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Original Article

Prevalence of hospital-associated infections and its association with discharge destinations and hospital readmissions in Brussels, Belgium, from 2008 to 2020: A hospital-based, cross-sectional study

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Abstract

Objectives: To examine time trends of hospital-associated infections (HAIs) in people living in the Brussels–Capital Region, and to evaluate the consequences for hospitals and long-term care facilities (LTCFs).

Design: Cross-sectional analyses of yearly hospital administrative data.

Setting: All Belgian hospitals and discharge destinations, focusing on LTCFs.

Participants: All individuals from the Brussels–Capital Region hospitalized for >1 day throughout Belgium between 2008 and 2020 (N = 1,915,572).

Methods: We calculated HAI prevalences and then, adjusting for confounders, the odds of being discharged to a LTCF or being readmitted within 30 days postdischarge after an HAI. HAIs included hospital-associated bloodstream infections, hospital-associated urinary tract infections, hospital-associated pneumonia, ventilator-associated pneumonia, and surgical-site infections.

Results: Between 2008 and 2020, we identified 77,004 HAIs. Changes in time trends occurred. We observed a decrease of all HAIs from 2012 to 2014 from 5.17% to 2.19% ($P < .001$) and an increase from 2019 to 2020 from 3.38% to 4.06% ($P < .001$). Among patients with HAIs, 24.36% were discharged to LTCFs and 13.51% underwent early readmission. For stays ≥4 days, HAIs were associated with higher odds of LTCF discharge (adjusted odds ratio [aOR], 1.25; 95% confidence interval [CI], 1.22–1.28), but with lesser odds of early readmission (aOR, 0.88; 95% CI, 0.85–0.90).

Conclusions: Administrative data can be useful to detect HAIs trends, but they seem to underestimate the burden compared to surveillance systems. Risk factors of readmission should be identified during hospital stays to ensure continuity of care. Considering the results from 2020 coinciding with the COVID-19 pandemic, monitoring the impact of HAIs should continue.

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Healthcare-associated infections represent a major public health concern globally, with hundreds of millions of patients affected yearly.[1] At the hospital level, hospital-associated infections (HAIs) can be transmitted during the entire process of care, whether related to treatment, intervention, procedure, or facility.[2] Occupational infections in this sector are also part of HAIs.[3] HAIs affect patients, communities, and all types of healthcare settings.[1–4] At the individual level, HAIs can lead to severe outcomes, including prolonged hospital stays, higher costs for the patient and their relatives, and the use of additional treatments including antibiotics which, in turn, promote antimicrobial resistance.[4]

In Europe, the European Centre for Disease Prevention and Control (ECDC) coordinates recurrent point-prevalence surveys to assess the burden of HAIs.[5–7] In 2017, they estimated that 8.9 million new episodes of healthcare-associated infections occurred in acute-care hospitals and long-term care facilities (LTCFs) within the European Union and European Economic Area.[7]

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The Belgian Performance Health System Report indicates that, in 2019 and contrary to other indicators, HAIs remain a point of attention because the prevalence among hospitalized patients has not improved for more than a decade.[8] Thus, more effort to prevent HAIs is required in Belgium, which includes strengthening surveillance. Furthermore, the evolution of HAIs following the COVID-19 pandemic is of interest.

Surveillance of postdischarge HAIs (ie, community-onset infections) is even more complex and costly.[9,10] The literature describes an association between HAIs and hospital readmissions[11–15] resulting in major costs for healthcare systems.[16] Although difficult to estimate accurately, the excess length of stay (LOS) due to HAIs is associated with additional hospital costs.[17–19] To improve the surveillance of postdischarge HAIs, we explored how HAIs and post–hospital discharge factors interact.

The primary objective of this study was to examine trends of HAIs among people living in the Brussels–Capital Region regardless of their hospitalization location in Belgium, from 2008 to 2020. The secondary objective was to identify the extent to which HAIs affect hospitals and LTCFs by determining the odds of being readmitted within 30 days after discharge to the same hospital and the odds of being discharged to a LTCF or another hospital, compared with HAI-free hospital stays.

