situation at the time of data collection (i.e. in calendar year 2018).

Classification of cases

All people admitted with complex wounds or who developed one or more complex wounds during their stay were identified according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) (see Table 1) and the

corresponding diagnosis in discharge records. This included people with pressure ulcers of Stage 2 or above,[22] ulcers in people with diabetes, venous leg ulcers, non-healing surgical wounds and other ulcers (leg ulcers, upper limb ulcers, skin ulcers, gangrene, infection of amputation stump). We did not include people with open, traumatic wounds or burns in this study.

[Insert Table 1 about here]

Statistical analysis

All analyses were performed using statistical analysis system R-3.5.1. All point prevalence estimates were produced using the binomial proportion and are presented alongside 95% confidence intervals (CIs). The inpatient point prevalence of complex wounds was estimated using the number of people with at least one wound (the numerator) and all inpatients as denominator. To get a crude estimate of the point prevalence of complex wounds in community-based population, this study assumed that all people with one or more complex wounds received inpatient service from healthcare institutions and the point prevalence of complex wounds for community-based population was estimated using people living in Sichuan at present and with at least one complex wound (the numerator) and the population of Sichuan in 2018[23] as the denominator.

When estimating the direct disease burden (median of length of stay (LOS) and medical costs) of complex wounds, only people whose principal cause of hospitalization (principal diagnosis) was the complex wound were included. Wilcox rank sum test and Kruskal-Wallis rank sum test were used to test if LOS and expense were statistically different between groups. We also extracted data on people whose principal cause of hospitalization was not the complex wound but who were recorded as having a complex wounds of relevance in this study as a comorbidity (i.e. though the patient did have one or more complex wound, their main reason for admission was not the wound), and compared their LOS and inpatient costs with patients without complex wounds to determine the additional effect of complex wounds on LOS and inpatient costs. Multivariable linear regression was fitted to control for potentially confounding factors which were documented. Since the confounders are multilevel in our study, we constructed a two-level hierarchical linear model, where level 1 covariables included the patient's age, gender, occupation, social insurance program, whether or not surgery was required, and Charlson Index (a widely used tool to measure comorbid disease status; a higher score equals worse health condition) adjusting for non-complex wound related comorbidity;[24] level 2 covariables included health care institution level type (tertiary hospital, secondary hospital, primary hospital, unassigned hospital, primary health care institution and others) and ownership type (public or private). Healthcare institutions were included as a random effect to account for the within institution correlation for patients admitted in the same institution.

To avoid the impact of incorrect records on disease burden estimates, when analyzing the effect of complex wounds on LOS and inpatient expense, observations were selected based on the following criteria: 1) the length of stay was at least one day; 2) the per capita inpatient expense was more than 100 CNY. Thus, ultimately 4,026,725 records were used for multivariable disease burden analysis.

Patient and public involvement

Neither patients nor members of the public were involved in the study design or conduct of this study.

RESULTS

Prevalence of complex wounds

A total of 16,426 cases of patients with complex wounds was identified from the records of 4,033,763 patients during the fourth quarter of calendar year 2018. The point prevalence of complex wounds was 4.07 per 1,000 of inpatients (95% CI: 4.01 to 4.13) and 0.19 per 1,000 of the whole population in Sichuan province (95% CI: 0.19 to 0.20) (Table 2). It should be noted that this prevalence is likely underestimated as it is almost certain that not all patients with complex wounds had been admitted. Pressure ulcers were the most common complex wound with a point prevalence of 1.47 per 1,000 of inpatients (95% CI: 1.43 to 1.50) and 0.07 per 1,000 of the whole population (95% CI: 0.07 to 0.07).

[Insert Table 2 about here]

Table 3 shows the point prevalence estimates for all complex wounds by demographic characteristics. Most inpatients with complex wounds were aged between 60 and 79 years old. The prevalence of complex wounds amongst inpatients increased with age, and was lowest in patients younger than 10 and highest in patients over 90. Males had higher point prevalence estimate (5.05 per 1,000 with 95% CI 4.95 to 5.15) than females (3.19 per 1,000 with 95% CI 3.12 to 3.27). Prevalence was higher for Han (Chinese) than ethnic minorities at 4.17 per 1,000 (95% CI: 4.11 to 4.23) compared with 2.28 per 1,000 (95% CI: 2.08 to 2.49). Of the 16,426 patients with complex wounds, most were agricultural labourers from rural areas, and the highest point prevalence estimate occurred in retired people with 10.24 per 1,000 (95% CI: 9.80 to 10.71). After adjusting for age, the prevalence of complex wounds was still significantly different by gender (likelihood ratio test: $P< 0.001$), ethnicity (likelihood ratio test: $P< 0.001$) and occupation (likelihood ratio test: $P< 0.001$).

[Insert table 3 and 4 about here]

Figure 1 shows the point prevalence estimates with 95% confidence intervals for individual complex wound types by demographic characteristics. Prevalence rates for individual wound types increased with age except for venous leg ulcers and non-healing surgical wounds whose highest rates occurred in 60-69 (0.50 per 1,000; 95% CI: 0.45 to 0.55) and 50-59 years old (1.45 per 1,000; 95% CI: 1.36 to 1.56) respectively. The highest point prevalence rates for pressure ulcers, diabetic ulcers and other ulcers were found in patients aged 90 years and over, which were 13.48 per 1,000 (95% CI: 12.30 to 14.78), 1.68 per 1,000 (95% CI: 1.30 to 2.18), 1.56 per 1,000 (95% CI: 1.19 to 2.05), respectively. Children younger than 10 were the least likely to have any complex wounds. Pressure ulcers are the most prevalent complex wound of those studied while venous leg ulcers are the least common, and females have much lower prevalence of all kinds of wounds than males. Prevalence rates for individual wound types were higher for Han (Chinese) than ethnic minorities except for non-healing surgical wounds. The

prevalence for individual complex wound types are highly different in occupation groups. The highest prevalence for pressure ulcer (5.89 per 1,000; 95% CI: 5.56 to 6.25) and diabetic ulcer (2.56 per 1,000; 95% CI: 2.35 to 2.80) both occurred in retired patients. Venous leg ulcer, non-healing surgical wounds and other ulcer were most common in agricultural labourers (0.34 per 1,000; 95% CI: 0.31 to 0.36), office clerks (1.47 per 1,000; 95% CI: 1.26 to 1.73), and freelancers (0.78 per 1,000; 95% CI: 0.63 to 0.98), respectively.

