Journal of Infection 93 (2026) 106792

Contents lists available at ScienceDirect

Journal of Infection

journal homepage: www.elsevier.com/locate/jinf

Viruses and Viral Diseases

Burden and economic impact of RSV hospitalisations among English adults, 2023/24

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ARTICLE INFO

Article history:
Accepted 7 June 2026
Available online 10 June 2026

Keywords:
Respiratory syncytial virus infections
Influenza
Respiratory tract infections
Hospitalisation
Underdiagnosis
Health care costs

SUMMARY

Objectives: To provide updated, national estimates of the burden and secondary-care costs of respiratory syncytial virus (RSV) hospitalisations among adults aged ≥40 years in England, using data from 2023/24, the last season before the UK implemented its adult RSV vaccination programme, given that, while the burden of RSV is well established in young children and older adults, it remains less well characterised in working-age adults.
Methods: We analysed adults admitted to hospital with an acute respiratory infection (ARI) using aggregated Hospital Episode Statistics (HES) data for England, 2023/24. RSV, influenza, and COVID-19 hospitalisations were identified using validated International Classification of Diseases, Tenth Revision (ICD-10) codes. Incidence proportion was calculated per 100,000 population by age group. To adjust for potential under-recognition of RSV among ARI admissions without an identified pathogen, proportional-redistribution methods were applied. Hospital costs were estimated using Healthcare Resource Group (HRG) emergency tariffs weighted by clinical presentation.
Results: In 2023/24, 803,088 ARI admissions occurred among adults ≥40 years; 18% had a viral and 79% an unspecified aetiology recorded. RSV accounted for 4836 admissions (16 per 100,000 population) based on primary diagnosis. After proportional redistribution to account for under-recognition, this increased to an estimated 23,407 admissions (75.9 per 100,000 population; £68.5 million), which we consider the base estimate. In an expanded scenario including all recorded diagnoses, RSV admissions were estimated at 25,264 (82 per 100,000 population; £74 million), of which approximately £54 million may be attributable to unrecognised cases. Around one-third of total estimated RSV-related costs occurred in adults aged 40–74 years. RSV incidence increased steeply with age, reaching its highest levels in adults aged ≥85 years.
Conclusions: RSV poses a substantial, under-recognised hospital burden in English adults and associated healthcare costs. Increased testing and improved coding and surveillance, particularly for adults aged 40–74 years, are needed to accurately measure potential impact of vaccination and guide prevention policy.

Introduction

Respiratory syncytial virus (RSV) is a leading cause of acute respiratory infections (ARIs) worldwide, particularly affecting older adults.[1] In Europe, RSV activity peaks early during winter and contributes substantially to seasonal healthcare pressures.[2] Among adults, RSV can sometimes cause disease as severe as or even more severe than influenza, leading to prolonged hospitalisation and increased risk of pneumonia and other lower respiratory tract infections.[2–4]

Before the COVID-19 pandemic, studies from England and other high-income temperate countries, with pronounced winter respiratory seasons, established RSV as a major contributor to adult

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https://doi.org/10.1016/j.jinf.2026.106792

morbidity and mortality.[3–6] However, routine surveillance and diagnostic testing for RSV in adults have remained limited, resulting in under-recognition and incomplete estimates of burden. Following recommendations from the UK Joint Committee on Vaccination and Immunisation (JCVI), the first national RSV immunisation programme for adults aged 75–79 years (or those who turned 80 after 1 September 2024) was introduced in September 2024.[7] The programme was subsequently extended from April 2026 to include adults aged 80 years and older and eligible care home residents.[8] Yet uncertainty persists regarding the disease burden in adults under 75 years, particularly those aged 40–74, due to non-specific coding, limited testing, and a lack of recent UK data.[5,7–10] Although a study using the Hospital-based ARI Sentinel Surveillance (HARISS) data provided valuable post-pandemic data in older adults and demonstrated that RSV is likely to be under-recognised in secondary care, its findings were based on only seven hospitals in England, limiting the generalisation of results.[11] Under-recognition of RSV has also been reported in multiple settings, with international studies and reviews showing limited diagnostic testing among hospitalised adults.[12,13] These patterns occurred against a backdrop of pandemic-related shifts in respiratory virus circulation, healthcare-seeking behaviour, and testing practices, which further complicate interpretation of recent RSV trends.[14,15]

Contemporary estimates on English RSV burden that are representative and correct for under-ascertainment, due to lack of testing and coding, are necessary for informing RSV vaccination strategies in younger adults and those at elevated risk. The objective of this study was to provide updated, national-level estimates of the burden of RSV in secondary care among adults aged ≥40 years in England, using data from the latest available season (2023/24), and prior to adult RSV vaccination rollout. We aimed to (1) quantify the incidence of RSV-associated ARI hospital admissions and compare them with influenza and COVID-19; (2) evaluate differences between cases coded as a primary diagnosis and those recorded as an additional diagnosis, and estimate the number of unrecognised RSV cases among all ARI admissions to account for diagnostic under-recognition; and (3) assess the secondary-care costs associated with both identified and unidentified RSV cases.

Methods

Study design and data sources

We conducted a national, population-based ecological analysis of hospital admissions for ARIs among adults aged ≥40 years in England. Routinely collected administrative and costing data were obtained from the National Health Service (NHS) *Hospital Episode Statistics (HES)* Admitted Patient Care dataset[16] and the *National Cost Collection (NCC)*.[17] HES data are structured at the level of Finished Consultant Episodes (FCEs), where each FCE represents a period of care under a single NHS consultant; as the data are provided in aggregated format, individual FCEs cannot be linked into continuous inpatient spells. In the context of acute respiratory admissions, formal consultant transfers generating multiple FCEs within a single spell are uncommon, occurring principally in cases involving critical care, which account for fewer than 5% of adult respiratory admissions.[18,19] The aggregated data format also precludes individual-level analysis by comorbidity, socioeconomic status, sex, ethnicity, or care pathway. We collected HES data covering six financial years (2018/19–2023/24; 1 April to 31 March each year), encompassing the pre-pandemic, pandemic, and post-pandemic periods. We present detailed results for the 2023/24 season. Full annual series for 2018/19–2022/23 are provided in the Supplemental Material (Supplementary Tables 2–14) and any references to earlier seasons in the Results draw on these supplementary data.

England provided an optimal setting for this study, as nearly all acute hospital care is delivered within the NHS, ensuring comprehensive national coverage. Standardised diagnostic coding is linked to Healthcare Resource Groups (HRGs), which informed activity-based commissioning and costing within the NCC. This integrated system enables robust linkage of clinical diagnoses, resource use, and costs, thereby capturing virtually all hospitalised ARI cases.

The primary focus of this analysis is RSV; however, influenza was reported as main epidemiological comparator. RSV and influenza share similar transmission patterns and overlapping clinical presentations but differ in testing intensity, surveillance coverage, and seasonality. Comparing RSV with influenza allowed RSV burden to be contextualised within the broader landscape of respiratory infections.

Case definition and classification

ARI admissions were identified using 92 validated *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* codes [20;21] and classified into seven pathogen subgroups: RSV, influenza, COVID-19, other viral, bacterial, other organisms, and unspecified (full code lists in the Supplementary Table 1, Supplemental Material). In HES, up to 20 diagnosis codes can be recorded per hospital episode. The primary (main) diagnosis represents the principal reason for hospitalisation as assessed at the point of discharge, based on the complete episode of care, and is used for NHS cost attribution. Analyses therefore focused initially on primary diagnoses. The ICD-10 codes used have been validated in prior studies for identifying laboratory-confirmed influenza and RSV hospitalisations[20] and COVID-19 among critically ill patients.[21] The RSV and influenza code list demonstrates high specificity internationally across 23 high-income countries,[22] and a multi-country study using England HES data found that RSV ICD-10-coded admissions underestimated laboratory-confirmed cases by an average of 1.9-fold, consistent with high specificity but limited sensitivity in routine administrative data.[23] Where testing is performed, these diagnostic codes in NHS practice typically reflect laboratory confirmation, as microbiological results are integrated into electronic patient records and inform discharge coding. However, coding accuracy depends on both testing being performed and results being available before discharge coding is finalised. When no causative organism was documented because testing was not performed, results were negative, or results were unavailable at the time of coding, national clinical coding standards required assignment of site-based, non-specific ARI ICD-10 codes.[24] Admission episodes were stratified by 5-year age groups, as provided in the HES dataset.