Methods

Data source

The Minimum Hospital Dataset (MHD, *Résumé Hospitalier Minimum (RHM)/Minimale Ziekenhuis Gegevens (MZG)*) contains mandatory reported data of each hospital admission from all Belgian acute-care hospitals. No data were available for 2015, which was a transition year following the change from *International Classification of Diseases Ninth Revision Clinical Modification* (ICD-9-CM) to the ICD-10-BE.

Study population

The study population comprised all inhabitants from the Brussels–Capital Region, Belgium, admitted for >1 day (ie, "classic" admissions) within hospitals across the country. We focused on people with a registered address in the region because data on HAIs, postdischarge destinations and early readmissions are lacking in the context of Brussels–Capital Region.

Two exclusions criteria were defined. The first exclusion criteria concerned stay with a psychiatric diagnosis coded as the main cause of admission because coding practices vary too much between hospitals. The second exclusion criteria referred to newly born children only admitted within maternity facilities without any complications.

Exposure

Based on common classifications and ECDC case definitions, we assessed 5 kinds of HAIs: hospital-associated urinary tract infection (HAUTI), hospital-associated bloodstream infection (HABSI), hospital-acquired pneumonia/ventilator-associated pneumonia (HAP/VAP), surgical-site infection (SSI), and other HAIs.[9,20]

After reviewing ICD coding handbooks and previous studies, a list of ICD codes corresponding to each of these types was elaborated. For all ICD codes, ICD-10 codes were manually converted to ICD-9 codes and vice versa to allow comparison between the pre-2015 and post-2015 periods. Eventually, the variable only comprised infections that occurred during hospitalization and were not present upon admission.

HAUTIs included all urinary tract infections acquired within the healthcare facility: urinary catheter–related and non–device-associated infections. HABSIs require a positive blood culture and covered central-line–associated bloodstream infections, catheter-related bloodstream infections and non–device-associated infections. SSI included cellulitis, abscesses, organisms isolated from normally sterile body fluids, and infections following surgical procedures. HAP/VAP were all pneumonia cases acquired by patients during their stay.

To ensure that all HAIs were covered, we created a fifth type of HAI to include *Clostridioides difficile*, bloodborne, gastrointestinal, and vaccine preventable infections. HAIs that can be assigned to >1 category were also part of this group. Excessively rare or eradicated diseases in Belgium were omitted.

We used these categories to detect stays during which HAIs occurred. Due to the nature of the database, and to facilitate comparison with other studies, we subsequently estimated yearly prevalence for each HAI type and the total of all HAIs combined.[21] The variable, whether HAI-infected or not, was integrated into models as the main exposure to detect associations of interest.

Outcomes

The 2 outcomes under study were related with postdischarge aspects, which were posthospital discharge destinations, focusing on LTCFs, and early readmission. Early readmission was defined as an unplanned readmission to the same hospital within 30 days after discharge, regardless of the cause. In addition, we identified fatal cases.

Confounders

Age at admission, sex, LOS, ICU stay, severity of illness (SOI) score,[22] and place of residence prior to hospital admission (eg, home, nursing home or equivalent) were considered possible confounders.

Statistical analysis

We proceeded with univariable analysis to examine the association between HAIs, LTCF discharge, early readmission, and possible confounders for each yearly database as well as all databases combined. We assessed strength of evidence with χ^2 test. Odds ratios (ORs) and their 95% confidence interval (CIs) were used, comparing hospital stays without HAI and those with HAI.

We tested for confounding and effect modification with stratified analyses using Mantel-Haenszel methods. A 10% change between crude and adjusted summary effect measures was a criterion to determine whether the variable was a confounder or not.

We developed 2 multivariable logistic regression models, 1 for LTCF discharge and 1 for early readmission, controlling simultaneously for confounders, to report adjusted odds ratios (aOR). A test of departure for linear trend was used for ordinal variable. An interaction term was added in case of relevant effect modification.

We assessed time trends by plotting prevalences on a graph and by testing the hypothesis of no difference between yearly prevalences, for which we observed changes with a test on the equality of proportions. We used a test of departure for linear trend with a likelihood ratio test to estimate the effect of time on LTCFs

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discharge and early readmission. The model assuming a linear trend over time was compared to the model relaxing the assumption of linearity with the year of admission variable. To account for demographic changes over time, we used methods of direct standardization by age and sex with the total of the study population.

