Hospitalisation profile in England and Wales, 1999 to 2019: an ecological study

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ABSTRACT
Objective Hospital-related indicators are used to prioritise, benchmark and monitor certain healthcare components to improve quality. This study aimed to determine the hospital admissions profile in England and Wales between 1999 and 2019.

Design Ecological study.

Setting A population-based study of hospitalised patients in England and Wales.

Participants All patients of all ages and genders who were hospitalised in National Health Service (NHS) hospitals and NHS-funded independent sector hospitals.

Outcome measure Hospital admission rates in England and Wales related to various diseases/causes, which were identified using the diagnostic codes (A00-Z99).

Results There was a 48.5% rise in hospital admission rates from 246 366.7 (95% CI 246 249.8 to 246 483.7) in 1999 to 365 858.7 (95% CI 365 736.3 to 365 981.2) in 2019 per million persons (p<0.05). The most common causes of hospital admissions were diseases of the digestive system; symptoms, signs, and abnormal clinical and laboratory findings; and neoplasms, which accounted for 11.5%, 11.4% and 10.5%, respectively. The age range of 15–59 years accounted for 43.4% of all hospital admissions. Around 56.0% of all hospital admissions were by female patients. In comparison to 1999, the hospital admission rate for males grew by 53.7%, from 218 618.9 (95% CI 235 448.1 to 235 789.6) per million persons in 2019. When compared with 1999, the hospital admission rate for females increased by 44.7%, rising from 273 032.5 (95% CI 272 863.5 to 273 201.5) to 395 154.6 (95% CI 394 979.9 to 395 329.4) per million persons.

Conclusion A notable increase was observed in the rate of hospital admissions for all causes in England and Wales. Elderly age and female gender were significant factors that influenced the rate of hospital admissions. Future research is required to identify preventable risk factors for hospital admission.

INTRODUCTION
Hospital admission is an official process that accompanies a decision performed by a certified clinical practitioner at the concerned hospital that a patient’s state necessitates admission for proper care, an estimate of needs, or proper management or treatment of their condition. Patients are regularly admitted to the hospital as either a booked admission or an emergency. Most patients get services in the hospital with a booked admission (optional), as either an inpatient or a same-day patient. Emergency admission patients are regularly admitted within the Accident and Emergency department; these are patients who require urgent treatment or are critically injured.

Most patients who have had an episode of hospital care express contentment with the hospital services on discharge. Nevertheless, patient admission to inpatient care is a complicated process that, unless carefully administered, can cause lengthy lags in service and consequently a bad patient experience. Waiting for the allocation of a bed or acceptance papers can be disappointing for anybody. However, waiting times can become physically and emotionally exhausting for the tired mother who has a crying baby who requires admission or for patients. Hospital admission carries a risk of harm. In addition, hospital admission itself also carries the risk of adverse issues, in addition to those linked to any medical therapy performed. These risks rarely involve death, injury or cross-infection.

Hospital admissions associated indicators (including demographics and characteristics) are employed to measure qualitative and quantitative care and are usually related to outcomes, processes and structure. Hospital-associated indicators represent specific healthcare aspects applied for constant quality enhancement by prioritising activities, benchmarking and monitoring. Data on the quality of care play a leading role in healthcare planning and improvement. Attention
to the quantitative evaluation of healthcare quality has risen as an outcome of the following: proof of variance in the quality of care, rising costs and the increasing requirement for healthcare. Moreover, today’s community wants perpetually additional transparency, which requires the healthcare sector and other public sectors to give insight into their performance. Additionally, various stakeholders may use the quality of care data for diverse planning objectives. Previous studies in the UK examined the hospital admission profile for specific acute and chronic diseases or a specific age group, with no previous study that examined the admission profile for all conditions among all age groups. This study aimed to determine the hospital admissions profile in England and Wales during the period between 1999 and 2019. Consequently, this study will help in evaluating the efficiency of healthcare in England and Wales and direct planning and management efforts more effectively.

