EE510

Healthcare Resource Utilization Among Adults With Pneumococcal Disease in England, 2017-2022: A Retrospective Database Analysis

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Introduction

- Pneumococcal disease (PD), caused by *Streptococcus pneumoniae*, includes invasive pneumococcal disease (IPD) and non-bacteremic pneumococcal pneumonia (NBPP)
- In England, despite existing guidelines for adult pneumococcal vaccination, PD continues to impose a substantial health burden, particularly among older adults and individuals with certain underlying medical conditions
- Understanding age, risk and regional variations is essential for informing targeted prevention strategies, optimizing resource allocation and guiding evidence-based policy making
- This study estimated healthcare resource utilization (HCRU) and associated costs of pneumococcal disease among adults in England at both national and regional levels, stratified by age and risk group

Methods

Study design and data sources

- Retrospective study using linked electronic healthcare records (EHRs) from Clinical Practice Research Datalink (CPRD) Aurum and Hospital Episode Statistics (HES)
  - Includes primary care, inpatient, and outpatient records
- Study period: 2016-2023 (Includes 1 year of baseline data for comorbidity assessment and 6 months of follow-up for HCRU and cost estimation)

Study population and follow-up

- Adults ≥18 years from nine English regions (North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, South West, South Central, London)
- Diagnosed between 1 January 2017 and 31 December 2022 with ≥1 episode of:
  - Invasive pneumococcal disease (IPD)
  - Non-bacteremic pneumococcal pneumonia (NBPP)
  - All-cause pneumonia (ACP)
- Followed for 12 months prior to first recorded episode to assess baseline history
- Followed until the end of the study period, to assess (HCRU) and associated costs

Study measures and analysis

- Unit of analysis: patient with ≥1 disease episode
- Episode Identification and Severity Hierarchy (**Figure 1**):
  - ICD-10 codes (secondary care) and Medcodes (primary care) were used across all diagnosis fields
  - Multiple records for the **same disease manifestation** within 30 days were grouped into a single episode
  - Multiple records for **different disease manifestations** within 30 days were assigned to the most severe manifestation (IPD > NBPP/ACP)

Figure 1: Episode identification and severity hierarchy

IPD	NBPP	=	IPD	
IPD	ACP	=	IPD	
NBPP	ACP	=	NBPP	ACP

IPD: meningitis, bacteremia without a known focus, or bacteremic pneumonia with confirmed *Streptococcus pneumoniae*; NBPP: pneumonia with confirmed *S. pneumoniae* in the absence of bacteremia; ACP: pneumonia of any etiology (known or unknown pathogens).

- Outcomes:
  - All-cause HCRU and associated costs (using 2022 Healthcare Resource Group (HRG) values as reference)
  - Estimated across care settings: Primary care, inpatient and outpatient
  - Reported per patient and in total
- HCRU estimation windows:
  - Full diagnosis year: HCRU and costs estimated for each patient across the entire calendar year of disease diagnosis (pre- and post-diagnosis)
  - 6 months post-diagnosis: HCRU and costs estimated within 6 months of the disease start date
- Sensitivity analysis: To address the potential underreporting of pneumococcal pneumonia in EHRs due to diagnostic challenges, two disease groups were analyzed:
  - Pneumococcal-specific disease: Includes IPD and NBPP
  - Expanded pneumococcal disease: Includes IPD and ACP
    - ACP counts were used in place of NBPP to reflect the potential additional burden that may result from NBPP under-diagnosis

Results

Table 1. Patient counts by disease group (2017–2022)*

Pneumococcal-Specific Disease (IPD + NBPP)		Expanded Pneumococcal Disease (IPD + ACP)	
18,842 *Total patients with encounters*	**17,029** *Total patients with costs*	**1,172,850** *Total patients with encounters*	**914,361** *Total patients with costs*
3,140 *Average per year*	**2,942** *Average per year*	**195,475** *Average per year*	**183,239** *Average per year*

*Unique patient counts reported; patients may contribute encounters in multiple years within the study period.