To assess potential under-recognition of RSV, we also examined all diagnoses (primary plus up to 19 secondary codes) to capture cases where RSV may have been recorded but not as the primary reason for admission. Because HES aggregate data do not include the position of secondary codes, it was not possible to determine their relative clinical relevance. Results based on primary diagnoses are presented as conservative (base) estimates, whereas those including all diagnoses represent expanded estimates of RSV incidence and cost that is identifiable from the data based on limited RSV testing practices. However, these expanded estimates still likely underestimate true RSV burden, as they cannot capture RSV cases that were never tested or had false-negative test results.

RSV testing practices in England

RSV testing in England is not routine or standardised, particularly in adults, leading to under-ascertainment in hospital administrative datasets.[4,25,11] In secondary care, testing is typically performed via

multiplex PCR panels (RSV, influenza, SARS-CoV-2) with protocols set locally.[26,27] Some hospitals routinely test high-risk groups (e.g., immunocompromised or haematology/oncology/transplant admissions), while extended panels are limited to specific clinical indications.

United Kingdom Health Security Agency (UKHSA) surveillance relies on a limited number of sentinel sites, and although diagnostic laboratories have been required since April 2025 to report RSV results, this only covers tests performed and does not ensure universal testing.[28–31] In primary care, RSV testing is generally limited to sentinel surveillance networks, with only occasional use of point-of-care or external laboratory testing. Consequently, ICD-10 codes and routine electronic health records (EHR) only capture a fraction of RSV cases, and our proportional-redistribution approach provides conservative, lower-bound estimates that reflect expected under-ascertainment.[13,11]

Calculation of cases, incidence and pathogen attribution

We first calculated the number of ARI admissions and their cumulative incidence per 100,000 population during the 2023/24 financial year by pathogen category, using age-specific mid-year English population estimates from the Office for National Statistics (ONS) as denominators.[32] Percentages attributable to each pathogen were derived to describe the proportion of all ARI admissions explained by RSV, influenza, COVID-19, and other causes. To assess the impact of including secondary diagnoses, we also compared primary-diagnosis and all-diagnoses counts and reported these differences as fold-increases by age group.

Proportional-redistribution approach to estimate unrecognised RSV

To account for under-testing and coding of RSV among ARI admissions, we applied a proportional-redistribution approach, based on the methods used in prior burden-of-disease and cause-of-death analyses for reallocating unspecified events.[33,34] In this approach, the total number of identified cases was defined:

$$\text{Total identified cases} = \text{Total cases} - \text{Unspecified cases} \quad (1)$$

including the Total cases with a confirmed pathogen (bacterial, viral, or other). We then calculated the proportion of RSV among the Total identified cases:

$$\text{RSV proportion} = \frac{\text{RSV cases}}{\text{All identified cases}} \quad (2)$$

This proportion was applied to the unspecified cases to estimate unrecognised RSV:

$$\text{Estimatedunrecognised RSV} = \text{Unspecifiedcases} \times \text{RSV proportion} \quad (3)$$

The total estimated RSV equals the sum of observed and estimated unrecognised RSV cases:

$$\text{Total estimated RSV} = \text{Observed RSV} + \text{Estimated Unrecognised RSV} \quad (4)$$

The observed proportion of RSV (2) among all ARIs with a specified pathogen for each age group was applied to the subset of admissions without an identified pathogen, assuming similar aetiologic distribution among the identified and unspecified cases. This yielded adjusted estimates combining identified and estimated unrecognised RSV cases for both primary-diagnosis (base) and all-diagnoses (expanded) datasets. The redistribution approach assumes that the pathogen distribution of unspecified ARIs mirrors that of identified cases, which may not hold uniformly across pathogens or age groups. As RSV is typically tested less frequently than influenza and SARS-CoV-2 in routine NHS practice, RSV is likely underrepresented among identified cases relative to its true prevalence in the unspecified ARI pool, suggesting that the redistribution method would more likely underestimate than overestimate true RSV burden. This interpretation is consistent with evidence that ICD-coded RSV admissions underestimate laboratory-confirmed cases by an average of 1.9-fold across European countries including England,[23] and with enhanced surveillance data from seven English hospitals in 2023/24 showing that routine coding captured only a fraction of laboratory-confirmed RSV cases in adults.[11] Redistributed estimates should therefore be interpreted as conservative lower bounds of the true RSV burden.

The need to adjust for unrecognised RSV burden is increasingly recognised, as studies show that routine hospital data identify only part of the true RSV activity and require additional methods to estimate missed cases.[35,36] Similar under-ascertainment has been demonstrated in other national settings, including a recent French analysis that used laboratory testing to quantify unrecognised RSV hospitalisations.[37] Although under-ascertainment may also affect COVID-19 and influenza hospitalisations, particularly outside peak testing periods, RSV testing in adults has historically been less routine and less systematically implemented. Therefore, comparisons between redistributed RSV estimates and observed counts for other pathogens should be interpreted with this context in mind.

Estimation of secondary-care costs

For cost estimation, RSV and influenza admissions were linked to HRG emergency tariffs from the NCC[17,38] with 2023/24 costs in British Pounds Sterling. Costs were calculated for both observed admissions and redistributed (estimated) case totals under the primary-diagnosis and all-diagnoses scenarios. As most hospitalisations for RSV and influenza in adults are acute in nature (i.e., unscheduled/emergency), we focused on the average emergency admission cost. This approach aligns with our data for the whole population, which show that over 90% of RSV- and influenza-related hospitalisations were emergency admissions,[17] and with UK studies on RSV,[4] which have also restricted their analyses to emergency admissions. The HRG-based tariff was £2963 per admission for pneumonia, £2769 for bronchitis, £2233 for bronchiolitis, and £2769 for other acute respiratory infections. Costs were weighted by the proportion of clinical manifestations in each age group to reflect differences in resource use (see Supplementary Table 16 for the full list of weights and weighted costs). HRG tariffs vary according to the level of complications and comorbidities (CC score). As the HES aggregated data do not include patient-level CC information, we applied the average HRG cost across all CC levels for each clinical manifestation. This approach aligns with NHS costing guidance and provides a representative mean cost per admission at the population level.[17,18]

The resulting weighted average cost per admission was multiplied by the observed and redistributed case totals to estimate total and age-specific secondary-care expenditure for both identified and unrecognised RSV cases. Costs were calculated separately for the primary-diagnosis and all-diagnoses datasets to provide a range of plausible estimates for RSV prevalence and economic burden. Given that RSV admissions in older adults may disproportionately involve higher CC scores due to the concentration of multimorbidity in this population, we conducted a sensitivity analysis examining the impact of alternative CC-score distributions on total cost estimates, derived empirically from NHS National Cost Collection data. Two scenarios were applied: Scenario 1 (older-adult CC mix) reflects the expected shift toward higher CC sub-codes in adults aged 75 years and over, and Scenario 2 (high-severity CC mix) represents concentration at the highest complexity levels in adults aged 85 years and over. Results are presented in the Supplementary Appendix (Supplementary Tables 17 and 18).

Information on clinical manifestation (pneumonia, bronchitis, bronchiolitis, and other acute respiratory infections) was available for most pathogens, but not for COVID-19 as the corresponding ICD-10 codes were introduced during the pandemic for surveillance of infection status only.

We calculated the absolute distribution of cases and incidence rates for RSV, influenza, COVID-19, and other pathogens to characterise hospital activity and the contribution of RSV within viral admissions. We then restricted proportional-redistribution and cost analyses to RSV and influenza, as detailed, condition-specific cost estimates were only available for these two pathogens. RSV and influenza were considered appropriate comparators because they have similar modes of transmission, overlapping clinical presentations, and are commonly used in burden-of-disease and costing analyses. However, influenza has a long-standing vaccination programme, so our comparisons are intended to provide cost context rather than to evaluate vaccine effects.