RESULTS
The total annual number for all hospital admissions for all causes increased by 69.3% from 12845586 in 1999 to 21746585 in 2019, representing an increase in hospital admission rate of 48.5% (from 246366.7 (95% CI 246 249.8 to 246 483.7) in 1999 to 365 858.7 (95% CI 365 736.3 to 365 981.2) in 2019 per million persons, \( p < 0.05 \)).

The most common causes of hospital admissions were diseases of the digestive system, symptoms, signs, and abnormal clinical and laboratory findings, and neoplasms which accounted for 11.5%, 11.4% and 10.5%, respectively (table 1).

Between 1999 and 2019, hospital admissions for all causes increased, except for diseases of the ear and mastoid process, pregnancy, childbirth and puerperium, and factors influencing health status and contact with health services, which decreased (table 2, figure 1).

Concerning age group differences for all causes of hospital admission, the age group 15–59 years accounted for 43.4% of the entire number of hospital admissions, followed by the age group 75 years and above with 23.1%, the age group 60–74 years with 21.9%, and then the age group below 15 years with 11.7%. Rates of hospital admission for all causes among patients aged below 15 years increased by 15.7% (from 177 439.6 (95% CI 177 201.7 to 177 677.5) in 1999 to 205 276.1 (95% CI 205 034.3 to 205 517.8) in 2019 per million persons). Rates of hospital admission among patients aged 15–59 years increased by 33.4% (from 191 098.3 (95% CI 190 960.8 to 191 235.9) in 1999 to 254 883.4 (95% CI 254 737.8 to 255 029.1) in 2019 per million persons). Rates of hospital admission among patients aged 60–74 years increased by 45.6% (from 375 768.8 (95% CI 375 408.3 to 376 129.2) in 1999 to 546 998.7 (95% CI 546 677.8 to 547 319.7) in 2019 per million persons). Rates of hospital admission among patients aged 75 years and older increased by 74.3% (from 627 731.9 (95% CI 626 972.1 to 628 491.8) in 1999 to 1094 394.0 (95% CI 1093 535.3 to 1095 252.6) in 2019 per million persons) (figure 2).

Admissions rates by gender
A total of 339 508 769 hospital admission episodes were reported in England and Wales throughout the study duration. Females contributed to 55.7% of the entire number of hospital admissions, accounting for 189 159 003 hospital admission episodes, or a mean of 945 795 950 per year. Hospital admission rate among males increased by 53.7% (from 218 363.7 (95% CI 218 203.2 to 218 524.3) in 1999 to 335 618.9 (95% CI 335 448.1 to 335 789.6) in 2019 per million persons). Hospital admission rate among females increased by 44.7% (from 273 032.5 (95% CI 272 863.5 to 273 201.5) in 1999 to 395 154.6 (95% CI 394 979.9 to 395 329.4) in 2019 per million persons) (figure 3).

Admission rates stratified by disease and gender
Hospital admission rates for the following 11 diseases or causes (infectious and parasitic diseases, neoplasms,
On the other hand, hospital admission rates for the following nine diseases or causes (diseases of the blood and blood-forming organs and disorders involving the immune mechanism, endocrine, nutritional and metabolic diseases, diseases of the nervous system, diseases of the eye and adnexa, diseases of the circulatory system, diseases of the digestive system, diseases of the skin and subcutaneous tissue, diseases of the musculoskeletal system and connective tissue, diseases of the genitourinary system, symptoms, signs and abnormal clinical and laboratory findings, and injury, poisoning and certain other consequences of external causes) were higher among females compared with males (p<0.05) (figure 4).

