Decoding UK Hospital Wait Times: Infrastructure, Workforce, and Demand*

How Systemic Pressures Shape Delays in Medical Care

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Hospital wait times in the United Kingdom are a critical measure of healthcare efficiency, reflecting the balance between resources and demand. This study examines the relationships between healthcare infrastructure, workforce availability, and patient attendance rates with average wait times for seven key medical procedures from 2015 to 2019. Using regression modeling, we find that reduced hospital beds per capita significantly prolong wait times,and while higher physician availability helps, it does little to offset the impact of declining bed availability. Additionally, Type 1 major care attendance rates correlate with increased delays, further indicating systemic bottlenecks. These findings highlight the urgent need for strategic resource allocation and demand management to address delays and improve patient outcomes.

1 Introduction

Timely access to healthcare is fundamental to achieving optimal health outcomes. In the United Kingdom, the National Health Service (NHS) faces mounting pressure to manage increasing patient demands amidst resource constraints. Hospital wait times, a key performance indicator, have become a focal point for policymakers and stakeholders alike. Extended wait times not only compromise patient care but also signal underlying inefficiencies in healthcare delivery systems.

This paper investigates how hospital infrastructure, workforce availability, and patient demand influence wait times for medical procedures across the UK. Specifically, it examines the roles of hospital beds per capita, physicians per 1,000 inhabitants, and Type 1 attendance rates in shaping delays for procedures like knee replacements, coronary artery bypass grafts, and

*Code and data are available at: https://github.com/chenikabukes/UnitedKingdomHealthcare.

cataract surgeries. While previous studies have explored individual contributors to wait times, this analysis integrates multiple predictors to provide a holistic view of systemic pressures.

The findings reveal that declining hospital bed availability has a pronounced negative impact on wait times, while higher physician density and attendance rates are associated with additional delays, potentially due to demand outstripping capacity. These results emphasize the need for a balanced approach to resource allocation, combining infrastructure investment with demand management strategies.

Understanding the drivers of wait times is vital for improving healthcare access and efficiency. By identifying the factors contributing to delays, this paper offers actionable insights for policymakers and healthcare administrators seeking to enhance patient outcomes and system resilience. The remainder of this paper is structured as follows: Section 1 details the data and methodology, Section 2 presents key results, Section 3 discusses implications, and Section 4 concludes with recommendations for future research.

2 Data

2.1 Overview

In this paper, the analysis will be carried out using the statistical programming language `R` (R Core Team 2023), using the haven and `tidyverse` (**citeTidy?**), `devtools` (Wickham, Hester, and Chang 2020) and `dplyr` (Wickham et al. 2021),. All figures in the report are generated using `ggplot2` (**citeGG?**). We run the model in R (R Core Team 2023) using the `modelsummary` package of (Arel-Bundock 2022).

This report integrates data from two key sources: the NHS and the OECD. These datasets provide critical information to analyze trends in healthcare demand and resources in the United Kingdom.

The NHS A&E Attendances and Emergency Admissions dataset captures the monthly demand for emergency services. It includes the total number of attendances at Accident & Emergency (A&E) departments and emergency admissions, alongside measures of wait times for admission. These statistics, collected at the provider organization level, are drawn from NHS Trusts, Foundation Trusts, and independent sector organizations. The data was aggregated from monthly submissions, a change implemented after Sir Bruce Keogh's review of waiting time standards. The dataset includes attendance and admission figures indexed to pre-pandemic and earlier baseline levels, enabling us to monitor trends and variations across years.

The remaining datasets are sourced from the OECD Health Statistics 2024 database, which provides standardized, internationally comparable data across healthcare systems. The OECD collaborates with organizations such as the United Nations and Eurostat to develop robust methodologies and benchmarks for health statistics. For the United Kingdom, data on hospital resources (e.g., hospital counts and bed availability), physician counts, and other health system

metrics are provided by various entities like NHS Digital and Public Health Scotland. The OECD ensures consistency and comparability of this data through rigorous quality checks and methodological adjustments.