All analyses were performed in R (version 4.5.1).[39]

Ethics and governance

This study was conducted under the umbrella of the ObservatARI study. Ethical approval for England and Wales was obtained from the Health Research Authority and Health and Care Research Wales on 14 September 2023 (IRAS project ID: 329790; South Central – Oxford A Research Ethics Committee reference 23/SC/0320). The study and data extract were additionally approved by the ORCHID Caldicott Guardian and the Primary Care Hosted Research Datasets Independent Scientific Committee of the Nuffield Department of Primary Care Health Sciences, University of Oxford (application reference PD-0030–2023).

Results

Observed incidence overall and by aetiology

A total of 803,088 acute respiratory infection (ARI) admissions were identified among adults aged ≥ 40 years in England during the 2023/24 season (Table 1). Of these, 141,507 (18%) had a viral aetiology recorded, while the majority (635,840; 79%) were classified as unspecified, with no pathogen identified. Bacterial and other non-viral causes accounted for 3% and < 1% of all ARI admissions, respectively.

Among viral ARIs, COVID-19, influenza, and RSV (in that order) remained the principal causes of viral admission in 2023/24. COVID-19 was associated with the highest overall incidence, 298 cases per 100,000 population, followed by influenza (121 per 100,000) and RSV (16 per 100,000). These values represent a marked rebound in RSV and influenza activity after the suppression observed during 2020/21 (RSV: 0.1 per 100,000, 16 cases; influenza: 0.8 per 100,000, 241 cases) and 2021/22 (RSV: 2.8 per 100,000, 843 cases; influenza: 2.4 per 100,000, 724 cases). By 2023/24, both viruses had rebounded to levels approaching pre-pandemic seasons (2018/19: RSV 6.6 per 100,000, influenza 134.3 per 100,000; see Supplementary Tables 2 and 9–14).

Relationship with age

There was a marked increase in the incidence of hospitalisations due to all, unspecified, and viral aetiologies from younger to older age groups (less so for bacterial and other non-viral aetiologies) (Table 1). Incidence of viral ARIs increased from 91.8 per 100,000 among adults aged 40–44 years to 3247.7 per 100,000 among those aged ≥ 90 years. COVID-19 remained the predominant viral cause at all ages, but influenza and RSV also made substantial contributions among older adults. In 2023/24, RSV incidence reached 51.8 per

Table 1
Observed ARI admissions by age group and aetiological category, with absolute number of cases (N) and incidence per 100,000 population in parenthesis, 2023/24.

Age	Total ARI Cases N, (Inc./100k)	All aetiologies			Viral aetiologies				
		Unspecified aetiology N, (Inc./100k)	Bacterial aetiologies N, (Inc./100k)	Other aetiologies N, (Inc./100k)	Viral aetiologies N, (Inc./100k)	RSV N, (Inc./100k)	Influenza N, (Inc./100k)	COVID-19 N, (Inc./100k)	Other viral N, (Inc./100k)
40–44	23,380 (588.7)	18,488 (465.5)	1046 (26.3)	199 (5.0)	3647 (91.8)	81 (2.0)	1628 (41.0)	1505 (37.9)	433 (10.9)
45–49	22,762 (631.1)	17,785 (493.1)	1024 (28.4)	164 (4.5)	3789 (105.1)	60 (1.7)	1664 (46.1)	1645 (45.6)	420 (11.6)
50–54	32,052 (797.6)	24,807 (617.3)	1420 (35.3)	197 (4.9)	5628 (140.1)	169 (4.2)	2300 (57.2)	2638 (65.6)	521 (13.0)
55–59	43,442 (1062.8)	33,972 (831.1)	1735 (42.4)	221 (5.4)	7514 (183.8)	190 (4.6)	2936 (71.8)	3705 (90.6)	683 (16.7)
60–64	54,668 (1484.8)	43,212 (1173.6)	2041 (55.4)	184 (5.0)	9231 (250.7)	300 (8.1)	3157 (85.7)	4980 (135.3)	794 (21.6)
65–69	66,897 (2182.5)	52,832 (1723.6)	2603 (84.9)	233 (7.6)	11,229 (366.3)	342 (11.2)	3230 (105.4)	6849 (223.4)	808 (26.4)
70–74	88,255 (3198.9)	69,616 (2523.3)	3228 (117.0)	229 (8.3)	15,182 (550.4)	506 (18.3)	3825 (138.6)	10,007 (362.7)	844 (30.6)
75–79	122,760 (4835.9)	96,483 (3800.8)	3746 (147.6)	249 (9.8)	22,282 (877.7)	799 (31.5)	5400 (212.7)	15,205 (599.0)	878 (34.6)
80–84	124,254 (7913.9)	97,832 (6231.1)	3053 (194.5)	177 (11.3)	23,192 (1477.1)	813 (51.8)	5212 (332.0)	16,337 (1040.5)	830 (52.9)
85–89	120,391 (12,273.4)	95,985 (9785.3)	2376 (242.2)	122 (12.4)	21,908 (2233.0)	800 (81.6)	4516 (460.4)	15,940 (1625.0)	652 (66.5)
90+	104,227 (18,890.0)	84,828 (15,374.1)	1425 (258.3)	69 (12.5)	17,905 (3247.7)	776 (140.6)	3397 (615.7)	13,164 (2385.8)	568 (102.9)
Tot. 40+	**803,088 (2604.8)**	**635,840 (2062.3)**	**23,697 (76.9)**	**2044 (6.6)**	**141,507 (458.9)**	**4836 (15.7)**	**37,265 (120.9)**	**91,975 (298.3)**	**7431 (24.1)**

Note: Unspecified aetiology includes ARI admissions coded with non-specific ICD-10 diagnoses in which no pathogen is identified (e.g., J06.9, J18.x, J22). "Other" aetiology includes ARIs attributed to non-viral, non-bacterial causes classified under ICD-10 codes such as other organisms (e.g., J02.8, J17.x). A full list of ICD-10 codes is provided in Table S.1. Cases refer to Finished Consultant Episode (FCE)-level counts from HES Admitted Patient Care data. Estimated cases include proportionally redistributed unspecified ARI admissions.