Admission rates by age group

The rate of hospital admissions for most of the diseases observed to be directly related to the patients’ age; as the patients’ age increased, the admission rates increased. This includes the following: neoplasms, diseases of the blood and blood-forming organs and disorders involving the immune mechanism, endocrine, nutritional and metabolic diseases, diseases of the nervous system, diseases of the eye and adnexa, diseases of the circulatory system, diseases of the digestive system, diseases of the skin and subcutaneous tissue, diseases of the musculoskeletal system and connective tissue, diseases of the genitourinary system, symptoms, signs and abnormal clinical and laboratory findings, and injury, poisoning and certain other consequences of external causes. Moreover, hospital admissions due to diseases of the respiratory system were more prevalent among the age group 75 years and older followed by 60–74 years. Hospital admissions due to mental, behavioural and neurodevelopmental disorders were more prevalent among the age group 75 years and older, followed by 15–59 years. Hospital admissions due to certain infectious and parasitic diseases were more prevalent among the age group 75 years and older, followed by below 15 years. Hospital admissions due to pregnancy, childbirth and puerperium were more prevalent among the age group 15–59 years. Hospital admissions due to diseases

### Table 1 Percentage of each hospital admission from total number of admissions per ICD code

<table>
<thead>
<tr>
<th>ICD code</th>
<th>Description</th>
<th>Percentage from total number of admissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A00-B99</td>
<td>Certain infectious and parasitic diseases</td>
<td>2.0%</td>
</tr>
<tr>
<td>C00-D49</td>
<td>Neoplasms</td>
<td>10.5%</td>
</tr>
<tr>
<td>D50-D89</td>
<td>Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism</td>
<td>1.7%</td>
</tr>
<tr>
<td>E00-E89</td>
<td>Endocrine, nutritional and metabolic diseases</td>
<td>1.6%</td>
</tr>
<tr>
<td>F01-F99</td>
<td>Mental, behavioural and neurodevelopmental disorders</td>
<td>1.4%</td>
</tr>
<tr>
<td>G00-G99</td>
<td>Diseases of the nervous system</td>
<td>2.2%</td>
</tr>
<tr>
<td>H00-H59</td>
<td>Diseases of the eye and adnexa</td>
<td>3.4%</td>
</tr>
<tr>
<td>H60-H95</td>
<td>Diseases of the ear and mastoid process</td>
<td>0.5%</td>
</tr>
<tr>
<td>I00-I99</td>
<td>Diseases of the circulatory system</td>
<td>8.1%</td>
</tr>
<tr>
<td>J00-J99</td>
<td>Diseases of the respiratory system</td>
<td>7.1%</td>
</tr>
<tr>
<td>K00-K95</td>
<td>Diseases of the digestive system</td>
<td>11.5%</td>
</tr>
<tr>
<td>L00-L99</td>
<td>Diseases of the skin and subcutaneous tissue</td>
<td>2.1%</td>
</tr>
<tr>
<td>M00-M99</td>
<td>Diseases of the musculoskeletal system and connective tissue</td>
<td>6.7%</td>
</tr>
<tr>
<td>N00-N99</td>
<td>Diseases of the genitourinary system</td>
<td>6.3%</td>
</tr>
<tr>
<td>O00-O9A</td>
<td>Pregnancy, childbirth and puerperium-related complications</td>
<td>8.1%</td>
</tr>
<tr>
<td>P00-P96</td>
<td>Certain conditions originating in the perinatal period</td>
<td>1.4%</td>
</tr>
<tr>
<td>Q00-Q99</td>
<td>Congenital malformations, deformations and chromosomal abnormalities</td>
<td>0.7%</td>
</tr>
<tr>
<td>R00-R99</td>
<td>Symptoms, signs and abnormal clinical and laboratory findings related complications</td>
<td>11.4%</td>
</tr>
<tr>
<td>S00-T88</td>
<td>Injury, poisoning and certain other consequences of external causes</td>
<td>6.5%</td>
</tr>
<tr>
<td>Z00-Z99</td>
<td>Factors influencing health status and contact with health services related complications</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

*All hospital admissions documented in National Health Service (NHS) and NHS-funded independent sector hospitals were accounted for. ICD, International Statistical Classification of Diseases.
of the ear and mastoid process, and factors influencing health status and contact with health services were more prevalent among the age group below 15 years, followed by 15–59 years. Hospital admissions due to certain conditions originating in the perinatal period were more prevalent among the age group below 15 years, followed by 15–59 years. Hospital admissions due to congenital malformations, deformations and chromosomal abnormalities were more prevalent among the age group below 15 years (figures 5 and 6).