[Insert Figure 1 about here]

Disease burden

Table 4 shows the central tendency and dispersion of per capita hospital LOS and medical costs for inpatients whose principal diagnosis was a complex wound. The median per capita LOS was 12 days (IQR: 7 to 22), which is significantly longer than the median per capita LOS for all inpatient in Sichuan (median: 7 days; IQR: 4 to 10; P<0.001). The median per capita medical cost for people with a complex wound was 6,500.18 CNY (IQR: 2,965.92 to 1,2975.23); nearly double the care costs of inpatients without complex wounds (median: 3,337.16; IQR: 1,759.02; 6,703.08; P<0.001). Patients with a principal diagnosis of pressure ulcer had the longest LOS (median: 20 days; IQR: 9 to 34). The median per capita LOS for patients whose principal diagnosis was diabetic ulcer, venous leg ulcer, surgical ulcer or other ulcer were 13 days (IQR: 7 to 22), 9 days (IQR: 7 to 14), 11 days (IQR: 7 to 20) and 13 days (IQR: 7 to 24) respectively (P<0.001). Diabetic ulcers costed the most among all types of complex wounds in this study, with a median per capita medical expense of 8,399.13 CNY (IQR: 3,435.24 to 16,267.55) followed by pressure ulcers (median: 8,039.12; IQR: 3,693.78 to 17,022.96) (P<0.001).

[Insert Table 4 about here]

Table 5 shows the comorbidity of inpatients included in this study. People with complex wounds averagely have higher Charlson Index (more serious comorbidities) than people without at 1.87 compared with 0.82 (P <0.001). People with diabetic ulcers have the most serious comorbidities (Charlson Index: 3.08), followed by people with pressure ulcers (Charlson Index: 2.38), as compared with people having other complex wounds or without any complex wounds.

[Insert Table 5 about here]

For patients with a complex wound which was not considered the main cause of hospitalization, controlling other confounders, the LOS was on average 47.7% (exp(0.39)-1) longer than the LOS for patients without complex wounds (first column of Table 6); the inpatient medical cost was also 60.0% (exp(0.47)-1) higher on average (second column of Table 6). Compared with patients without complex wounds, the presence of a complex wound was associated with increased LOS and increased costs. After controlling for severity of comorbidities and other confounders, we found people with non-healing surgical wounds alongside another main reason for hospital admission had the longest LOS and highest costs:

with a LOS 155.7% (exp(0.939)-1) higher and inpatient cost 124.8% (exp(0.81)-1) greater compared with those without complex wounds or with other types of complex wounds (pressure ulcers, venous leg ulcers or other ulcers) (the third and fourth column of Table 6).

[Insert Table 6 about here]

DISCUSSION

Complex wounds are a challenging public health problem.[25] In this study, we used three months of hospital discharge data from Sichuan province, China, and included all the healthcare institutions providing inpatient service in 2018. Our aim was to acquire more reliable estimates of the complex wound disease burden for inpatients. To identify patients with complex wounds more accurately, disease diagnosis and ICD-10 were used simultaneously.

This study discovered that the point prevalence of complex wounds among inpatients was 4.07 per 1,000, which is much higher than the earlier estimate from the 17 tertiary hospitals in China (1.69 per 1,000 inpatients).[17] Pressure ulcers were found to be the most common type of complex wound; similar to the result of an Irish study focusing on community care setting,[26] a two-week cross sectional survey in Leeds,[1] and Dutch study focusing on nursing homes.[5] Our point prevalence estimate of pressure ulcers among inpatients (1.47 per 1,000) is much lower than that of Indonesian inpatients (8.0%), and German inpatients (2.25%).[27,28] Assuming all patients with complex wounds got inpatient service from healthcare institutions, we have crudely estimated the point prevalence of complex wounds among community-based population in Sichuan (0.19 per 1,000). This rate is significantly lower than the estimates in previous studies which ranging from 0.04% to 1%.[25]

Many studies have previously shown that the prevalence of complex wounds is higher in older people[1,4,29], and our point prevalence rates of most complex wounds (including pressure ulcers, diabetic and other ulcers) are consistent with the highest rates occurring in age 90+ age group. It is worth noting that the highest rates of venous leg ulcers and non-healing surgical wounds occurred in age 60-69 and 50-59 groups respectively. For non-healing surgical wounds, this may due to the preference of conservative treatment for elderly population in China. For venous leg ulcers, the reason of this point prevalence peak in this age group requires further investigation.

This study also found that females have lower rates of complex wounds in China than males, which is consistent with previous study conducted in China and Slovenia,[4,16,17] but different from the UK[1,10] – which showed that females are more likely to suffer from complex wounds.[30] The difference may be partially explained by differences in occupational and lifestyle activities with heavy labour and activities such as smoking being more common in older men than women of the same age. Due to rapidly improving working environments and other risk factor related activities there may be a shift in these gender differences for wound point prevalence over subsequent generations. .