2.2 Measurement

Physicians per 1,000 (**physicians?**). Source: Physician counts are sourced from the OECD, relying on NHS Digital, Public Health Scotland, and the General Medical Council (GMC). The data reflect licensed physicians, encompassing both general practitioners and specialists. The metric is calculated as the total number of physicians per 1,000 population. The dataset includes both headcount and rolecount metrics, with post-2009 data transitioning to headcount for greater accuracy. Physician counts include GP retainers and full-time equivalents, providing an accurate picture of the available workforce. Historical data adjustments account for changes in collection methodologies. Similar datasets include WHO and Eurostat health statistics offer broader regional comparisons but lack the granularity needed for a UK-focused study.

Beds per 1,000 Population (**beds?**): This metric, provided by the OECD, uses data from NHS Digital, Public Health Scotland, and national agencies across the UK. It tracks the availability of inpatient beds. Annual averages of beds available overnight in public hospitals. Includes acute care and psychiatric beds but excludes private sector facilities for consistency. Data are for financial years and represent publicly funded healthcare infrastructure. No significant methodological breaks are noted for this variable.

Type 1 Major Care Attendances (**attendance?**): These figures represent percentages indexed to the baseline year 2011, providing a normalized measure of demand changes over time. The NHS uses administrative records to capture real-time data from provider organizations. The NHS employs administrative records to capture real-time data, validated through internal processes to mitigate potential inconsistencies or reporting delays. However, some unreported data at the trust level (e.g., support facilities and non-inpatient services) are excluded, which may lead to minor underestimations. Its about type 1 emergency admissions which are major

Waiting Times for Key Medical Procedures (**wait?**): Waiting time data are sourced from the OECD, which uses NHS data for the United Kingdom. The dataset covers average waiting times for seven key procedures, including knee replacements and coronary artery bypass grafts. Procedure-Specific Wait Times: Measured in months, these reflect the average time in the NHS between referral and procedure. This dataset includes detailed procedure-specific insights, allowing for cross-procedure comparisons. Data validation is conducted at both the NHS and OECD levels to ensure reliability.

Overall: All datasets rely on administrative data validated by their respective agencies, minimizing reporting errors. While historical methodological changes (e.g., hospital reporting standards) necessitated adjustments, these do not materially affect the study's conclusions. Similar datasets from organizations like WHO or Eurostat could offer supplementary insights but were not utilized due to a lack of UK-specific detail and consistency.

2.3 Methodology #{sec-methodology}

EXPLAIN HOW YOU CLEANED DATA HERE

Table 1: A summary table of the cleaned healthcare data displayed in parts

Table 1: Part 1: Hospital statistics

Year	beds_per_1000	physicians_per_1000	attendance	Wait_CorGraft	Wait_Angioplasty
2015	2.61	2.001022	0	24.5	12.0
2016	2.57	2.016125	3	24.7	15.8
2017	2.54	2.041272	3	25.4	15.9
2018	2.50	2.076583	6	28.8	14.2
2019	2.45	2.168461	6	29.4	16.8

Table 2: Wait times for medical procedures displayed separately

Table 2: Part 2: Wait Times for Key Medical Procedures in Months

Knee	Hysterectomy	Hip	Cataract	Prostatectomy	Pct_Wait_Avg
45.0	28.1	41.8	28.4	6.6	0.00
49.5	31.6	46.6	29.0	5.7	7.84
50.5	32.8	47.5	31.9	5.6	10.85
54.4	34.7	51.3	34.9	7.2	19.28
54.1	34.9	51.3	35.0	8.6	25.81

Table **??** presents the cleaned dataset presents hospital and healthcare statistics, consisting of 10 variables and 5 observations spanning the years 2015 to 2019. The variables include year, hospitals per 1,000,000 inhabitants, beds per 1,000 inhabitants, physicians per 1,000 inhabitants, emergency admissions, and attendance rates. Additional variables capture wait times (in months) for key medical procedures such as coronary grafts, angioplasty, knee surgery, hip surgery, cataract surgery, hysterectomy, and prostatectomy. The average percentage increase in wait times was calculated relative to 2015. All metrics are standardized based on population or healthcare utilization data for each year.