All analyses were carried out using Stata version 16.1/IC software (StataCorp, College Station, TX). Graphs have been created with Microsoft Excel software (Microsoft, Redmond, WA).

Ethics

This analysis received ethical approvals from the London School of Hygiene & Tropical Medicine MSc Ethics Committee (no. 27989/RR/29018).

Results

Hospital stays

Among the Brussels population, 1,915,572 hospital stays were registered throughout the study period, ranging from 146,853 hospital stays in 2020 to 166,723 in 2018. As detailed in Table 1, 77,004 HAIs were detected between 2008 and 2020. After removal of duplicates and combination of codes, 51,784 admissions were concerned with at least 1 HAI.

Prevalence and trends of hospital-associated infections

The overall prevalence of a minimum of 1 HAI was 2.70% (95% CI, 2.68–2.73) during the study period. HAUTIs were the most frequent HAIs from 2008 to 2014, whereas the "other HAIs" category was the most represented from 2016 to 2020. SSIs were the least common. Overall, HAIs prevalence decreased from 2012 to 2014 (from crude prevalence of 5.17% to 2.19%; $P < .001$). In contrast, there was a slight increase of all HAIs between 2016 and 2018 (from 3.30% to 3.54%; $P < .001$). The year 2020 was marked by an increase of all types of HAIs except for SSIs over 2019 (3.38% to 4.06%; $P < .001$).

Age- and sex-standardized prevalences are presented in Figure 1. The prevalence of HAUTIs decreased to levels comparable to the "other HAIs" category from 2008 to 2014, with the latter HAI type having the greatest increase between 2019 and 2020. From 2011 to 2020, HAP/VAP and HABSI followed similar trends.

Associations between hospital-associated infections, long-term care facility discharge, and early readmission

Distribution of outcomes is illustrated in Figure 2. The case fatality risk for all HAIs was 16.33% and ranged from 13.63% in 2017 to 21.05% in 2020. The maximum number of transfers in the HAI group from hospitals to LTCFs occurred in 2012 (n = 1,402), and the minimum in 2014 (n = 617), totaling 12,613 discharges (24.36% of HAI hospitalizations).

Regarding early readmission, 6,997 HAI-infected patients were admitted to the same hospital within 30 days (13.51% of HAI hospitalizations, compared to 10.19% of hospitalizations without HAI). Median time between discharge and early readmission was 11 days (interquartile range [IQR], 5–19) for the HAI group, and 12 days (IQR, 6–20) for patients without HAI.

Stratified analyses showed that the association between HAI and LTCF discharge was confounded by age category, LOS, ICU stays, SOI score, and place of residence, whereas LOS and SOI score acted as confounders for the association between HAI and early readmission (see Supplementary Material online). Strong evidence of interaction was detected for these associations with the LOS variable.

The final models for factors associated with LTCF discharge and early readmission are shown in Tables 2 and 3, with stratum-specific estimates for LOS. Regarding LTCF discharge, among those who had a LOS <4 days, we found no evidence of an association (aOR, 1.14; 95% CI, 0.97–1.35; $P = .121$), whereas among those who had a LOS ≥4 days, HAIs were associated with higher odds of LTCF discharge (aOR, 1.25; 95% CI, 1.22–1.28). No linear time trend was detected ($P < .001$).

Regarding early readmission, we found no evidence of an association for admissions with HAI among the group with LOS <4 days (aOR, 1.10; 95% CI, 0.97–1.24; $P = .143$). People with HAI who were hospitalized ≥4 days had a 12% reduction in odds of early readmission (aOR, 0.88; 95% CI, 0.85–0.90). Furthermore, LOS stratum-specific estimates show a protective effect against early readmission for both HAI and non-HAI groups with LOS ≥4 days (aOR, 0.75; 95% CI, 0.66–0.85) compared with hospital admissions of <4 days (aOR, 0.94; 95% CI, 0.93–0.95). We detected evidence for a departure from a linear time trend ($P < .001$).