This study found that where complex wounds was the major reason for hospital admission people had a significantly longer hospital LOS and higher medical costs than for all-cause admission in Sichuan. This is the first investigation of this kind in China. For patients who were admitted to health care institutions mainly for pressure ulcer, the LOS was longer than other complex wounds. Pressure ulcers often occur in people with limited mobility due to

physical or cognitive impairment, and people with pressure ulcers were more likely to have serious co-morbidities. The relatively poor psychological, behavioral and cognitive status of these patients may prolong the treatment period. The longest LOS may also partially explain why the median of per capita medical expense for those admitted with a pressure ulcer is higher than for people being admitted for most other types of complex wounds. Among all the complex wound types in this study, people with diabetes and one or more ulcers incurred the most medical costs with a median per capita medical expense of 8,399.13 CNY. Again these were people commonly affected by a range of other co-morbidities and who also required the use of blood glucose controlling drugs. Considering that the average yearly disposable income of Sichuan province is 20,580 CNY, this is a significant economic pressure to these patients. Median medical costs show similar trends, while differences between median and average costs likely reflects different basic costs of them. We also found that LOS and costs for people with complex wounds for whom this was not their principal diagnosis were higher when compared with patients without complex wounds. These data provide us a scope for further in-depth investigation and a hint for designing better prevention and financial support system for patients in China.

Strengths and limitations

This geographically defined study is the first to report the prevalence of complex wounds in inpatients in China using data from all health care institutions providing inpatient services during the study period. It is also the first to quantify disease burden of complex wounds in China. Both disease code (ICD-10) and disease diagnosis were used to make sure that complex wounds were correctly identified and classified.

This study also had some limitations. The estimates of prevalence may be underestimated. When estimating the prevalence of complex wounds for inpatients, this study was unable to identify the patients who may have had complex wounds that were not recorded in discharge records. This is also the case for patients with certain other illnesses or systematic problems, which may contribute to increased medical costs due to their links to the wounds. The point prevalence of complex wounds for the whole population in Sichuan does not capture the information of people who may have complex wounds but receive care at outpatient sectors or/and do not receive inpatient care during the study period but are "self-treating". Besides, basing on hospital discharge data, we were unable to identify whether the wounds were hospital acquired or pre-existed, we may have ignored the heterogeneity between these two conditions when measuring the effect of complex wounds on LOS and costs. Further research in this area could pay attention to these problems.

Contributors

ZL and JP conceived the idea and design for this study; ZL and QJ were responsible for data analysis; JP, JD and NC contributed to data analysis; QJ created the original draft of this manuscript. All authors contributed to the interpretation of the findings, critical version of the manuscript.

Competing interests

The authors declare that they have no competing financial interests.

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Data sharing statement

Data may be obtained from a third party and are not publicly available.

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Ethical approval

Not applicable since the data we used was administrative data without involving any private information of patients, e.g. the patients' name, ID number.

REFERENCE

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Table 1. ICD-10 classification associated with complex wounds

Wound types	Identifying methods
Pressure ulcer	Code L89.-, excepting grade one pressure ulcer coded L89.000
Diabetic ulcer	1) code E10.504, E11.504, E14.501, E10.505, E11.505 2) code E11.502 with the corresponding diagnosis containing "gangrene" 3) E14.606, E11.601, E11.503, E10.503, BD54 excepting these whose Wagner classification is level zero. 1) or 2) or 3)
Venous leg ulcer	Code I83.0-, I83.2-
Non-healing surgical wound	1) code T81.3- 2) code T81.4- excepting biliary tract infection after surgery coded T81.404 3) code T81.8- excepting abdominal pain after surgery 1) or 2) or 3)
Other ulcer	Code L97.-, L98.4-, R02, T87.4-, T87.5-

Table 2. Wounds point prevalence estimates by wounds type

Wounds type	Frequency	Point prevalence per 1,000	95% CI
Inpatient point prevalence [a]			
All Wounds	16,426	4.07	(4.01, 4.13)
Pressure ulcers	5,915	1.47	(1.43, 1.50)
Diabetic ulcers	3,269	0.81	(0.78, 0.84)
Venous leg ulcers	1,139	0.28	(0.27 0.30)
Non-healing surgical wounds	4,090	1.01	(0.98, 1.05)
Other ulcer	2,013	0.50	(0.48, 0.52)
Point prevalence in community-based population [b]			
All Wounds	16,086	0.19	(0.19, 0.20)
Pressure ulcers	5,842	0.07	(0.07, 0.07)
Diabetic ulcers	3,230	0.04	(0.04, 0.04)
Venous leg ulcers	1,116	0.01	(0.01, 0.01)
Non-healing surgical wounds	3,936	0.05	(0.05, 0.05)
Other ulcers	1,962	0.02	(0.02, 0.03)

[a]. Using the total number of inpatient in Sichuan province during the fourth quarter of calendar year 2018 as denominator.

[b]. Using inpatients who were living in Sichuan at present and have at least one wounds we defined as the numerator and the population of Sichuan in 2018 as the denominator.

Table 3. Inpatient wounds point prevalence estimates by demographic characteristics

Variable	Patients with wounds	Total patients	Point prevalence per 1,000 [a]	95% CI
Age group [b]				
0-9	95	423,706	0.22	(0.18, 0.27)
10-19	171	98,270	1.74	(1.50, 2.02)
20-29	462	293,458	1.57	(1.44, 1.72)
30-39	584	281,722	2.07	(1.91, 2.25)
40-49	1,569	480,648	3.26	(3.12, 3.43)
50-59	2,489	571,865	4.35	(4.19, 4.53)
60-69	3,763	835,686	4.50	(4.36, 4.65)
70-79	3,885	715,667	5.43	(5.26, 5.60)
80-89	2,825	299,432	9.44	(9.10, 9.79)
90+	583	33,309	17.50	(16.15, 18.97)
Gender				
Male	9,676	1,916,399	5.05	(4.95, 5.15)
Female	6,746	2,114,331	3.19	(3.12, 3.27)
Missing	4	3,033	1.32	(0.51, 3.39)
Ethnic Group				
Minority	471	206,921	2.28	(2.08, 2.49)
Han	15,955	3,826,844	4.17	(4.11, 4.23)
Occupation				
Civil servants & active army	88	20,341	4.33	(3.51, 5.33)
Professionals & technical	96	33,195	2.89	(2.37, 3.53)
Office clerk & manager	347	103,284	3.36	(3.03, 3.73)
Worker	356	82,198	4.33	(3.91, 4.80)
Agricultural labourer	6,284	1,816,499	3.46	(3.38, 3.55)
Student	133	103,659	1.28	(1.08, 1.52)
Freelancer	427	98,469	4.34	(3.95, 4.77)
Self-employed	63	19,021	3.31	(2.59, 4.24)
Unemployed	491	124,972	3.93	(3.60, 4.29)
Retired	1,934	188,829	10.24	(9.80, 10.71)
Others	6,207	1,443,296	4.30	(4.20, 4.41)

[a]. Using the total number of inpatient people in Sichuan province during the fourth quarter of calendar year 2018.