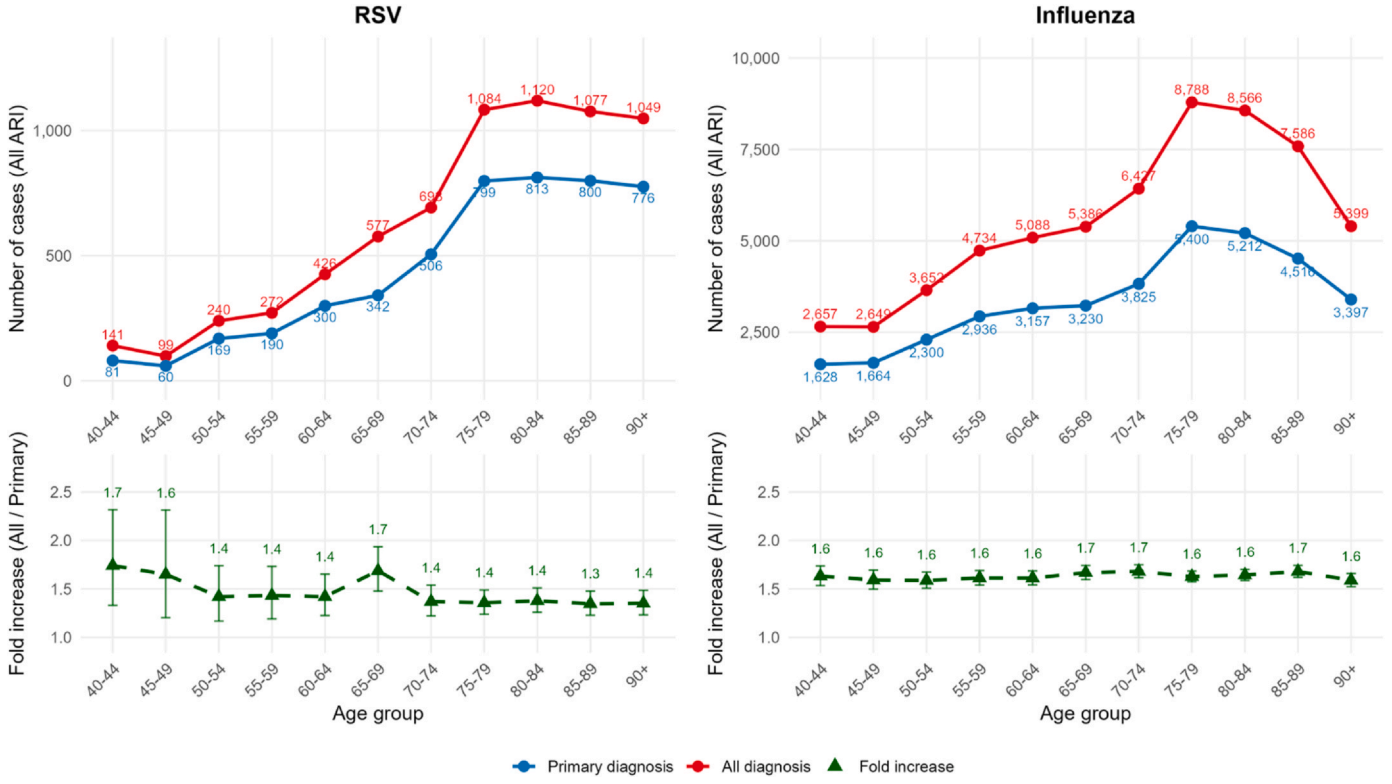

Fig. 1. Observed RSV and influenza hospitalisations based on primary versus all recorded diagnoses among adults aged ≥40 years, England, 2023/24. Blue lines represent cases identified from primary diagnoses only, red lines represent cases when secondary diagnoses were also included, and green triangles indicate fold increases (all vs primary). The y-axis in the upper panels uses different scales for RSV and influenza to facilitate interpretation of values. Note: for full calculation of under-recognised cases, see Methods section and Supplementary Table 15. Cases refer to Finished Consultant Episode (FCE)-level counts from HES Admitted Patient Care data. Estimated cases include proportionally re-distributed unspecified ARI admissions.

100,000 in adults aged 80–84 years and 81.6 per 100,000 in those 85–89 years, confirming that RSV circulation and associated hospital burden have rebounded following the pandemic period. Although RSV incidence was the lowest of the three major viral pathogens, it remained detectable across all age groups, with measurable numbers of hospitalisations even in adults below the current vaccination threshold of 75 years. In 2023/24, RSV incidence among 5-year age bands, ranged from 8.1 to 18.3 per 100,000 among adults aged 60–74 years (approximately 1150 hospitalisations) and was still evident in those aged 40–64 years (approximately 800 hospitalisations; 2.0 to 8.1 per 100,000).

Primary diagnosis versus all diagnoses

When all recorded diagnoses were considered, substantially (30 to 70%) more RSV and influenza hospitalisations were identified compared with analyses limited to the primary diagnosis (Fig. 1). Among adults aged ≥ 40 years in 2023/24, inclusion of all diagnoses increased RSV counts from 4836 to 6778 cases, corresponding to a 1.4-fold increase overall. The relative increase varied by age, ranging from 1.3-fold in those ≥ 80 years to 1.6–1.7-fold in adults aged 40–69 years, where RSV was less often coded as the primary diagnosis. Absolute numbers remained highest in adults aged ≥75 years, exceeding 1000 RSV admissions in these age groups. For influenza, a similar pattern was observed, with admissions increasing across all ages from 37,265 to 60,932 cases (a 1.6-fold rise) when all diagnoses were considered.

Observed versus estimated incidence

Applying the proportional-redistribution method to account for unspecified ARIs markedly increased (~4 times higher) the estimated number of hospitalisations and incidence attributed to each virus of interest, across all age groups (Table 2). For RSV, admissions rose from 4836 to 23,407 in the primary-diagnosis (base) scenario (4.84-fold increase) and from 6778 to 25,264 in the all-diagnoses (expanded) scenario (3.73-fold increase). Corresponding incidences increased from 16.0 to 75.9 per 100,000 (base) and 22.0 to 82.0 per 100,000 (expanded). Estimated RSV incidence ranged from 11.9 per 100,000 in adults aged 40–44 years to 752.0 per 100,000 in those aged ≥ 90 years, showing a steep age gradient.

Influenza followed similar age-related trends but remained three to four times more frequent overall, with estimated admissions rising from 37,265 to 140,574 in the base scenario (3.77-fold increase) and from 60,932 to 164,403 in the expanded scenario (2.70-fold increase).

Economic impact

In 2023/24, the average emergency-admission cost was estimated at £2931 per RSV case and £2849 per influenza case, based on HRG tariffs weighted by clinical conditions within each age group (Table 3). Average costs showed little variation across age groups, remaining within ± 3% of these values.

Observed RSV admissions (primary diagnoses only) accounted for £14.2 million in hospital expenditure, increasing to £19.8 million when all diagnoses were included. After applying the redistribution method to account for under-recognition, total RSV-related secondary-care costs rose to £73.9 million, of which £54.1 million reflected costs associated with unrecognised RSV cases. RSV expenditure followed a steep age gradient, with the highest totals in adults aged ≥ 75 years (around £12 million among those ≥ 90 years), but non-trivial costs were also observed in younger age bands. Adults aged 40–74 years together contributed £15–20 million in

Table 2
Age-specific RSV and Influenza cases and incidences among adults aged 40+ in secondary care, 2023–24. Cases are shown for both primary diagnosis and all diagnoses, with observed and estimated values using the redistribution method. Population size, incidence per 100,000, and totals for adults aged 40+ are included.

Age group	Population Size	RSV Primary Diagnosis				RSV, All Diagnosis			
		Primary, RSV observed		Primary, RSV estimated		All, RSV observed		All, RSV estimated	
		Cases	Incidence /100k	Cases	Incidence /100k	Cases	Incidence /100k	Cases	Incidence /100k
40–44	3,971,625	81	2.0	387	9.7	141	3.6	474	11.9
45–49	3,606,800	60	1.7	274	7.6	99	2.7	355	9.8
50–54	4,018,382	169	4.2	748	18.6	240	6.0	863	21.5
55–59	4,087,573	190	4.6	872	21.3	272	6.7	996	24.4
60–64	3,681,890	300	8.1	1432	38.9	426	11.6	1619	44.0
65–69	3,065,200	342	11.2	1627	53.1	577	18.8	2137	69.7
70–74	2,758,878	506	18.3	2396	86.9	693	25.1	2581	93.6
75–79	2,538,513	799	31.5	3733	147.0	1084	42.7	3968	156.3
80–84	1,570,063	813	51.8	3823	243.5	1120	71.3	4101	261.2
85–89	980,911	800	81.6	3946	402.4	1077	109.8	4021	410.0
90+	551,758	776	140.6	4169	756.0	1049	190.2	4149	752.0
Tot. 40+	30,831,593	4836	16.0	23,407	75.9	6778	22.0	25,264	82.0
Age group	**Population Size**	**Influenza, Primary Diagnosis**				**Influenza, All Diagnosis**			
		Primary, Influenza observed		**Primary, Influenza estimated**		**All, Influenza observed**		**All, Influenza estimated**	
		Cases	Incidence /100k	Cases	Incidence /100k	Cases	Incidence /100k	Cases	Incidence /100k
40–44	3,971,625	1628	41.0	6153	154.9	2657	66.9	6282	158.2
45–49	3,606,800	1664	46.1	5946	164.9	2649	73.4	6849	189.9
50–54	4,018,382	2300	57.2	7875	196.0	3652	90.9	9486	236.1
55–59	4,087,573	2936	71.8	10,532	257.7	4734	115.8	12,598	308.2
60–64	3,681,890	3157	85.7	11,908	323.4	5088	138.2	14,247	386.9
65–69	3,065,200	3230	105.4	12,133	395.8	5386	175.7	14,560	475.4
70–74	2,758,878	3825	138.6	14,286	517.8	6427	233.0	17,508	634.6
75–79	2,538,513	5400	212.7	19,828	781.0	8788	346.2	23,379	921.0
80–84	1,570,063	5212	332.0	19,298	1229.1	8566	545.4	22,797	1452.0
85–89	980,911	4516	460.4	17,761	1810.8	7586	773.4	20,740	2114.1
90+	551,758	3397	615.8	14,854	2692.7	5399	978.8	15,957	2891.3
Tot. 40+	30,831,593	37,265	120.9	140,574	455.8	60,932	197.7	164,403	533.3

Note: Cases refer to Finished Consultant Episode (FCE)-level counts from HES Admitted Patient Care data. Estimated cases include proportionally redistributed unspecified ARI admissions.