Table 4 describes yearly crude and fully adjusted odds ratios for LTCF discharge and early readmission after having acquired an HAI. From 2008 to 2020, HAIs were associated with higher odds of LTCF discharge, except for 2014 (aOR, 0.94; 95% CI, 0.85–1.05), and with lesser odds of early readmission between 2008 to 2011 and from 2018 to 2020.

Discussion

Substantial changes in trends of different HAI types over time occurred throughout the study period. The most frequently detected HAI types were HAUTI from 2008 to 2014, and the "other HAIs" category from 2016 to 2020, whereas the least frequent was SSI. All HAIs decreased from 2012 to 2014. From 2011 to 2014 and from 2016 to 2019, HABSI and HAP/VAP followed similar patterns. A major increase of all HAIs, except SSIs, was evident in 2020.

Mantel-Haenszel estimates provided indications that LOS acted as effect modifier for associations of interest. Compared with no HAI, individuals with HAI and a LOS >4 days had higher odds of LTCF discharge and lower odds of early readmission. The final yearly models further suggested that HAIs were associated with higher odds of LTCF discharge and with lower odds of early readmission.

These findings are consistent each other. If patients infected with an HAI have higher odds of being admitted to a LTCF immediately after their hospital stay, a follow-up should be considered, and further medical care can be provided by the LTCF. Consequently, they would be less likely readmitted to the same hospital within 30 days. The interaction could be related to the elderly being more likely to have a short admission and be discharged back to an LTCF.

This observation highlights the importance of postdischarge surveillance. Specifically, planning SSIs surveillance with the help of surgeons, and prevalence surveys within LTCFs, contribute to assessments of community-onset infections.

Interestingly, the clear increase of all HAIs with the exception of SSIs in 2020 is indicative of the COVID-19 pandemic during which the risk of HAI rose[23] and many nonurgent elective surgeries were postponed.[24] Identical patterns were described in the United

Table 1. Distribution of Hospital-Associated Infection (HAI) Occurrences Among Classic Hospitalizations (Admissions for >1 Day) From People From the Brussels-Capital Region, from 2008 to 2020 (except 2015)[a,b]

Variable	2008 (n= 151,934)	2009 (n=156,640)	2010 (n=158,242)	2011 (n=159,926)	2012 (n=162,690)	2013 (n=161,227)	2014 (n=161,708)	2016 (n=163,277)	2017 (n=163,421)	2018 (n=166,723)	2019 (n=162,931)	2020 (n=146,853)	Total (N= 1,915,572)
HAUTI, No.	2,575	2,464	2,519	2,773	2,629	2,039	1,154	1,410	1,463	1,545	1,371	1,360	23,302
HABSI, No.	899	950	1,029	1,078	1,224	888	454	708	692	804	778	844	10,348
SSI, No.	723	796	797	883	958	654	369	590	587	610	627	499	8,093
HAP/VAP, No.	1,110	1,184	1,207	1,114	1,275	942	552	792	751	860	843	1,061	11,691
Other HAIs, No.	2,103	1,978	2,128	2,286	2,320	1,749	1,016	1,882	1,938	2,081	1,887	2,202	23,570
Total HAIs, No. % (95% CI)	7,410 4.88 (4.78–4.99)	7,372 4.71 (4.60–4.81)	7,680 4.85 4.75–4.96)	8,134 5.09 (4.98–5.19)	8,406 5.17 (5.06–5.28)	6,272 3.89 (3.80–3.99)	3,545 2.19 (2.12–2.26)	5,382 3.30 (3.21–3.38)	5,431 3.32 (3.24–3.41)	5,900 3.54 (3.45–3.63)	5,506 3.38 (3.29–3.47)	5,966 4.06 (3.96–4.16)	77,004 4.02 (3.99–4.05)
Admission with ≥1 HAI, No.[c] % (95% CI)	5,266 3.47 (3.37–3.56)	5,203 3.32 (3.23–3.41)	5,407 3.42 (3.33–3.51)	5,675 3.55 (3.46–3.64)	5,906 3.63 (3.54–3.72)	4,460 2.77 (2.69–2.85)	2,523 1.56 (1.50–1.62)	3,382 2.07 (2.00–2.14)	3,345 2.05 (1.98–2.12)	3,621 2.17 (2.10–2.24)	3,391 2.08 (2.01–2.15)	3,605 2.45 (2.38–2.54)	51,784 2.70 (2.68–2.73)

Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.
Note. HAUTI, hospital-associated urinary tract infection. HABSI, hospital-associated bloodstream infection. SSI, surgical-site infection. HAP/VAP, hospital-associated pneumonia/ventilator-associated pneumonia. CI, confidence interval.
[a]>1 HAI occurrence can be encoded per admission.
[b]Excludes 142 observations.
[c]After removal of duplicates or multiple codes to only keep 1 code per admission.

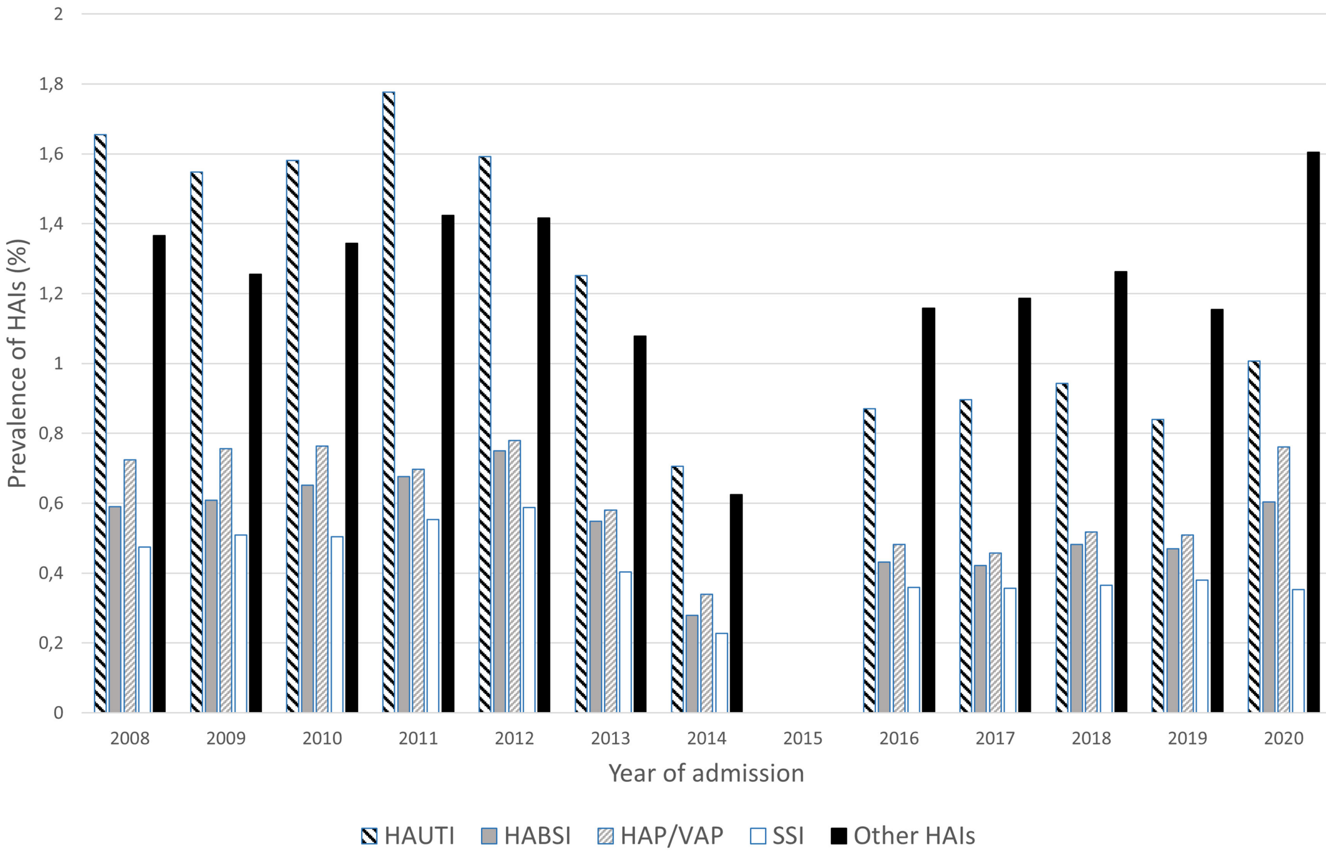

Figure 1. Age- and sex-standardized prevalence of hospital-associated infection (HAI) types among hospitalized people from the Brussels–Capital Region between 2008 and 2020 (2015 excepted) (N=1,915,572), using the total of the study population as standard population. Identification of HAIs was based upon International Classification of Diseases (ICD) codes (ICD-9-CM for 2008–2014 and ICD-10-BE for 2016–2020) applied retrospectively with hospital administrative data. HAIs include hospital-associated urinary tract