**DISCUSSION**

This study aimed to describe the hospitalisation profile in England and Wales in the past 20 years and highlight disease areas and patient groups that dominate hospital admissions. The key findings are: (1) A notable increase was observed in the rate of hospital admissions for all diseases and causes in England and Wales, representing an increase in hospital admission rate of 48.5%, with an average increase of 2.4% per year during the period between 1999 and 2019, (2) The leading causes of hospital...
admissions were diseases of the digestive system, symptoms, signs and abnormal clinical and laboratory findings, and neoplasms, (3) Elderly age and female gender were significant factors that influenced the rate of hospital admission for multiple causes, (4) Hospital admission for all causes increased, except for diseases of the ear and mastoid process, pregnancy, childbirth and puerperium, and factors influencing health status and contact with health services, which decreased, (5) The age group 15–59 years had the highest share of hospital admissions (43.4%), and (6) Females contributed for more than half of the number of hospital admissions (55.7%).

**Hospital admission rate**

In this study, an increase in hospital admission rate of 48.5% (from 246,366.7 (95% CI 246,249.8 to 246,483.7) in 1999 to 365,858.7 (95% CI 365,736.3 to 365,981.2) in 2019 per million persons, p<0.01) was observed. This increase could reflect an increase in the population of

![Figure 1](image1.png) **Figure 1** Rates of hospital admission for all diseases in England and Wales, stratified by type, between 1999 and 2019.

![Figure 2](image2.png) **Figure 2** Rates of hospital admission for all diseases in England and Wales, stratified by age group.
England and Wales or an actual increase in the hospital admission rate due to existing clinical problems that face the patients and require a higher level of medical attention and lead to hospital admission. Comparing the increase in the absolute number of hospital admissions to the increase in the population during the same period, the increase in hospital admissions is much higher than that for the population.\textsuperscript{21} During the study period (1999–2019) the population in England and Wales increased by 14.0% (from 52\,140\,100 to 59\,439\,840), while the number of hospital admissions increased by 69.3% (from 12\,845\,586 to 21\,746\,585). Similar findings were observed when comparing the increase in the number of hospital admissions for males and females separately (77.5% for males and 62.9% for females) to the increase in the population of males and females (12.5% for males and 12.6% for females) during the same period.\textsuperscript{21} Additionally, the increase in the number of hospital admissions across all age groups (below 15 years, 15–59 years, 60–74 years, and 75 years and older) (25.2%, 46.2%, 94.0%, and 126.2%) was not proportional to that regarding the increase in the population for each age group (8.2%, 9.6%, 33.3% and 29.7%).\textsuperscript{21}

This was aligned with the findings of previous studies from different countries.\textsuperscript{22–24} Between 1999 and 2014, the annual hospital admission rate per 1000 persons increased
During the same period, the yearly hospital admission rate for all diseases in England and Wales for patients aged 60 years and older.

![Figure 5](image)

**Figure 5** Hospital admission rates for all diseases in England and Wales for patients younger than 60 years.

by 37.8% (from 246.37 to 339.40) in the present study. During the same period, the yearly hospital admission rate per 1000 persons increased by 122.9% (from 16.6 to 37.0) in India. However, the age-standardised rate of hospital admissions declined by 10.2% (from 69.8% to 54.2%) in Brazil during the same period. For Australians, the

![Figure 6](image)