[b]. Continuous variable was transferred to 10-year age categories manually.

Table 4. Disease burden of complex wounds

Wounds type	Frequency [a]	LOS (days) [b]		Per capita inpatient cost (CNY) [b]	
		Mean± SD	Median (IQR)	Mean± SD	Median (IQR)
All wounds	5,048	18± 22	12 (7; 22)	11,347.54± 16,715.62	6,500.18 (2,965.92; 1,2975.23)
Pressure ulcers	583	31± 41	20 (9; 34)	15,852.69± 23,630.01	8,039.12 (3,693.78; 17,022.99)
Diabetic ulcers	843	18± 23	13 (7; 22)	13,528.74± 17,966.84	8,399.13 (3,435.24; 16,267.55)
Venous leg ulcers	903	12± 8	9 (7; 14)	8,865.53± 6,866.72	7,496.02 (4,063.37; 11,388.46)
Non-healing surgical wounds	1,639	16± 17	11 (7; 20)	10,071.35± 15,240.53	4,954.22 (2,316.53; 10,774.30)
Other ulcers	1,080	18± 19	13 (7; 24)	11,225.03± 18,425.64	6,152.69 (3,011.88; 13,719.34)

[a] Only patient whose principal cause of hospitalization was the complex wound were included in this table.

[b] mean with standard deviation (SD) and median with inter-quantile range (IQR) were presented.

Table 5. Comorbidities of people with complex wounds

Group	Charlson Index	
	Mean±SD	Median (IQR)
Patients without complex wounds	0.82±1.29	0 (0;1)
Patients with complex wounds	1.87±1.93	1 (0;3)
Pressure ulcers	2.38±1.86	2 (1;3)
Diabetic ulcers	3.08±1.97	3 (1;4)
Venous leg ulcers	0.51±1.03	0 (0;1)
Non-healing surgical wounds	0.91±1.46	0 (0;2)
Other ulcers	1.17±1.58	1 (0;2)

Table 6. Two-level hierarchical model results

Explaining variables	*Dependent variable*			
	log(LOS)	log(expense)	log(LOS)	log(expense)
	(1)	(2)	(3)	(4)
Complex wounds (*vs NO*)	0.39***	0.47***		
	(0.01)	(0.01)		
Wounds type (vs patients without complex wounds)				
Pressure ulcers			0.23***	0.48***
			(0.01)	(0.01)
Diabetic ulcers			0.18***	0.19***
			(0.01)	(0.01)
Venous leg ulcers			0.27***	0.14**
			(0.04)	(0.04)
Non-healing surgical wounds			0.94***	0.81***
			(0.01)	(0.01)
Other ulcers			0.38***	0.33***
			(0.02)	(0.02)
Observations [a]	4,021,677	4,021,677	4,021,677	4,021,677

Note: Cells contain coefficient (and standard error). *p <0.05, **p<0.01, ***p<0.001. All models had adjusted for patient's age (continuous, years), gender (male, female or missing), occupation (11 categories: Civil Servants & active army, professionals & technical, office clerk & manager, worker, agricultural labourer, student, freelancer, self-employed, unemployed, retired, others), social insurance program (four categories: Urban Employee Basic Medical Insurance, Urban Resident Basic Medical Insurance, New Rural Cooperative System), whether or not surgery was required (yes or no), Charlson Index (continuous, adjusting for comorbidity), health care institution level (six categories: primary hospitals, secondary hospitals, tertiary hospitals, unassigned hospitals, primary health care sectors, other providers) and ownership type (public or private). The full results were displayed in table A2 in appendix.

a. Only patients whose principal cause of hospitalization was not complex wound were selected to fit the two-level hierarchical models.

Figure 1. Inpatient wounds point prevalence estimates by wound types and demographic characteristics

Note: Point estimates with 95% confidence intervals were displayed in this figure. Occupation 1: Civil Servants and active army; 2: Professionals and technical; 3: Office clerk and manager; 4: Worker; 5: Farmer; 6: Student; 7: Freelancer; 8: Self-employed; 9: Unemployed; 10: Retired; 11: Others. Exact data was showed in table A1 in appendix.