infection (HAUTI), hospital-associated bloodstream infection (HABSI), hospital-associated pneumonia/ventilator-associated pneumonia (HAP/VAP), surgical-site infection (SSI), and other HAIs. Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.

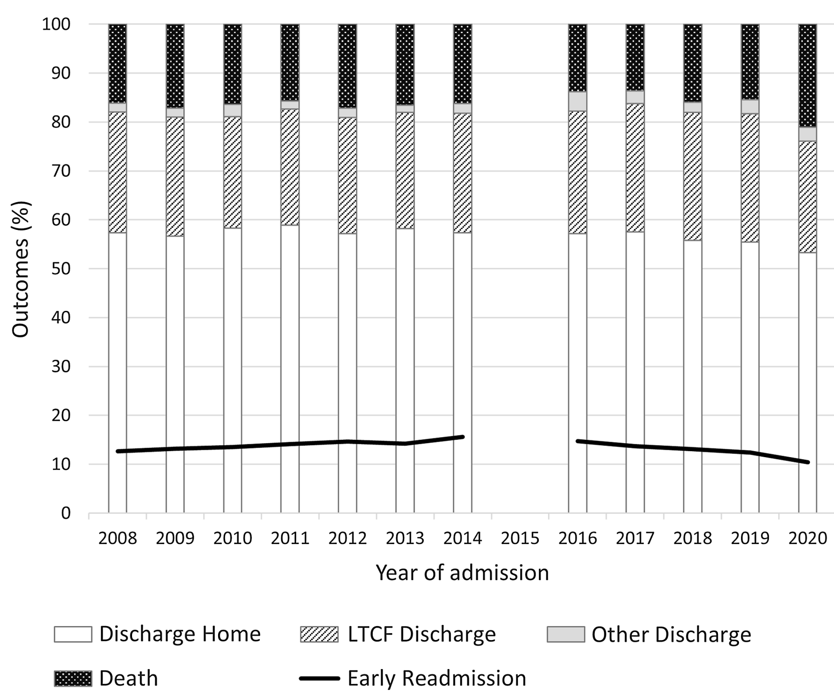

Figure 2. Distribution (in percentage) of post-hospital discharge destinations and outcomes among admissions with at least one hospital-associated infection (HAI) from the Brussels–Capital Region, from 2008 to 2020 (except 2015) (n=51,784). Destinations were either home, long-term care facility (LTCF) or other (including prisons, boarding schools and unknown). Early readmission was defined as an unplanned readmission to the same hospital within 30 days after discharge. Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.

Table 2. Final Model With Fully Adjusted Odds Ratios for Factors Associated With Hospital-Associated Infection (HAI) and Long-Term Care Facility (LTCF) Discharge, With Stratum-Specific Associations[a]