**Figure 6** Hospital admission rates for all diseases in England and Wales for patients aged 60 years and older.
age-adjusted hospital admission rates (excluding dialysis) increased by 48.0% between 2004/2005 and 2016/2017. In the present study, the hospital admission rates have increased by 28.2% between 2004/2005 and 2016/2017. However, it is worth mentioning that different methodologies were used across different studies, which might have contributed to the difference in admission rates estimates. Zhao et al.25 used data from the Brazilian Unified Health System to analyse hospital admissions in 1816 cities between 2000 and 2015. Another study in India used cross-sectional nationwide surveys between 1995 and 2014 to examine the hospitalisation trends for different age groups across the states of India.22

Most common causes of hospital admission
In the present study, the principal causes of hospital admissions were diseases of the digestive system, symptoms, signs and abnormal clinical and laboratory findings, neoplasms, and diseases of the circulatory system. There is a significant increase in most gastrointestinal diseases in the UK, and the burden of these diseases is heavy on the National Health Service (NHS), patients and economy, affecting future healthcare needs.26 The reasons mentioned above may have contributed to the increase in hospitalisation due to gastrointestinal diseases, as found in the present study. In 2018, the most common hospital admission causes in a Canadian study were diseases of the circulatory system, followed by diseases of the digestive system, diseases of the respiratory system, and injury and poisoning.27 In a previous study in Singapore, from 2012 to 2018, the most common hospital admission causes were accidents, poisoning, violence, cancer, pneumonia and ischaemic heart diseases.28 Between July 2015 and June 2017, the most common hospital admission causes in Australia were care involving dialysis, injury, poisoning and certain other consequences of external causes, diseases of the respiratory system, and symptoms, signs and abnormal clinical and laboratory findings.29 In 2014, the most common diagnoses for hospital stays in the USA were pregnancy, childbirth, newborns, neonates, septicaemia and osteoarthritis.30 Previous literature revealed significant, unexplained variations in the patterns of unplanned hospitalisation in 22 countries throughout Europe, Australia and New Zealand.31 The variations are significant, ranging from 145 per 100 000 people per year in Italy to 282 per 100 000 people per year in Austria for involuntary hospitalisations. Although these results are compelling and consistent with earlier studies, it is important to keep in mind that comparisons across different countries are challenging. When residential facilities are included in bed counts, the number of beds in Italy is comparable to that in the UK and other countries, for instance, even though many patients with mental illness receive treatment there rather than in hospital units.32,33 Variations across studies may be attributable to a number of variables, including the time period analysed, the research method used, changes in healthcare systems and disparities in healthcare coverage.

Admissions rates by gender
Females accounted for more hospital admission episodes than males in England and Wales during the study period (contributed for 55.7% of the total number of hospital admissions). A previous study in Australia was in line with this finding, in which 53% of total hospital admissions were among females during 2017/2018.32 Similarly, in the USA, the rates of hospital stays were higher among females compared with males during the period between 2005 and 2014.28 The fact that hospital admissions for females include hospital stays for delivery and pregnancy is one of the major contributing factors to these findings.28

In the USA, the rate of hospital stays decreased by 15.3% among females and 10.0% among males between 2005 and 2014,28 while in the present study, the rate of hospital admissions increased by 24.4% among females and 27.9% among males during the same time interval. In India, there was an increase in the rate of hospitalisation in 2014, but the increase was higher among females than males (2.71-fold vs 1.89-fold).33 This study suggests that the difference in the rate of hospital admission from one area to another may be due to many factors, including the following: the median age of the population (life expectancy), treatment guidelines, environment, economic situation, education and knowledge degree.

In 2015, hospital admissions for injury and poisoning were higher among males than females in Brazil.23 In 2018, the proportion of hospital admissions for diseases of the circulatory system was higher among males than females, in Canada.34 Among the Danish population after age 50 years, hospital admissions for neoplasms, diseases of the blood and blood-forming organs, endocrine, nutritional and metabolic diseases, diseases of the eye and adnexa, musculoskeletal disorders and diseases of the genitourinary system were higher among females than males, and for ischaemic heart diseases, cerebrovascular diseases and other circulatory diseases, as well as due to diseases of the respiratory system, and diseases of the digestive system, were higher among males than females.35 The previous results were in line with the present results except for two points; in the present study, the difference between genders represented all age groups, and hospital admissions due to neoplasms were higher among males than females.