Table 3
Hospital admission costs of RSV and influenza cases among adults aged ≥40 years, England, 2023/24. Results are shown separately for RSV and influenza, each stratified by primary and all recorded diagnoses. Costs are reported for observed admissions and for estimates after redistribution to account for under-recognition, with data presented by age group. Average costs per admission were derived from HRG-based tariffs weighted by clinical presentation.

		Primary Diagnosis				All Diagnosis				
	Cost per case	Observed cases	Total costs	Estimated cases	Total costs	Cost per case	Observed cases	Total costs	Estimated cases	Total costs
RSV										
40–44	£2889.8	81	£234,071	387	£1118,341	£2897.5	141	£408,543	474	£1373,401
45–49	£2940.4	60	£176,422	274	£805,661	£2941.9	99	£291,249	355	£1044,378
50–54	£2885.0	169	£487,570	748	£2158,010	£2892.9	240	£694,294	863	£2496,564
55–59	£2916.2	190	£554,072	872	£2542,900	£2907.2	272	£790,764	996	£2895,591
60–64	£2915.2	300	£874,560	1432	£4174,566	£2909.9	426	£1239,626	1619	£4711,160
65–69	£2942.7	342	£1006,415	1627	£4787,740	£2934.8	577	£1693,362	2137	£6271,603
70–74	£2926.7	506	£1480,896	2396	£7012,325	£2917.6	693	£2021,897	2581	£7530,326
75–79	£2923.7	799	£2336,972	3733	£10,914,097	£2922.3	1084	£3167,784	3968	£11,595,726
80–84	£2926.4	813	£2378,157	3823	£11,187,589	£2923.0	1120	£3273,805	4101	£11,987,387
85–89	£2931.2	800	£2344,960	3946	£11,566,515	£2930.7	1077	£3156,321	4021	£11,784,184
90+	£2942.0	776	£2283,018	4169	£12,265,240	£2937.9	1049	£3081,826	4149	£12,189,223
Tot. 40+	—	4936	£14,156,109	23,407	£68,532,986	—	6778	£19,819,470	25,264	£73,879,543
Influenza										
40–44	£2833.1	1628	£4612,303	6153	£17,432,126	£2822.7	2657	£7500,020	6282	£17,732,453
45–49	£2837.9	1664	£4722,266	5946	£16,874,153	£2831.5	2649	£7500,749	6849	£19,393,217
50–54	£2846.3	2300	£6546,398	7875	£22,414,298	£2838.3	3652	£10,365,545	9486	£26,924,304
55–59	£2851.3	2936	£8371,299	10,532	£30,029,470	£2840.1	4734	£13,444,844	12,598	£35,779,076
60–64	£2845.2	3157	£8982,296	11,908	£33,880,642	£2834.8	5088	£14,423,513	14,247	£40,387,538
65–69	£2847.7	3230	£9198,200	12,133	£34,551,629	£2839.9	5386	£15,295,648	14,560	£41,348,798
70–74	£2854.6	3825	£10,918,883	14,286	£40,780,958	£2842.3	6427	£18,267,398	17,508	£49,762,813
75–79	£2851.9	5,400	£15400,368	19,828	£56,547,870	£2840.7	8788	£24,964,072	23,379	£66,412,725
80–84	£2853.3	5212	£14,871,452	19,298	£55,063,176	£2842.2	8566	£24,346,285	22,797	£64,793,633
85–89	£2857.4	4516	£12,903,883	17,761	£50,749,749	£2843.8	7586	£21,573,294	20,740	£58,981,034
90+	£2858.7	3397	£9711,072	14,854	£42,463,427	£2849.4	5399	£15,383,641	15,957	£45,467,078
Tot. 40+	—	37,265	£106,238,420	140,574	£400,787,498	—	60,932	£173,065,009	164,403	£466,982,670

Note: Cases refer to Finished Consultant Episode (FCE)-level counts from HES Admitted Patient Care data. Estimated cases include proportionally redistributed unspecified ARI admissions.

estimated hidden costs, reflecting under-recognition in populations below the current vaccination age threshold. In this context, adults aged 75–79 years, the initial target group for the UK RSV immunisation programme launched in September 2024,[7] incurred substantial RSV-related costs in the estimated scenario, ranging from £10.9 million (primary diagnosis) to £11.6 million (all diagnoses). Adults aged 70–74 years also contributed a notable burden, with estimated RSV-related costs of approximately £7.0 million in the primary-diagnosis scenario and £7.5 million in the all-diagnoses scenario, indicating meaningful resource use in age groups just below the updated eligibility threshold. The RSV programme was extended from April 2026 to include adults aged 80 years and older and eligible care home residents,[8] who accounted for approximately £35.0 million (primary-diagnosis estimated) to £36.0 million (all-diagnoses estimated) in RSV-related hospital costs in 2023/24.

Influenza showed a similar age gradient but higher overall expenditure (£106–173 million observed and £401–467 million estimated after redistribution). Redistribution increased influenza estimates by three- to four-fold, compared with a four- to five-fold increase for RSV.

Sensitivity analysis for RSV cost estimates applying an older-adult CC mix (Scenario 1, reflecting higher comorbidity burden in adults aged 75 years and over) and a high-severity CC mix (Scenario 2, reflecting concentration at the highest complexity levels in adults aged 85 years and over) yielded total costs of £80.8 million to £87.2 million (+19%) and £92.5 million to £99.7 million (+35%) respectively, compared with the base-case range of £68.5 million to £73.9 million (Supplementary Tables 17 and 18).

Discussion

This national analysis provides updated evidence on the burden of RSV in adults aged ≥ 40 years in England, quantifying both directly coded and unrecognised hospitalisations as well as associated secondary-care costs. Using the latest year of HES data, 2023/24, RSV-associated ARI admissions were found to be substantially under-identified in routine hospital records, reflecting both coding limitations and a high proportion of unspecified ARIs without an identified pathogen, due to lack of testing and variations in test sensitivity by age, time of testing since symptom onset, type of swab taken, and type of test used (antigen vs. PCR). The share of unspecified cases increased with age, ranging from approximately 79% in those aged 70–89 years to exceeding 81% among adults aged ≥90 years likely due to limited diagnostic testing in older patients, where management often proceeds without microbiological confirmation[40,41] and reduced diagnostic test accuracy in adults.[12,42] Redistribution of unspecified ARIs suggested that the true number of RSV-related hospitalisations may be around five times higher than coded data indicate, corresponding in the adjusted all-diagnoses scenario to approximately 25,000 admissions and approximately £74 million in secondary-care costs in 2023/24. Adults aged 40–74 years accounted for an estimated £22.6 million in the primary-diagnosis scenario and £26.3 million in the all-diagnoses scenario, indicating a substantial burden below the current vaccination threshold. Adults aged 75 years and older accounted for the remaining £45.9 million and £47.6 million in the respective scenarios, consistent with the concentration of RSV-related hospitalisations in older age groups.