Variable	Fully Adjusted Odds Ratio for LTCF Discharge	95% CI	*P* Value[b]
HAI (stratum-specific)			
Length of stay <4 d			
No-HAI	Reference		
HAI	1.14	0.97 to 1.35	.121
Length of stay ≥4 d			
No-HAI	Reference		
HAI	1.25	1.22 to 1.28	<.001
Length of stay (stratum-specific)			
No-HAI			
<4 d	Reference		
≥4 d	2.18	2.15 to 2.22	<.001
HAI			
<4 d	Reference		
≥4 d	2.38	2.01 to 2.82	<.001
Age category			<.001[c]
<31 y	Reference		
≥31–52 y	1.20	1.16 to 1.23	<.001
≥52–73 y	2.32	2.26 to 2.38	<.001
≥73 y	6.27	6.13 to 6.42	<.001
ICU stay			
No	Reference		
Yes	1.05	1.03 to 1.07	<.001
Severity of illness score			<.001[c]
1	Reference		
2	1.45	1.42 to 1.48	<.001
3	2.09	2.05 to 2.13	<.001
4	2.03	1.98 to 2.08	<.001
Place of residence			
Not LTCF	Reference		
LTCF	6.91	6.81 to 7.00	<.001
Year of admission			<.001[c]

Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.
Note. CI, confidence interval. ICU, intensive care unit.
[a]Total N=1,915,430 (excludes 142 observations).
[b]From likelihood-ratio test.
[c]From test of departure from linear trend.

Table 3. Final Model With Fully Adjusted Odds Ratios for Factors Associated with Hospital-Associated Infection (HAI) and Early Readmission (<30 days), With Stratum-Specific Associations[a]

Variable	Fully Adjusted Odds Ratio for Early Readmission	95% CI	*P* Value[b]
HAI (stratum-specific)			
Length of stay <4 d			
No-HAI	Reference		
HAI	1.10	0.97–1.24	.143
Length of stay ≥4 d			
No-HAI	Reference		
HAI	0.88	0.85–0.90	<.001
Length of stay (stratum-specific)			
No-HAI			
<4 d	Reference		
≥4 d	0.94	0.93–0.95	<.001
HAI			
<4 d	Reference		
≥4 d	0.75	0.66–0.85	<.001
Severity of illness score			<.001[c]
1	Reference		
2	1.89	1.87–1.91	<.001
3	2.74	2.70–2.78	<.001
4	2.89	2.83–2.96	<.001
Year of admission			<.001[c]

Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.
Note. CI, confidence interval.
[a]Total N=1,915,430 (excludes 142 observations).
[b]From likelihood-ratio test.
[c]From test of departure from linear trend.

States,[25,26] and in the countrywide HABSI surveillance.[27] A similar trend applied to the case fatality risk, which was the highest in 2020 (21.05%). Delayed patient care and poorer infection prevention and control (IPC) measures, due to the heavy workload that healthcare-workers were facing, might explain this increase. The assignment of workers in unfamiliar departments due to staff shortages, and performing procedures or care they were not accustomed to, could have contributed to lower IPC compliance. Patient characteristics upon admission had also shifted during COVID-19 waves, with more severely ill patients requiring complex care.[28]

Strengths and limitations

The major strengths of this analysis are the long study period and the sample size, which allowed us to compensate for the generally low statistical power of test for interaction. Furthermore, the data sets are considered exhaustive and complete, meaning that they captured all admissions with no missing data. Additionally, variables are measured the same way across the entire study period. The methodology, which included critical review of literature and ICD reference manuals, allowed comparison between the pre-2015 and post-2015 periods with detailed ICD code conversions. Also, we assessed mortality, which is not always feasible in surveillance programs.[29]

This study had several limitations. First, misclassification of exposure is inherent to this type of analysis because ICD codes are not as sensitive for identification of HAIs as traditional methods of surveillance.[30–34] Moreover, ICD-9-CM and ICD-10-BE classifications are not fully comparable because some codes are not equivalent across systems. Likewise, all HAIs are not

Table 4. Yearly Crude and Fully Adjusted Odds Ratios (ORs) for Long-Term Care Facility (LTCF) Discharge or Early Readmission (<30 days), After Having Acquired an Hospital-Associated Infection (HAI)