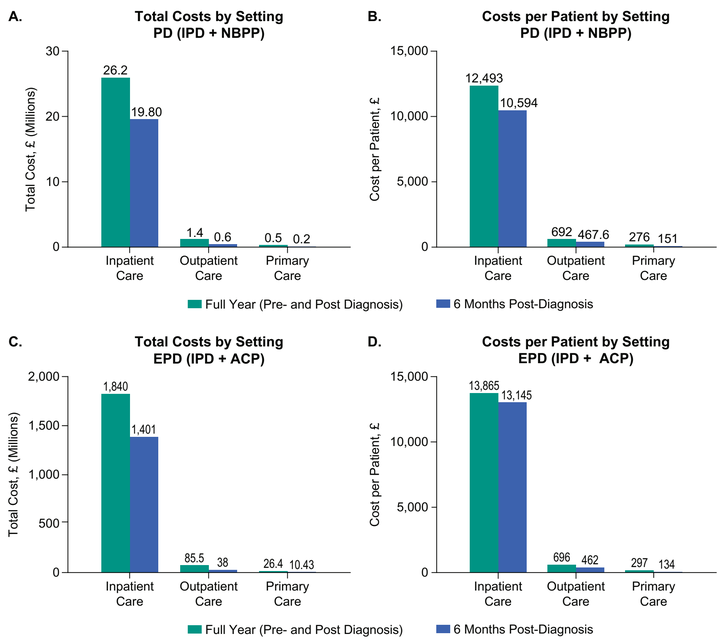
Table 2. Average healthcare resource utilization and costs (per year)

Healthcare utilization and costs estimated by disease group, across two analysis timeframes

Pneumococcal-Specific Disease (IPD + NBPP)		Expanded Pneumococcal Disease (IPD + ACP)	
Full Year	**6 Months**	**Full Year**	**6 Months**
43,917 *Encounters*	**21,813** *Encounters*	**2,775,483** *Encounters*	**1,315,524** *Encounters*
£27 *Million*	**£21** *Million*	**£1,890** *Million*	**£1,450** *Million*

Figure 2. Average healthcare costs by healthcare setting (per year)

Healthcare costs, estimated by disease group and healthcare setting, across two analysis timeframes.



EPD:Expanded pneumococcal disease
PD: Pneumococcal disease

Figure 3. Cost drivers by disease group (2017-2022)

When analyzed by disease subtype, age, risk group, and region, the top drivers of total cost were:

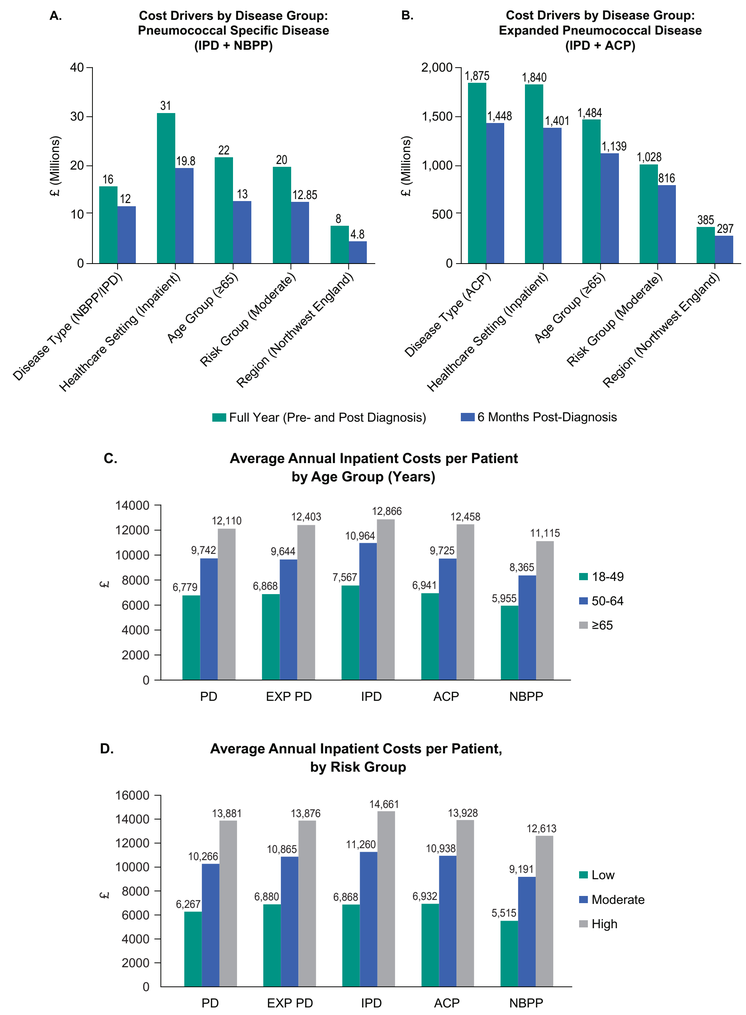


Figure 3E. Total inpatient admission cost (£mn)