In the areas of physician and home care use, hospital service, outpatient surgery, and preventive services, gender variations in health and the use of health services have been recognised, specifically among the elderly.34,35 Compared with males, females are more likely to be older, disabled and have more health needs in terms of functional disabilities (mobility, difficulty climbing stairs and upper extremity problems).36 Moreover, males reported a higher prevalence of cancer, diabetes and heart disease, whereas females reported more arthritis, hypertension and poor vision.36 Another important factor is that females were less likely than males to use preventive healthcare, such as vaccinations and cholesterol screenings.36 Besides, females encounter more complications...
Admissions rates by age

In India, hospital admission rates increased with age between 1995 and 2014, with persons aged 70 years and older experiencing the largest increases. The hospital admission rate rose by 2.01-fold for the population <60 years and by 2.21-fold for the older age group. Between 1995 and 2014 in India, hospital admission rates for young individuals were more than three times lower than for old persons. The aforementioned results are consistent with the present study's finding that hospitalisation rates rise with age. From 1999 to 2019, the hospital admission rate in England and Wales for people 75 years of age and older climbed at the highest rate. In the present study, the hospital admission rate increased for patients under the age of 60 years by 29.4% and for patients over the age of 60 years by 58.8%. Additionally, 88.3% of all hospital admissions were for patients aged 15 years and above. Additionally, a previous study found that between 2005 and 2014, the Dutch population aged, which contributed to an increase in the rate of elderly hospitalisation, as is the situation in many other European countries. Age-related morbidity and chronic diseases may be responsible for a rise in elderly hospital admissions. In accordance with the aforementioned findings, a previous study conducted in Germany found that morbidity had a significant impact on hospital admission disparities, followed by changes in the number of the surviving population that varied widely throughout the age range.

Patients aged 65 years and older made up 42% of hospital admission episodes in Australia in 2017/2018, and between 2013/2014 and 2017/2018, the hospital admission episode grew by 28% for patients aged 65–74 years. Contrarily, between 2005 and 2014, the number of inpatient stays per 100,000 people in the USA fell for all age categories as follows: decreased by 18.0% for those aged 0–17 years, by 12.9% for those aged 18–44 years, and by 8.9% for those aged 45–64 years, 22.4% for those aged 65–74 years, and by 21.0% for those aged 75 and older.

Consistent with the present study, hospital admissions for diseases of the circulatory system were more common among the elderly according to the findings of a previous study in Canada in 2018. Between 1997 and 2009 in the USA, the hospital admissions per 100,000 population for diseases of the musculoskeletal system increased by 15%, and those for diseases of the circulatory system decreased by 13%. While in the present study, hospital admissions rates increased by 90% for diseases of the musculoskeletal system and connective tissue and by 23% for diseases of the circulatory system. In the end, growing older does not necessarily result in increased demand on the NHS’s limited resources or increased access to healthcare unless it is associated with higher rates of long-term problems and rising chronic disease.
leading cause of hospital admissions were diseases of the digestive system. Older age and female gender were significant factors that influenced the rate of hospital admissions. Preventing readmissions would be one of the best approaches for lowering hospitalisation rates. Future research is required to identify preventable risk factors so that health professionals can emphasise them to lower the hospitalisation rate.

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Patient consent for publication  Not applicable.

Ethics approval  Hospital admissions and population data are publicly available as de-identified data. Therefore, this study was exempt from requirements for ethical approval.

Provenance and peer review  Not commissioned; externally peer reviewed.

Data availability statement  Data are available in a public, open access repository. The data used in this research are publicly available at the following URLs: https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics and https://doi.nlm.nih.gov/information-services/health-intelligence/pedw-data-online/

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