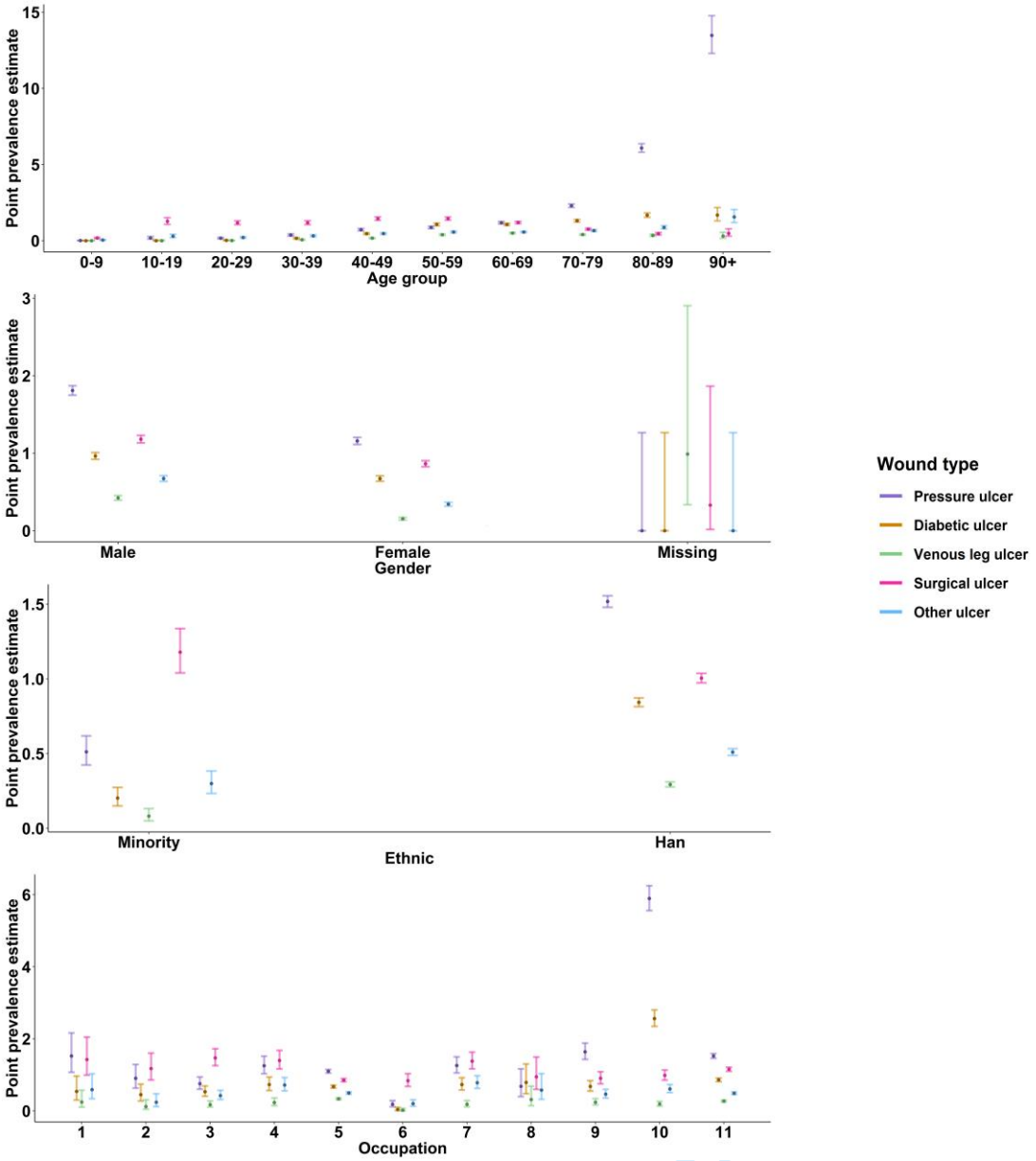

Figure 1. Inpatient wounds point prevalence estimates by wound types and demographic characteristics

Note: Point estimates with 95% confidence intervals were displayed in this figure. Occupation 1: Civil Servants and active army; 2: Professionals and technical; 3: Office clerk and manager; 4: Worker; 5: Farmer; 6: Student; 7: Freelancer; 8: Self-employed; 9: Unemployed; 10: Retired; 11: Others. Exact data was showed in table A1 in appendix.

APPENDIX

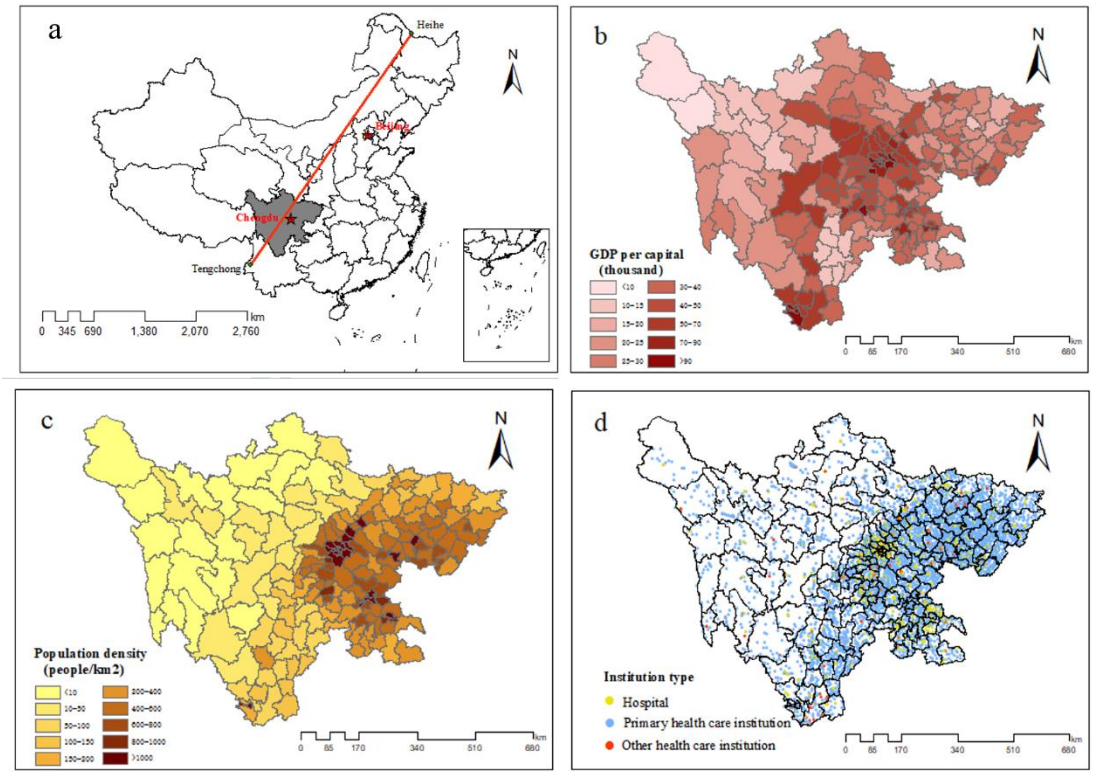

Figure A1. Characters of Sichuan province.

(a) Geographic position of Sichuan; (b) Per capital GDP among counties in 2017; (c) Population density among counties in 2017; (d) Distribution of health care institutions in 2018.