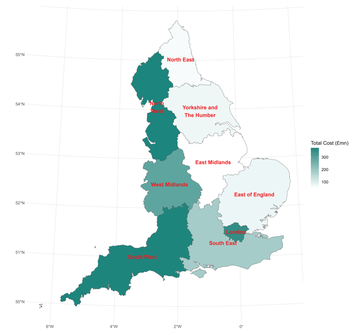


Figure 3F. Average inpatient admisison cost per patient (£)

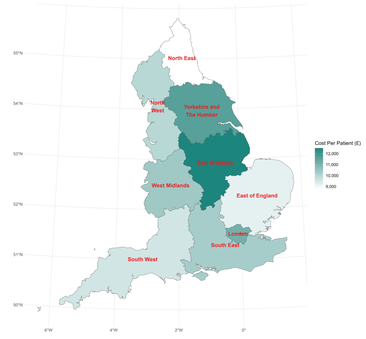
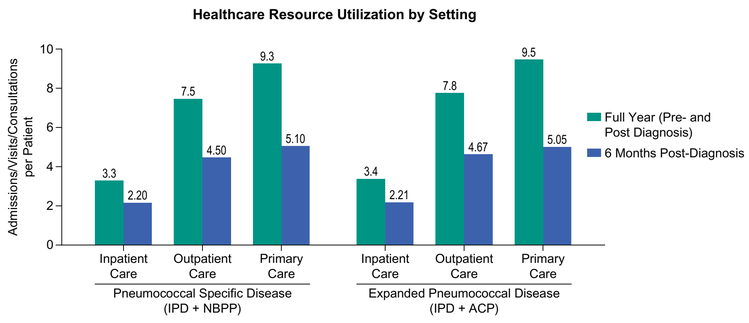


Figure 4. Average healthcare resource utilization by healthcare setting (per year)

Healthcare utilization estimated by disease group and healthcare setting, across two analysis timeframes.



Discussion

This study demonstrates a persistent and substantial economic burden of pneumococcal disease (PD) among adults in England, despite existing prevention efforts.

Key Finding

Inpatient care drives most of the economic burden, despite being the setting with the fewest encounters, with high per-patient costs highlighting the resource intensity of severe disease management.

Relevance: Highlights significant clinical and financial implications for the National Healthcare System (NHS). Given the high cost per inpatient admission, modest reductions in hospitalization rates could result in considerable cost savings.

Key Finding

Stratified analyses highlight additional cost drivers, with older adults (≥65 years) and those with moderate clinical risk contributing disproportionately. Regional differences suggest potential disparities in disease burden, healthcare access, or service delivery, warranting further investigation to guide localized vaccination strategies.

Relevance: Evidence of cost concentration and regional variation underscores the importance of targeted strategies for high-impact subgroups.

Limitations

- **Incomplete capture of healthcare interactions:** Linking CPRD Aurum and HES provides a comprehensive view of primary and secondary care but may not capture healthcare encounters in private or community-based settings not recorded in HES. As a result, reported results may underestimate the true frequency of healthcare utilization, particularly for patients who rely on private or community services. However, most pneumococcal care occurs within NHS settings, so the data remains representative of typical care pathways
- **Incomplete capture of procedure-level costs:** Not all patients with healthcare encounters have associated cost data, particularly in the outpatient setting where procedure-level cost data are often missing or inconsistently recorded in HES. As a result, outpatient visits may be captured in terms of frequency but lack corresponding financial data, leading to an underestimation of total costs. However, inpatient care costs are well captured and drive most of the economic burden, making reported estimates robust for key cost components

Conclusions

Pneumococcal disease imposes a high economic burden, primarily from inpatient care and older adults. Targeted vaccination and prevention strategies are essential to reduce this impact.

Glossary

HCRU: healthcare resource utilization; PD: Pneumococcal Disease; IPD: invasive Pneumococcal Disease; NBPP: non-bacteremic pneumococcal pneumonia; EHRs: Electronic Healthcare Records; CPRD: Clinical Practice Research Datalink; HES: Hospital Episodes Statistics; HRG: Healthcare Resource Group.

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