These findings are consistent with recent national data from France (2017–2022), where a virology-linked analysis of hospital discharge records reported a similar four- to five-fold under-reporting of RSV hospitalisations among adults aged ≥ 65 years.[37] Despite methodological differences, our proportional-redistribution approach versus laboratory-based correction in France, the magnitude of under-recognition and adjusted incidence rates were comparable. In adults aged ≥75 years, the estimated incidence in England (57–288 per 100,000 under the most conservative and upper-range scenarios) overlapped with corrected French estimates (85–221 per 100,000 for the same age group). Both analyses identified marked under-ascertainment in administrative data and concentration of RSV-related costs among older adults. The recent HARISS study, which used enhanced surveillance across seven English hospitals in 2023/24, reached similar conclusions: routine diagnostic coding captured only a fraction of laboratory-confirmed RSV cases in adults.[11] Collectively, these findings indicate that apparent cross-country differences largely reflect variation in testing and coding practices rather than true epidemiological divergence.

The COVID-19 pandemic has further complicated the understanding of RSV disease burden in adults, disrupting respiratory virus circulation, altering healthcare-seeking behaviours, and increases in respiratory testing practices.[14] These changes introduced major uncertainty into burden estimates and exposed weaknesses in existing surveillance systems. In parallel, influenza vaccine formulations and coverage among high-risk adults have improved, and COVID-19 vaccination has been widely adopted to protect older and vulnerable populations.[15] Together, these developments underscore the importance of better characterising RSV burden in adults of different ages and risk profiles, particularly younger and high-risk groups, to inform future prevention policy discussions.

Our results also align with earlier modelling and surveillance work in the United Kingdom and other high-income settings, which found that routine coding captures only a minority of adult RSV admissions.[3–6,11,12,37] Pre-pandemic estimates suggested approximately 18,000–20,000 annual RSV hospitalisations among English adults ≥ 65 years[4]; our results imply a higher contemporary burden (we estimated around 23,407 – 25,264 based on primary and additional diagnosis), consistent with the post-pandemic rebound in RSV activity. The estimated total secondary-care cost of RSV hospitalisations in England (approximately £20–74 million for those aged ≥40 years and £13–48 million for adults aged ≥75 years in 2023/24) was comparable to adjusted national estimates from France (€27–76 million among adults aged ≥ 75 years[37]), underscoring the consistency of RSV's economic burden across European health systems and with other recent analyses.[6,9] Beyond hospital costs, a RAND Europe analysis[43] estimated the total annual economic burden of adult RSV at about £320 million in 2019/20, including £140 million in direct NHS expenditure, covering primary, community, and secondary care, and £179 million in indirect societal costs from productivity losses among adults aged ≥18 years. These broader national figures are also consistent with our finding that hospital admissions alone account for a substantial share of the overall burden.

From a public health perspective, these findings highlight persistent under-recognition of RSV in adults and the need to strengthen diagnostic and coding practices, especially in older populations. Wider implementation of multiplex molecular testing during winter seasons could improve case detection and surveillance accuracy. The presence of a substantial number of RSV admissions among adults aged 40–74 years underscores an unrecognised contribution to hospital burden outside the oldest age groups. As the United Kingdom introduces vaccination for adults aged ≥ 75 years, extending surveillance to younger and high-risk populations will be essential to guide policy decisions and evaluate programme impact.

This study's strengths include comprehensive national coverage of hospital admissions in England for 2023/24 (and previous pre- and during the pandemic years), providing estimates of the burden of RSV, as well as COVID-19 and influenza as comparator, up until two years post-pandemic. We also used validated codelists to define pathogens and redistribution methods to quantify under-ascertainment.

Three limitations should be acknowledged. First, the aggregated nature of the data precluded linkage of individual hospital episodes and assessment of patient-level outcomes. Second, Second, data are available as aggregated FCE-level counts, precluding deduplication

of multiple episodes within the same admission spell and individual-level adjustment for comorbidities, socioeconomic status, care pathway, or readmissions. FCE-level counts may modestly overestimate unique hospitalisations; however, multiple FCEs within a single respiratory spell arise principally in cases involving critical care, which account for fewer than 5% of adult respiratory admissions,[18] and cardiac complications requiring specialist input are similarly infrequent in uncomplicated viral respiratory presentations. The cases most likely to generate multiple FCEs are also associated with higher unit costs, but given their small proportion, any resulting overestimation in total expenditure is expected to remain modest. Furthermore, our age-specific incidence estimates are consistent with those reported in comparable national and European studies, including pre-pandemic UK estimates, enhanced surveillance data from seven English hospitals in 2023/24,[11] and a multi-country European study including England HES data,[23] providing reassurance that FCE-based counts yield epidemiologically coherent estimates. Cost estimates were based on average HRG tariffs and mean lengths of stay, and it was not possible to distinguish intensive-care costs or decompose admissions by CC score at the patient level, which may underestimate true resource variability. However, sensitivity analysis using NHS National Cost Collection data across alternative CC-score distributions confirmed that base-case estimates are robust and conservative, with total RSV-related costs remaining substantial across all scenarios. Third, the redistribution approach assumes that pathogen distribution among unspecified ARIs mirrors that of identified cases, which may not hold uniformly across viral pathogens, age or risk groups. Additionally, if test sensitivity differs across viruses, for example if RSV detection in upper respiratory specimens is less sensitive than influenza,[12] particularly in adults presenting later in disease,[44] redistribution could amplify misclassification. The unspecified ARI category therefore includes a mixture of untested cases and cases that were tested for RSV but had negative results, as negative virological findings cannot be encoded as pathogen-specific diagnoses.[24] Our estimates are conservative and more likely to underestimate rather than overestimate true RSV burden in secondary care. RSV testing in adults in England is not routine or standardised, varies across local NHS pathology services, and has historically been optimised for paediatric populations rather than older adults.[4,11,25,44] Real-world studies show that RSV testing among hospitalised adults is substantially less frequent than testing for influenza or SARS-CoV-2, particularly outside classic influenza-like illness presentations, leading to systematic under-ascertainment in routine data.[11,13] The persistence of a large unspecified ARI category (79% of ARIs), despite expanded but incomplete adoption of multiplex PCR testing during the COVID-19 pandemic, further supports incomplete routine RSV detection.[15,45]

Finally, independent analyses using virology-linked hospital data and enhanced surveillance in France and the UK (HARISS) yield results consistent with our adjusted estimates, despite differing methodologies and study populations.[11,37] Taken together, these findings provide further context for our redistributed estimates as conservative lower bounds of the true RSV-associated hospital burden in adults. Our empirically derived hospitalisation and secondary-care cost estimates also provide context for recent UK evaluations of adult RSV vaccination. A UK cost-effectiveness analysis incorporating adjustments for under-ascertainment projected that vaccination of older adults would be cost-effective under standard NHS thresholds.[46] In addition, early real-world evidence from England has demonstrated substantial effectiveness of RSV vaccination in reducing hospital admissions among eligible older adults following programme implementation.[47] While our analysis predates widespread adult vaccination and does not model vaccine impact directly, the magnitude and age distribution of hospital burden observed here are broadly compatible with assumptions underlying these economic and effectiveness evaluations.

Conclusion

COVID-19 and influenza remain the main causes of viral ARI admissions, but RSV consistently follows them as a significant contributor to hospital burden, particularly in older adults. RSV activity has rebounded to pre-pandemic levels and now imposes a substantial and systematically underestimated burden of hospitalisation and healthcare cost among adults in England, part of which will remain unaddressed without vaccination coverage to widespread age groups. Although total RSV-related expenditure remains lower than that associated with influenza, it follows a similarly steep age gradient and translates into a substantial economic burden in older adults. Notably, a meaningful share of RSV-related costs arises in adults below the current vaccination threshold, highlighting the relevance of these findings for future age-based prevention strategies. The convergence of our results with both French and UK enhanced-surveillance data confirms a possible under-reporting of RSV among adults is present across Europe. Improved diagnostic testing, coding accuracy, and continued surveillance will be essential for accurately measuring vaccine impact. As national RSV immunisation programmes for adults aged 75 and older are implemented, the estimates of RSV burden presented here can inform health technology assessments and policy discussions on which additional age and risk groups might be prioritised for RSV prevention, alongside evidence on vaccine efficacy, safety and cost effectiveness, and in line with regulatory indications.

CRediT authorship contribution statement

Conceptualisation and study design: JEM, JMR, LL, JMOM, CN. Data collection: TT, JEM. Data analysis: JEM, TT. First draft of the manuscript: JEM, JMR, LL, CN, TT, JMOM, UH, OB, ABA, SdL. Critical review, editing, and approval of the final version of the manuscript: All authors.