Table A1. Ghost table for discharge data

Home page of inpatient record

Year _____

Name of Hospital_____ (Organization code: □□□□□□□□ – □)

Number of Health Card: Hospitalization count: Patient's identification number:

Name _____ **Gender** □ 1.M 2. F **Birthday**_____ **Age**_____
Nationality _____ **Neonatal birth weight**_____g **Neonatal admission weight**_____g
Birthplace _____ **Native place**_____ **Ethnic group** _____
ID number_____ **Occupation**_____ **Marital status** _____
Present address _____ **Tel**_____**Post code**_____
Registered address_____**Post code**_____
Work address_____**Office Tel**_____**Post code**_____
Contact person _____ **Relationship** _____ **Address**_____**Tel**_____
Admission type □ 1. emergency 2. outpatient clinic
3.Referred from other institutions and its name is_____ 9. others
Admission time_____year____month____day____hour___minute
Hospital department_____ **Inpatient ward number**_____ **The department the patient transferred to is**_____
Discharge time_____year____month____day____hour___minute
Diagnosis in outpatient (emergency) department_____ **ICD-10**_____
Health status at admission □1. critically ill 2. acute 3. ordinary
Diagnosis at admission_____ **ICD-10**_____ **Date of making the principal diagnosis**_____
Whether the patient was critically ill during hospitalization □ 1.yes 2.no

Diagnosis on Discharge	ICD-10	Disease status at admission (DSA)	Disease status on discharge (DSD)
Principal diagnosis:			
Other diagnosis:			

DSA: 1.yes 2.clinically undetermined 3.unclear 4.no **DSD:** 1.cured 2.improved 3.not cured 4.deceased 5.others

Cause of injury/poisoning_____**ICD-10**_____

pathological diagnosis: _____**ICD-10**_____**Pathological examination number**_____

TNM stage: □1.I 2.II 3.III 4.IV

drug allergy □1.no 2.yes, and the allergic drug is: _____ **Autopsy of deceased patient** □ 1.yes 2.no

Blood type □ 1. A 2.B 3.O 4.AB 5.unclear 6. unchecked
Rh □1. negative 2. positive 3. unclear 4. unchecked

Follow up clinic □ 1.yes 2.no **Follow-up period** _____

Section director's name_____ **Chief doctor**_____ **Attending doctor**_____ **Visiting staff**_____
Resident doctor _____**Primary nurse**_____ **Refresher doctor**_____**Intern**_____ **coder**_____

The quality of medical record □ 1. high 2.medium 3.low **Quality control doctors**_____
Quality control nurses_____ **Date of making quality control**_____

Prophylactic use of antimicrobial drugs for primary surgical incision □ 1.yes 2.no
Duration(hours): _____ **Drug combination □1.yes 2.no**

Surgery code	time	level	Name of the operation	Operating Doctor			Wound healing grade	anesthesia	Anesthesiologists
				Operator	Assistant 1	Assistant II			
							/		
							/		
							/		
							/		
							/		
							/		
							/		
							/		

Clinical pathway management □1.yes 2.no **Complete clinical pathway** □1.yes 2.no, and the reason is_____
Variation □ 1.yes 2.no; the reason is: _____

Discharge type □
1 Discharge on doctor's orders
2.Be referred to a superior hospital, and its name is_____
3.Be referred to primary health institution(THC/CHC), and its name is_____
4.Leave hospital without medical advice 5.dead 9.others

Does she/he has the plan to be readmitted within 31 days □ 1.no 2.yes, and the reason is_____

How long did the craniocerebral injury patient remain in a coma:
Before admission, she/he was in coma for _____minutes
After admission, she/he was in coma for_____minutes

Whether the patient was readmitted for the same disease □1.yes 2.no
How long has it been since the last discharge? _____days

Inpatient expense (yuan): Total expense_____ (out-of-pocket payment: ___others: _____)
1. Comprehensive medical services:
(1) General medical service expense: _____ (2) General treatment expense: _____
(3) Nursing expense: _____ (4) Other expense: _____
2.Diagnosis: (5) Pathological diagnosis: _____ (6) laboratory diagnosis: _____
(7) Imaging diagnosis: _____ (8) Clinical diagnosis: _____
3.Treatment: (9) Non-surgical treatment: _____ (Clinical physiotherapy: _____)
(10) Surgical treatment expense: _____ (Anesthetic expense: _____ Operation: _____)
4.Recovery: (11) Recovery expense: _____
5.Traditional Chinese treatment: (12) Traditional Chinese treatment expense: _____
6.Western medicine: (13) Western medicine expense: _____ (Antimicrobial expense: _____)
7. Traditional Chinese medicine (TCM):
(14) Proprietary Chinese medicine expense_____ (15) Chinese herbal medicine expense: _____
8. Blood and blood products: (16) Blood expense: _____ (17) Albumin products: _____
(18) Globulin products: ____ (19) Hemagglutinin sub products: ____ (20) Subclass of cytokines: _____
9. Consumable materials: (21) Disposable medical materials for inspection: _____
(22) Disposable medical materials for treatment: _____
(23) Disposable medical materials for surgery: _____
10.Others: (24) Other expense: _____

Table A2. Full results of two-level hierarchical models

Explaining variables	*Dependent variable*			
	log(LOS)	log(expense)	log(LOS)	log(expense)
	(1)	(2)	(3)	(4)
Wounds	0.390***	0.472***		
	(0.006)	(0.006)		
Wounds type (vs patients without complex wounds)				
Pressure ulcers			0.233***	0.484***
			(0.009)	(0.009)
Diabetic ulcers			0.183***	0.194***
			(0.014)	(0.013)
Venous leg ulcers			0.268***	0.137**
			(0.044)	(0.042)
Non-healing surgical wounds			0.939***	0.807***
			(0.013)	(0.013)
Other ulcers			0.380***	0.333***
			(0.020)	(0.019)
Age (year)	0.003***	0.008***	0.003***	0.008***
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Gender (vs male)				
Female	-0.061***	-0.056***	-0.061***	-0.056***
	(0.001)	(0.001)	(0.001)	(0.001)
Missing	-0.055***	-0.061***	-0.055***	-0.061***
	(0.015)	(0.014)	(0.015)	(0.014)
Charlson Index	0.075***	0.116***	0.075***	0.116***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Social insurance program (vs UEBMI) [a]				
URBMI	-0.059***	-0.036***	-0.059***	-0.036***
	(0.001)	(0.001)	(0.001)	(0.001)
NRCMS	-0.078***	-0.036***	-0.078***	-0.036***
	(0.002)	(0.002)	(0.002)	(0.002)
Others	-0.127***	-0.078***	-0.127***	-0.078***
	(0.001)	(0.001)	(0.001)	(0.001)
Occupation (vs Civil Servants & active army) [b]				
Professionals & technical	-0.055***	-0.031***	-0.055***	-0.031***
	(0.006)	(0.006)	(0.006)	(0.006)