2.4 Outcome variables

Figure **??** depicts the percentage increase in wait times for various medical procedures compared to 2015. By 2019, most procedures show a notable increase in wait times, with angioplasty and prostatectomy exhibiting the largest rises. While some procedures, such as knee

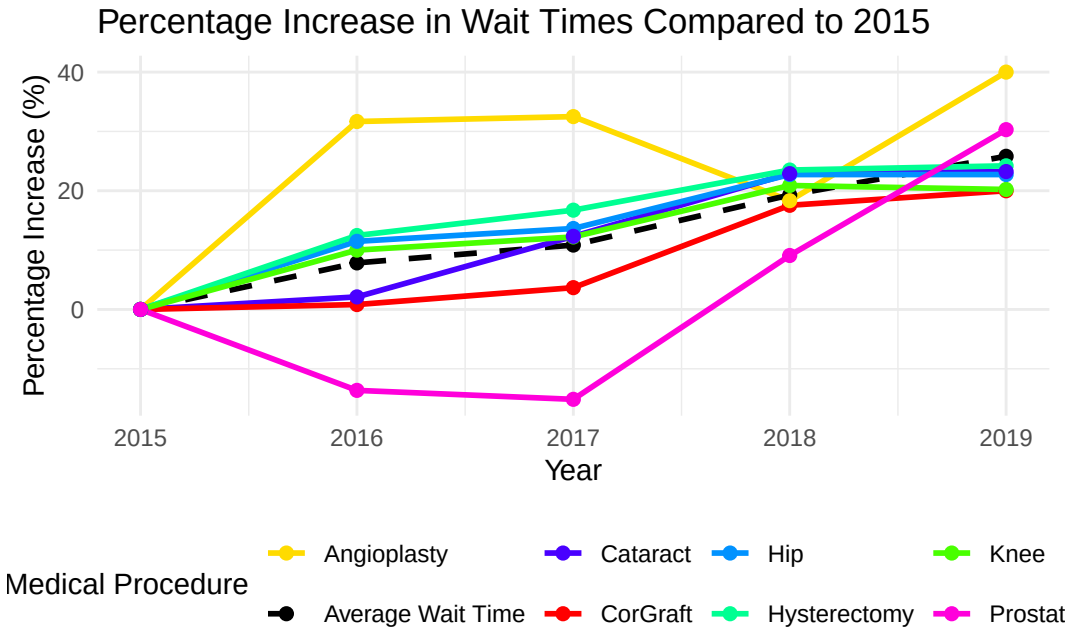

Figure 1

and hip surgeries, show consistent increases, others, like prostatectomy, initially decline before rising sharply. The steady increase across most procedures highlights a systemic trend of growing delays in accessing medical care, potentially signaling resource limitations or increased demand in healthcare services. Overall, wait times have risen by over 20% since 2015, further emphasizing the need for targeted interventions to improve healthcare accessibility and efficiency. ## Predictor variables

2.4.1 Physicians per 1,000

Figure **??** shows a steady increase in the number of physicians per 1,000 inhabitants from 2015 to 2019, rising from approximately 2.0 to 2.15. This consistent growth indicates an improvement in physician availability relative to population size, potentially reflecting increased investment in healthcare workforce development or recruitment efforts. The trend suggests progress in addressing healthcare access, but further analysis is needed to determine whether this growth aligns with demand and regional healthcare needs.