	OR for LTCF Discharge		OR for Early Readmission	
Year	Crude OR (95% CI)	Adjusted OR (95% CI)[a]	Crude OR (95% CI)	Adjusted OR (95% CI)[b]
2008	4.28 (4.01–4.57)	1.23 (1.13–1.33)	1.23 (1.13–1.34)	0.83 (0.76–0.90)
2009	4.03 (3.78–4.31)	1.16 (1.07–1.26)	1.29 (1.19–1.40)	0.83 (0.76–0.91)
2010	3.71 (3.47–3.97)	1.10 (1.01–1.19)	1.29 (1.19–1.40)	0.88 (0.81–0.96)
2011	4.00 (3.75–4.27)	1.27 (1.17–1.37)	1.36 (1.26–1.47)	0.90 (0.83–0.97)
2012	3.93 (3.69–4.18)	1.26 (1.17–1.36)	1.43 (1.33–1.54)	0.92 (0.85–1.00)
2013	3.78 (3.52–4.06)	1.21 (1.11–1.32)	1.33 (1.22–1.45)	0.91 (0.84–1.00)
2014	3.70 (3.38–4.06)	0.94 (0.85–1.05)	1.47 (1.32–1.64)	1.01 (0.90–1.13)
2016	4.06 (3.74–4.39)	1.47 (1.34–1.62)	1.38 (1.25–1.52)	0.94 (0.85–1.04)
2017	4.22 (3.90–4.57)	1.42 (1.29–1.56)	1.55 (1.40–1.71)	0.97 (0.88–1.08)
2018	4.38 (4.05–4.72)	1.46 (1.33–1.60)	1.47 (1.34–1.63)	0.87 (0.78–0.96)
2019	4.42 (4.08–4.78)	1.49 (1.36–1.64)	1.41 (1.27–1.56)	0.84 (0.75–0.94)
2020	4.17 (3.84–4.52)	1.29 (1.17–1.42)	1.37 (1.23–1.52)	0.81 (0.72–0.90)

Data Source: Minimal Hospital Dataset (MHD), Belgian Federal Public Service Health Food Chain Safety and Environment.
Note. CI, confidence interval.
[a]Adjusted for age category, length of stay (LOS), ICU stay, severity of illness (SOI) score and place of residence.
[b]Adjusted for LOS and SOI score.

equivalent in severity. The lack of standardized methods to assess HAI with ICD-codes could be an issue because the classification process may occasionally rely on subjective interpretation to decide whether the infection was absent upon admission (by the physician in charge of the patient or the encoder) and in which category the HAI belongs (eg, aspergillosis, which can be disseminated or pulmonary). Another phenomenon that must be considered is the deliberate overvaluation of codes associated with higher payment; misuse has already been noted in Belgium.[35] The HAI decline from 2012 to 2014 remained unexplained and could be attributed to a drop in reporting in anticipation of the transition to the new ICD coding.

The overall prevalence of the occurrence of 1 or more HAIs was 2.70%, which is lower than the 7% that has been reported in high-income countries[36] and the overall 7.30% detected in 2017 in Belgium.[29] This lower prevalence could be related to the study population, and the database choice because both numerator (HAIs retrospectively coded) and denominator (inhabitants instead of hospitals) differ. Furthermore, community-onset HAIs, particularly SSIs, would be diagnosed during ambulatory follow-up and may have been underestimated. Thus, administrative data can be useful to detect trends, but they might not be valid enough to capture HAIs as accurately as surveillance systems.[30,34]

Due to the limited number of variables, residual confounding may have occurred. Other factors may have confounded associations of interest such as invasive device use (eg, duration or material) or socioeconomic status.[37] Moreover, the datasets did not allow for examination of between-hospital readmissions, resulting in nondifferential misclassification of outcome. Generalizability to other populations, even within Belgium, is also limited. Disparities regarding social determinants of health are present between the 3 Belgian regions, rendering comparisons more complex.[38]

In conclusion, this analysis sheds further light on the importance of LOS. There are historical and recent financial incentives for hospitals to shorten LOS in Belgium[39] and in other European countries.[40] This finding could affect early readmission after discharge if quality of care and specific support during hospitalization are suboptimal. Continuity of care should be anticipated by identifying early risk factors of readmission (eg, sociodemographic factors)[37] during the index hospitalization, enabling targeted interventions.

Because long LOS is both a cause and effect of HAI occurrence, further research should be conducted using time-varying methods. Considering the COVID-19 pandemic, a high level of HAI surveillance should be maintained from 2021 onward, and cost-effectiveness of IPC measures should be re-evaluated based on subsequent findings.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2023.161

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