Office clerk & manager	-0.057***	-0.024***	-0.057***	-0.024***
	(0.005)	(0.005)	(0.005)	(0.005)
Worker	0.013*	0.050***	0.013*	0.050***
	(0.005)	(0.005)	(0.005)	(0.005)
Agricultural labor	-0.006	0.050***	-0.006	0.050***
	(0.005)	(0.005)	(0.005)	(0.005)
Student	-0.051***	-0.100***	-0.050***	-0.100***
	(0.005)	(0.005)	(0.005)	(0.005)
Freelancer	-0.057***	-0.001	-0.057***	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Self-employed	-0.051***	-0.017*	-0.051***	-0.017*
	(0.007)	(0.007)	(0.007)	(0.007)
Unemployed	-0.048***	-0.014**	-0.048***	-0.014**
	(0.005)	(0.005)	(0.005)	(0.005)
Retired	0.062***	0.030***	0.062***	0.030***
	(0.005)	(0.005)	(0.005)	(0.005)
Others	0.004	0.021***	0.005	0.021***
	(0.005)	(0.005)	(0.005)	(0.005)
Whether or not surgery was required (vs No)				
Surgery (Yes)	0.127***	0.714***	0.126***	0.714***
	(0.001)	(0.001)	(0.001)	(0.001)
Health care institution levels (vs primary hospital)				
Secondary hospital	0.067	0.443***	0.067	0.443***
	(0.035)	(0.043)	(0.035)	(0.043)
Tertiary hospital	-0.190***	0.681***	-0.190***	0.681***
	(0.049)	(0.061)	(0.049)	(0.061)
Unassigned hospital	0.055	0.168***	0.055	0.168***
	(0.028)	(0.035)	(0.028)	(0.035)
Primary healthcare sector	-0.456***	-0.825***	-0.456***	-0.825***
	(0.036)	(0.045)	(0.036)	(0.045)
Other providers	-0.548***	0.014	-0.547***	0.014
	(0.048)	(0.059)	(0.048)	(0.059)
Ownership type (vs private)				
Public	0.222***	-0.041	0.222***	-0.041
	(0.027)	(0.034)	(0.027)	(0.034)

Missing	0.171*	-0.325***	0.172*	-0.325***
	(0.067)	(0.083)	(0.067)	(0.083)
Constant	1.848***	7.337***	1.848***	7.337***
	(0.025)	(0.031)	(0.025)	(0.031)
Observations	4,021,677	4,021,677	4,021,677	4,021,677

Note: Cells contain coefficient (and standard error). *p <0.05, **p<0.01, ***p<0.001.

[a]. UEBMI (Urban Employee Basic Medical Insurance); URBMI (Urban Resident Basic Medical Insurance); NRCMS (New Rural Cooperative System).

[b]. Occupations with too small a sample were merged with similar occupations.

Table A3. Inpatient wounds point prevalence estimates by wound types and demographic characteristics

Variable	Pressure ulcers		Diabetic ulcers		Venous leg ulcers		Non-healing surgical wounds		Other ulcers	
	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)	frequency	point prevalence (95% CI)
Age group										
0-9	4	0.009 (0.004, 0.024)	0	0.000 (0.000, 0.009)	0	0.000 (0.000, 0.009)	73	0.172 (0.137, 0.217)	18	0.042 (0.027, 0.067)
10-19	17	0.173 (0.108, 0.277)	0	0.000 (0.000, 0.039)	0	0.000 (0.000, 0.039)	125	1.272 (1.068, 1.515)	29	0.295 (0.205, 0.424)
20-29	48	0.164 (0.123, 0.217)	7	0.024 (0.012, 0.049)	2	0.007 (0.002, 0.025)	344	1.172 (1.055, 1.303)	61	0.208 (0.162, 0.267)
30-39	104	0.369 (0.305, 0.447)	43	0.153 (0.113, 0.206)	17	0.060 (0.038, 0.097)	331	1.175 (1.055, 1.308)	89	0.316 (0.257, 0.389)
40-49	347	0.722 (0.650, 0.802)	221	0.460 (0.403, 0.525)	81	0.169 (0.136, 0.209)	695	1.446 (1.342, 1.557)	225	0.468 (0.411, 0.533)
50-59	498	0.871 (0.798, 0.951)	611	1.068 (0.987, 1.157)	223	0.390 (0.342, 0.445)	831	1.453 (1.358, 1.555)	326	0.570 (0.511, 0.635)
60-69	983	1.176 (1.105, 1.252)	891	1.066 (0.998, 1.138)	415	0.497 (0.451, 0.547)	997	1.193 (1.121, 1.269)	477	0.571 (0.522, 0.624)
70-79	1,643	2.296 (2.188, 2.409)	939	1.312 (1.231, 1.399)	287	0.401 (0.357, 0.45)	542	0.757 (0.696, 0.824)	474	0.662 (0.605, 0.725)
80-89	1,822	6.085 (5.813, 6.370)	501	1.673 (1.533, 1.826)	104	0.347 (0.287, 0.421)	136	0.454 (0.384, 0.537)	262	0.875 (0.775, 0.987)