2.4.2 Hospital Beds per 1,000

Figure **??** shows a steady decline in hospital beds per 1,000 inhabitants from 2015 to 2019, decreasing from approximately 2.6 to 2.45 beds. This consistent downward trend suggests

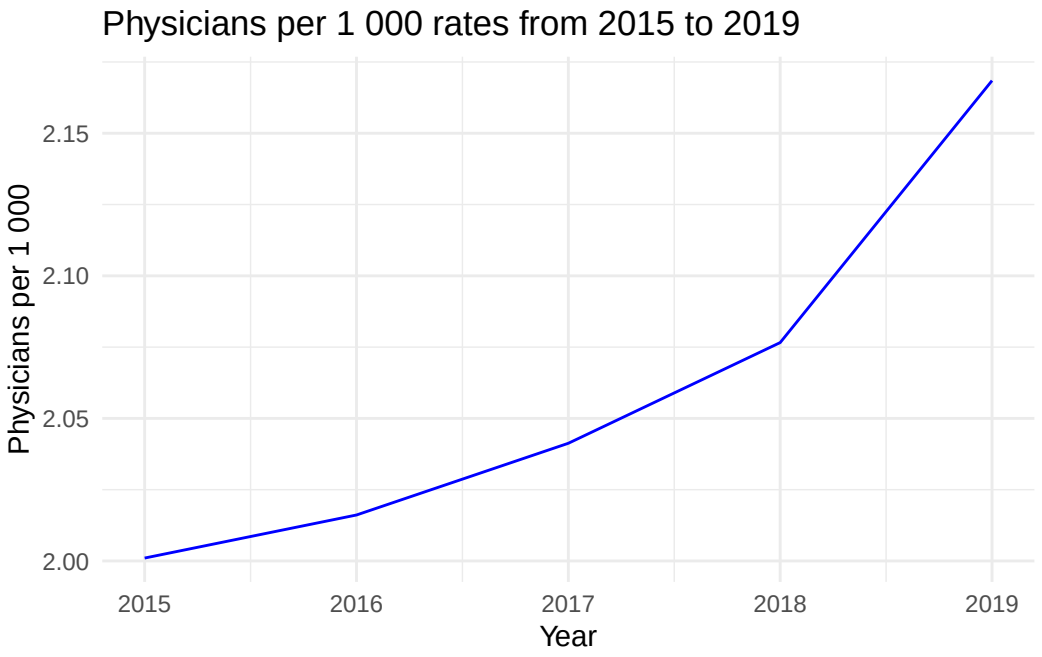

Figure 2: United Kingdom's Physician rate per 1000 Inhabitants from 2015 to 2019

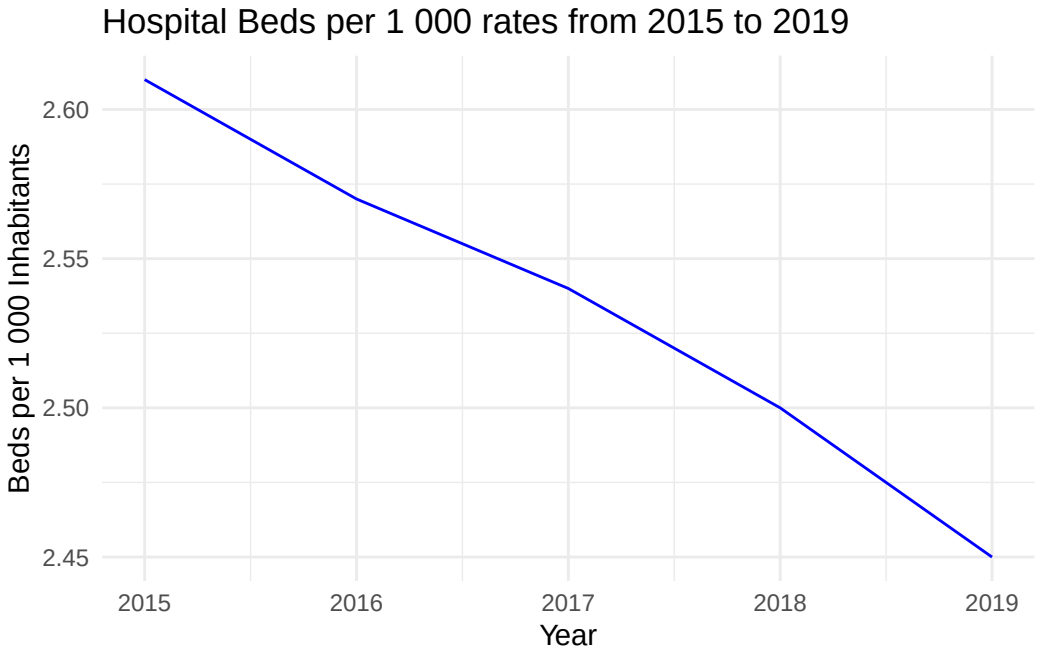

Figure 3: United Kingdom's Hospital Beds per 1000 Inhabitants from 2015 to 2019

a reduction in bed capacity relative to population growth, potentially indicating healthcare system pressures such as resource reallocation, efficiency measures, or underinvestment in infrastructure. The decline highlights the need to assess the impact on patient care and explore strategies to balance population needs with available resources.

2.4.3 Demand for Services

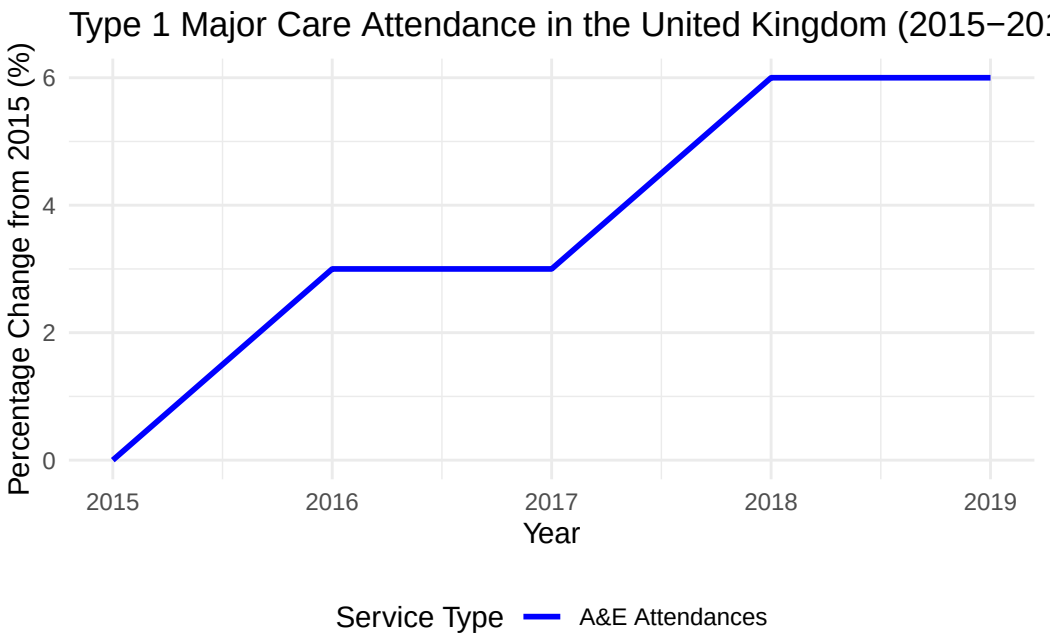

Figure 4: Type 1 Major Care Attendance in the United Kingdom from 2015 to 2019

Figure **??** illustrates the percentage change in Type 1 Major Care Attendance (A&E Attendances) in the UK from 2015 to 2019. A&E attendances showed a modest, steady increase over the observed period, plateauing slightly by 2019. This trend highlights the growing demand for emergency services and underscores the need for further investigation into factors contributing to increased attendance, such as population growth, access to primary care, or changes in healthcare-seeking behavior. Addressing these factors through improved preventive and community-based care could help reduce the burden on emergency services.

3 Model

After conducting exploratory analysis on the dataset, we observed relationships between healthcare system factors (e.g., number of physicians, hospital beds per 1,000 people, and attendance