Ethical approval

This study was conducted under the umbrella of the ObservatARI study. Ethical approval for England and Wales was obtained from the Health Research Authority and Health and Care Research Wales on 14 September 2023 (IRAS project ID: 329790; South Central – Oxford A Research Ethics Committee reference 23/SC/0320). The study and data extract were additionally approved by the ORCHID Caldicott Guardian and the Primary Care Hosted Research Datasets Independent Scientific Committee of the Nuffield Department of Primary Care Health Sciences, University of Oxford (application reference PD-0030-2023).

Funding

This work describes a part of the ObservatARI study which has been funded by Moderna.

CN has also received funding by the European Union through the PCR-4-ALL project under the Horizon Europe research and innovation programme (grant agreement N. 101095606).

Conflicts of interest

JMR, LL, OB and ABA are employees of Moderna, Inc and may hold stock/stock options in the company. JEM, TT, JMOM, UH, CN and SdeL received research funding from Moderna, Inc. for this work through their institution. All other authors declare no additional conflicts of interest.

Role of the funder

Moderna employees contributed to study design, data interpretation, and manuscript preparation. Data extraction and analysis were conducted independently by the University of Oxford team.

Data availability

All data used in this study are publicly available administrative and costing datasets. Hospital admission data were obtained from Hospital Episode Statistics (HES) Admitted Patient Care, published by NHS England: https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity. Hospital cost data were obtained from the National Cost Collection (NCC), published by NHS England: https://www.england.nhs.uk/publication/2024–25-national-cost-collection-data-publication/. Population denominators were obtained from the Office for National Statistics (ONS) mid-year population estimates: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates. All datasets are accessible without restriction via the respective public websites.

Declaration of Competing Interest

JMR, LL, ABA, and OB are employees and shareholders of Moderna, Inc. All other3 authors have no conflict of interest to declare.

Declaration of Generative AI and AI-assisted technologies in the writing process

ChatGPT 4o was used in a limited way to support writing of the first draft of the manuscript. The manuscript subsequently underwent multiple rounds of substantial editing, re-structuring of sections, scientific interpretation, revision, and intellectual input by all co-authors. All conducted analyses followed the protocol and the tables were created following the pre-specified shell tables. All the literature cited in the manuscript is included in the list of references and has been verified by the authors. This manuscript represents an authentic and original contribution reflecting the authors' own work. The final version was verified for scientific accuracy and originality by the authors.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jinf.2026.106792.

References

1. World Health Organization (WHO). *Respiratory syncytial virus (RSV).* Geneva: WHO,; 2025 (Available from: ⟨https://www.who.int/news-room/fact-sheets/detail/respiratory-syncytial-virus-(rsv)⟩).
2. Chadha M, Hirve S, Bancej C, Barr I, Baumeister E, Caetano B, et al. *Human respiratory syncytial virus and influenza seasonality patterns: early findings from the WHO global respiratory syncytial virus surveillance. Influenza Other Respir Virus* 2020;**14**(6):638–46. https://doi.org/10.1111/irv.12773
3. Fleming DM, Taylor RJ, Lustig RL, Schuck-Paim C, Haguinet F, Webb DJ, et al. *Modelling estimates of the burden of respiratory syncytial virus infection in adults and the elderly in the United Kingdom. BMC Infect Dis* 2015;**15**:443. https://doi.org/10.1186/s12879-015-1218-z
4. Sharp A, Minaji M, Panagiotopoulos N, Reeves R, Charlett A, Pebody R. *Estimating the burden of adult hospital admissions due to RSV and other respiratory pathogens in England. Influenza Other Respir Virus* 2022;**16**(1):125–31. https://doi.org/10.1111/irv.12910
5. Wilkinson T, Beaver S, Macartney M, McArthur E, Yadav V, Lied-Lied A. *Burden of respiratory syncytial virus in adults in the United Kingdom: a systematic literature review and gap analysis. Influenza Other Respir Virus* 2023;**17**(9):e13188. https://doi.org/10.1111/irv.13188
6. Shi T, Vennard S, Jasiewicz F, Brogden R, Nair H, Investigators RESCEU. *Disease burden estimates of respiratory syncytial virus–related acute respiratory infections in adults with comorbidity: a systematic review and meta-analysis. J Infect Dis* 2022;**226**(1):S17–21. https://doi.org/10.1093/infdis/jiab040
7. UK Government. *UK's first RSV vaccination programme protects older people.* London: Department of Health and Social Care; 2024 (Available from: ⟨https://www.gov.uk/government/news/uks-first-rsv-vaccination-programme-protects-older-people⟩).
8. UK Government. *Advice accepted on extending the RSV vaccination programme [Internet].* London: GOV.UK; 2026 [cited 2026 May 12]. Available from: ⟨https://www.gov.uk/government/news/advice-accepted-on-extending-the-rsv-vaccination-programme⟩.
9. Nguyen-Van-Tam JS, O'Leary M, Martin ET, Heijnen E, Callendret B, Fleischhackl R, et al. *Burden of respiratory syncytial virus infection in older and high-risk adults: a systematic review and meta-analysis. Eur Respir Rev* 2022;**31**(166):220091. https://doi.org/10.1183/16000617.0091-2021
10. Savic M, Penders Y, Shi T, Branche A, Pirçon JY. *Respiratory syncytial virus disease burden in adults aged 60 years and older in high-income countries: a systematic literature review and meta-analysis. Influenza Other Respir Virus* 2023;**17**(1):e13031. https://doi.org/10.1111/irv.13031
11. Symes R, Keddie SH, Walker J, McKeever T, Ahmad S, Arnold D, et al. *Burden of respiratory syncytial virus infection in older adults hospitalised in England during 2023/24. J Infect* 2025;**91**(3):106570. https://doi.org/10.1016/j.jinf.2025.106570
12. Onwuchekwa C, Moreo LM, Menon S, Machado B, Curcio D, Kalina W, et al. *Underascertainment of respiratory syncytial virus infection in adults due to diagnostic testing limitations: a systematic literature review and meta-analysis. J Infect Dis* 2023;**228**(2):173–84. https://doi.org/10.1093/infdis/jiad012
13. Rozenbaum MH, Judy J, Tran D, Yacisin K, Kurosky SK, Begier E. *Low levels of RSV testing among adults hospitalised for lower respiratory tract infection in the United States. Infect Dis Ther* 2023;**12**(2):677–85. https://doi.org/10.1007/s40121-023-00758-5
14. Rios-Guzman E, Simons LM, Dean TJ, Agnes F, Pawlowski A, Alisoltanidehkordi A, et al. *Deviations in RSV epidemiological patterns and population structures in the United States following the COVID-19 pandemic. Nat Commun* 2024;**15**(1):3374. https://doi.org/10.1038/s41467-024-47757-9
15. UK Health Security Agency. *Surveillance of influenza and other seasonal respiratory viruses in the UK, winter 2023 to 2024.* London: UK Health Security Agency; 2024 [cited 2025 Oct 22]. Available from: ⟨https://www.gov.uk/government/statistics/surveillance-of-influenza-and-other-seasonal-respiratory-viruses-in-the-uk-winter-2023-to-2024⟩.
16. NHS Digital. *Hospital episode statistics: admitted patient care activity, England.* London: NHS Digital; 2024 (Available from: ⟨https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity⟩).
17. NHS England. *National cost collection for the NHS 2023/24.* London: NHS England; 2024.
18. Campling J, Wright HF, Hall GC, Mugwagwa T, Vyse A, Mendes D, et al. *Hospitalization costs of adult community-acquired pneumonia in England. J Med Econ* 2022;**25**(1):912–8. https://doi.org/10.1080/13696998.2022.2090734
19. NHS England. *2023/25 NHS payment scheme: Annex B: NHS England. 2023/25 NHS Payment Scheme: Annex B — Guidance on currencies.* London: NHS England; 2023 (Available from:). ⟨https://www.england.nhs.uk/wp-content/uploads/2023/03/23-25NHSPS_Annex-B-Guidance-on-currencies-1.pdf⟩.
20. Agyei-Manu E, Atkins N, Nundy M, St-Jean C, Gornall-Wick A, Birley E, De Silva U, et al. *Characteristics of influenza, SARS-CoV-2, and RSV surveillance systems that utilise ICD-coded data: a systematic review. J Glob Health* 2025;**15**:04177. https://doi.org/10.7189/jogh.15.04177. PMID: 40406976; PMCID: PMC12100576.
21. Urchueguía-Fornes A, Osei-Yeboah R, Jollivet O, Johannesen CK, Lehtonen T, van Boven M, et al. *Hospitalisation trends of respiratory syncytial virus (RSV) infection in adults, six European countries, before and during COVID-19, 2016 to 2023. Eur Surveill* 2025;**30**(25). https://doi.org/10.2807/1560-7917.ES.2025.30.25.2400624. pii=2400624.
22. Hamilton MA, Calzavara A, Emerson SD, Djebli M, Sundaram ME, Chan AK, et al. *Validating international classification of disease 10th revision algorithms for identifying influenza and respiratory syncytial virus hospitalisations. PLoS One* 2021;**16**(1):e0244746. https://doi.org/10.1371/journal.pone.0244746
23. Bosch NA, Law AC, Peterson D, Walkey AJ. *Validation of the international classification of diseases code for COVID-19 among critically ill patients. Ann Am Thorac Soc* 2022;**19**(5):861–3. https://doi.org/10.1513/AnnalsATS.202106-729RL
24. NHS England. *National clinical coding standards: ICD-10 5th edition for morbidity coding (Version 10.1).* Leeds: NHS England; 2024.
25. Malmenas M, Bayerl B, Carroll S, Desai M, Balogh O, Ahmed T. *Disease burden of respiratory syncytial virus (RSV) in adults 60+ in the UK: targeted literature review (TLR). Age Ageing* 2024;**53**(Suppl_3):104.
26. Oxford University Hospitals (OUH). Respiratory virus testing (Microbiology A–Z). ⟨https://www.ouh.nhs.uk/microbiology/a-z/respiratory-virus-testing.aspx⟩. [Accessed 6 Jan 2026].
27. East London NHS Foundation Trust (ELFT). Respir Infect Policy (Respir Pathw Policy) Version 5 0 (18 6 24). 2024. (PDF published Dec 2024). ⟨https://www.elft.nhs.uk/sites/default/files/202412/respiratory_pathways_policy_5.0_18.6.24.pdf⟩.
28. The Health Protection Regulations 2025. *SI 2025/291* (coming into force 6 Apr 2025). ⟨https://www.legislation.gov.uk/uksi/2025/291/contents/made⟩; Explanatory Memorandum PDF: ⟨https://www.legislation.gov.uk/uksi/2025/291/pdfs/uksiem_20250291_en_001.pdf⟩.
29. UK Health Security Agency (UKHSA) *Respiratory syncytial virus (RSV) – UKHSA data dashboard*. Last updated 24 Dec 2025. ⟨https://ukhsa-dashboard.data.gov.uk/respiratory-viruses/respiratory-syncytial-virus-rsv⟩. [Accessed 6 Jan 2026].
30. UK Health Security Agency (UKHSA). *Expansion of mandatory disease reporting requirements* (news release, published 18 Mar 2025; effective 6 Apr 2025). ⟨https://www.gov.uk/government/news/expansion-of-mandatory-disease-reporting-requirements⟩.