90+	449	13.480 (12.296, 14.776)	56	1.681 (1.295, 2.182)	10	0.300 (0.163, 0.553)	16	0.480 (0.296, 0.780)	52	1.561 (1.191, 2.046)
Gender										
Male	3,466	1.809 (1.749, 1.870)	1,848	0.964 (0.921, 1.009)	810	0.423 (0.395, 0.453)	2,263	1.181 (1.133, 1.230)	1,289	0.673 (0.637, 0.710)
Female	2,449	1.158 (1.113, 1.205)	1,421	0.672 (0.638, 0.708)	326	0.154 (0.138, 0.172)	1,826	0.864 (0.825, 0.904)	724	0.342 (0.318, 0.368)
Missing	0	0.000 (0.000, 1.265)	0	0.000 (0.000, 1.265)	3	0.989 (0.336, 2.904)	1	0.330 (0.017, 1.865)	0	0.000 (0.000, 1.265)
Ethnic group										
Minority	106	0.512 (0.424, 0.619)	42	0.203 (0.150, 0.274)	17	0.082 (0.051, 0.132)	244	1.179 (1.040, 1.337)	62	0.300 (0.234, 0.384)
Han	5,809	1.518 (1.479, 1.557)	3,227	0.843 (0.815, 0.873)	1,12 2	0.293 (0.277, 0.311)	3,846	1.005 (0.974, 1.037)	1,951	0.510 (0.488, 0.533)
Occupation										
Civil Servants & active army	31	1.524 (1.074, 2.162)	11	0.541 (0.302, 0.968)	5	0.246 (0.105, 0.575)	29	1.426 (0.993, 2.047)	12	0.590 (0.338, 1.031)
Professionals & technical	30	0.904 (0.633, 1.290)	15	0.452 (0.274, 0.745)	4	0.121 (0.047, 0.310)	39	1.175 (0.86, 1.606)	8	0.241 (0.122, 0.476)
Office clerk & manager	78	0.755 (0.605, 0.942)	55	0.533 (0.409, 0.693)	18	0.174 (0.11, 0.275)	152	1.472 (1.256, 1.725)	44	0.426 (0.317, 0.572)
Worker	103	1.253 (1.033, 1.519)	60	0.730 (0.567, 0.939)	19	0.231 (0.148, 0.361)	115	1.399 (1.166, 1.679)	59	0.718 (0.557, 0.926)
Agricultural labor	1,999	1.100 (1.053, 1.150)	1,226	0.675 (0.638, 0.714)	608	0.335 (0.309, 0.362)	1,549	0.853 (0.811, 0.896)	902	0.497 (0.465, 0.53)

Student	19	0.183 (0.117, 0.286)	4	0.039 (0.015, 0.099)	2	0.019 (0.005, 0.07)	87	0.839 (0.681, 1.035)	21	0.203 (0.133, 0.31)
Freelancer	124	1.259 (1.056, 1.501)	72	0.731 (0.581, 0.921)	18	0.183 (0.116, 0.289)	136	1.381 (1.168, 1.633)	77	0.782 (0.626, 0.977)
Self-employed	13	0.683 (0.399, 1.169)	15	0.789 (0.478, 1.301)	6	0.315 (0.145, 0.688)	18	0.946 (0.599, 1.495)	11	0.578 (0.323, 1.035)
Unemployed	205	1.640 (1.431, 1.881)	85	0.680 (0.550, 0.841)	30	0.240 (0.168, 0.343)	113	0.904 (0.752, 1.087)	58	0.464 (0.359, 0.600)
Retired	1,113	5.894 (5.559, 6.250)	484	2.563 (2.345, 2.802)	36	0.191 (0.138, 0.264)	186	0.985 (0.853, 1.137)	115	0.609 (0.507, 0.731)
Others	2,200	1.524 (1.462, 1.589)	1,242	0.861 (0.814, 0.910)	393	0.272 (0.247, 0.301)	1,666	1.154 (1.100, 1.211)	706	0.489 (0.454, 0.527)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Yes, Page 2 Line 3 and Line 29.
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Yes, Page 2 from Line 35 to Line 53.
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Yes, Page 3 from Line 35 to Line 45.
Objectives	3	State specific objectives, including any prespecified hypotheses Yes, Page 3 from Line 45 to Line 50.
Methods		
Study design	4	Present key elements of study design early in the paper Yes, Page 5 from Line 46-53
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Yes, Page 5 from line 32-53.
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants Yes, from Page 5 line 57 to Page 6 line 9.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Yes, Page 6 from line 40-52.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Yes, Page 6 from line 28-52.
Bias	9	Describe any efforts to address potential sources of bias Yes, Page 6 from line 40-58.
Study size	10	Explain how the study size was arrived at Yes, Page 5 from line 46-53.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Yes, Page 6 from line 40-52 and Table 6.
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Yes, Page 6 line 15-58.
		(*b*) Describe any methods used to examine subgroups and interactions Yes, Page 6 line 18-40.
		(*c*) Explain how missing data were addressed Yes, Page 6 line 53-59.
		(*d*) If applicable, describe analytical methods taking account of sampling strategy NA
		(*e*) Describe any sensitivity analyses NA
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Yes, Page 7 line 6-35.
		(b) Give reasons for non-participation at each stage NA
		(c) Consider use of a flow diagram NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Yes, Table 3.
		(b) Indicate number of participants with missing data for each variable of interest Yes, Table 3.
Outcome data	15*	Report numbers of outcome events or summary measures Yes, Table 2 and 3.
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and

		their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Yes, Table 4 and 6, reasons for adjusted estimates were mentioned in Page 6 line 40-50.
		(*b*) Report category boundaries when continuous variables were categorized Yes, table 3.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA
Discussion		
Key results	18	Summarise key results with reference to study objectives Yes, Page 9 line 14-27, and line 39-48.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Yes, Page 10 Line 28-40.
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Yes, Page 10 Line 28-40.
Generalisability	21	Discuss the generalisability (external validity) of the study results Yes, Page 10 Line 15-18.
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Yes, Page 10 Line 42-44.

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.