31. UK Health Security Agency (UKHSA). *Laboratory reporting to UKHSA: a guide for diagnostic laboratories* (April 2025 PDF). ⟨https://assets.publishing.service.gov.uk/media/680f7e9611d566056bcae966/laboratory-reporting-to-UKHSA-a-guide-for-diagnostic-laboratories-april-2025.pdf⟩.
32. Office for National Statistics. *Mid-year population estimates: England and Wales, single year of age and sex, 2018–2024.* London: ONS; 2024 (Available from). ⟨https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates⟩.
33. Scohy A, Lesnik T, Devleesschauwer B, Haneef R. *The importance of redistribution process of ill-defined deaths in national mortality database. Arch Public Health* 2025;**83**:185.
34. Naghavi M, Liane Ong K, Aali A, Ababneh HS, Habtegiorgis Abate Y, Abbafati C. *Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the global burden of disease study 2021. Lancet* 2024;**403**(10440):2100–32.
35. Heemskerk S, Baliatsas C, Stelma F, Nair H, Paget J, Spreeuwenberg P. *Assessing the impact of non-pharmaceutical interventions during the COVID-19 Pandemic on RSV seasonality in Europe. Influenza Other Respi Viruses* 2025;**19**:e70066. https://doi.org/10.1111/irv.70066
36. US Centers for Disease Control and Prevention (CDC). *RSV burden estimates.* Atlanta (GA): CDC; 2024 (Available from:). ⟨https://www.cdc.gov/rsv/about/burden.html⟩.
37. Marot S, Demont C, Cocherie T, Jiang M, Charpentier C, Araujo A, et al. *Incidence and burden of respiratory syncytial virus-associated hospitalizations among people 65 and older in France: a national hospital database study. Open Forum Infect Dis* 2025;**12**(9):ofaf528. https://doi.org/10.1093/ofid/ofaf528
38. NHS. *Healthcare Resource Groups 2024.* London: NHS Digital; 2024 (Available from: ⟨https://digital.nhs.uk/services/secondary-uses-service-sus/payment-by-results-guidance/sus-pbr-reference-manual/hrg-grouping⟩).
39. R Core Team. *R: A language and environment for statistical computing. Version 4.5.1.* Vienna: R Foundation for Statistical Computing; 2023 (Available from). ⟨https://www.r-project.org/⟩.
40. High KP, Bradley SF, Gravenstein S, Mehr DR, Quagliarello VJ, Richards C, et al. *Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. Clin Infect Dis* 2009;**48**(2):149–71.
41. Woodhead M, Blasi F, Ewig S, Garau J, Huchon G, Ieven M, et al. *Guidelines for the management of adult lower respiratory tract infections. Clin Microbiol Infect* 2011;**17**(6):E1–59.
42. McLaughlin JM, Khan F, Begier E, Swerdlow DL, Jodar L, Falsey AR. *Rates of medically attended RSV among US Adults: a systematic review and meta-analysis. Open Forum Infect Dis* 2022;**9**(7):ofac300. https://doi.org/10.1093/ofid/ofac300. PMID: 35873302.
43. Herbert K, Cabling M, Morris S, Olumogba F, Stockwell S, Todsen AL, et al. *The burden of respiratory syncytial virus in adults in the UK.* Santa Monica (CA) and Cambridge (UK): RAND Corporation; 2024. Report No.: RRA3133-1.
44. Coultas JA, Smyth RL, Openshaw PJM. *Respiratory syncytial virus (RSV): a scourge from infancy to old age. Thorax* 2019;**74**(10):986–93.
45. United Kingdom Health Security Agency (UKHSA). *Mycoplasma pneumoniae surveillance in England and Wales: January 2019 to March 2024.* London: UKHSA; 2025 Available from: ⟨https://www.gov.uk/government/publications/mycoplasma-pneumoniae-surveillance-january-2019-to-march-2024/mycoplasma-pneumoniae-surveillance-in-england-and-wales-january-2019-to-march-2024⟩.
46. York Health Economics Consortium. *The cost-effectiveness and public health impact of vaccination against respiratory syncytial virus (RSV) with mRNA-1345 in adults aged ≥60 years in the UK [Internet].* York (UK): York Health Economics Consortium; 2025 [cited 2026 Feb 15]. Available from: ⟨https://www.yhec.co.uk/publication/the-cost-effectiveness-and-public-health-impact-of-vaccination-against-respiratory-syncytial-virus-rsv-with-mrna-1345-in-adults-60-years/⟩.
47. Mensah AA, Whitaker H, Andrews NJ, Watson CH. *Early impact of RSV vaccination in older adults in England. Lancet* 2025;**405**(10485):1139–40. https://doi.org/10.1016/S0140-6736(25)00346-0