Research Square

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Nosocomial Influenza: Effectiveness of Mandatory Surgical Masks for Prevention, Associated Risk Factors, and Prognostic Value

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Abstract

Background:

Nosocomial influenza (NI) represents a potentially preventable adverse event with significant clinical impact, particularly in vulnerable hospitalised populations. During the 2024–2025 influenza season, a stepped programme of mandatory surgical mask use (MSMU) was implemented in response to increasing NI clusters. This study aimed to evaluate the effectiveness of three MSMU-based interventions and to analyse the risk factors associated with NI and its prognostic value for adverse clinical outcomes.

Methods:

A before–after observational study was conducted in an open cohort of hospitalised patients with PCR-confirmed influenza A or B in a tertiary-care hospital. Three MSMU interventions were implemented sequentially at the unit and hospital levels. For each intervention, the burden of NI was assessed using incidence rates per 10^4 patient-days and the proportion of nosocomial cases among all influenza cases. Rate ratios (RRt), relative risks (RR), and prevention program effectiveness (PPE) were estimated by comparing for the pre-intervention (PIP) and intervention (IP) periods. Multivariable logistic regression was used to identify risk factors associated with NI and to evaluate its association with prolonged length of stay (≥11 days), intensive care unit (ICU) admission and all- cause mortality.

Results:

Among 340 influenza cases, 57 (16.8%) were nosocomial. Across the three interventions, NI incidence rates and proportions were consistently lower during IP than during PIP. PPE estimates based on incidence rates were 71.7%, 71.4%, and 69.9% for the first, second, and third interventions, respectively, based on proportions, PPE estimates were 25.3%, 40.8%, and 78.3%. In multivariable analysis, MSMU was associated with a reduced likelihood of NI (adjusted odds ratio [OR] 0.17), while chronic kidney disease (aOR 1.99) and haematologic disease (aOR 2.28) were independently associated with NI. NI was further associated with prolonged hospitalization (aOR 1.99) and mortality (aOR 4.57).

Conclusions:

MSMU was associated with a lower burden of NI during periods of high influenza circulation, with increasing effectiveness when applied hospital-wide. NI occurs more frequently in clinically vulnerable patients and was associated with worse outcomes. MSMU may be a useful preventive strategy during seasonal influenza peaks, particularly in high-risk wards.

Background

Respiratory hygiene, integrated into standard precautions in healthcare settings, is a fundamental measure for preventing healthcare-associated respiratory infections and for protect both patients and

healthcare professionals [1].

Nosocomial influenza (NI), defined as influenza occurring at least 48 hours after hospital admission [2-4], represents a potentially preventable adverse event and a significant burden for both patients and healthcare systems. Its impact in terms of morbidity, mortality, and prolonged length of stay is well documented, particularly among immunocompromised patients or those with severe comorbidities [5].

Nevertheless, NI remains a challenge during periods of high viral circulation, driven by factors such as low vaccination coverage among the general population and healthcare workers, sustained community circulation of influenza virus, and the presence of asymptomatic reservoirs within hospital [6].

During the COVID-19 pandemic, the use of surgical masks became established as a key non-pharmacological measure to reduce the transmission of respiratory viruses in healthcare settings, and several guidelines and reviews supported their systematic use [7-8]. However, evidence regarding their specific impact on prevention of NI remains limited, with available studies showing substantial methodological heterogeneity and low statistical significance in many cases [9]. Consequently, relevant knowledge gaps persist regarding the true impact of mandatory mask-use interventions in specific hospital wards, the risk factors associated with NI, and the prognostic implications of this infection for adverse clinical outcomes.

During the 2024–2025 influenza season, and in response to a sustained increase in nosocomial cases, a stepped programme of mandatory surgical mask use (MSMU) was implemented in several hospital wards. The main objective of this study was to estimate the effectiveness of three MSMU-based interventions for preventing NI, which were not planned at the start of the season but were introduced in response to the detection of in-hospital transmission clusters. Secondary objectives were to analyse risk factors associated with NI and to assess its value as a prognostic marker of adverse clinical outcomes, including prolonged length of stay, intensive care unit admission, and mortality.

Materials and Methods

Study design and setting

A before–after observational study was conducted in an open cohort in a tertiary-care hospital. The overall study period extended from Week 44 of 2024 to Week 9 of 2025 (W44–W9). During this interval, the burden of nosocomial influenza (NI) and the effectiveness of three stepped interventions implemented to reduce in-hospital transmission were evaluated.

Study population and case definitions

All hospitalised patients with a laboratory-confirmed diagnosis of influenza A or B during the study period were included.

Nosocomial influenza (NI) was defined as influenza occurring in a patient admitted for a reason other than influenza who developed symptoms of acute respiratory infection from the third day of hospitalization onwards, with confirmation by a positive PCR test for influenza A or B.

Following the influenza diagnosis, enhanced droplet and contact precautions were prescribed through the hospital's electronic therapeutic prescription application. These measures are recommended for seven days in immunocompetent patients and for ten days in immunosuppressed patients. The admission and clinical documentation service, as well as the involved clinical wards, were notified by telephone to ensure proper implementation.

Data collection

Influenza cases were identified through the hospital´s electronic system that manages the results of all laboratory tests processed at the centre, include nasopharyngeal swabs and aspirates, bronchoaspirates, and tracheobronchial aspirates. Positive cases were confirmed by PCR, and each episode was recorded in a specific relational database. Clinical information was obtained from the electronic medical records.

Cases were detected within the framework of the hospital's Epidemiological Surveillance Programme for Infections. No missing data were recorded for the main variables. No prior sample size calculation was performed, as all hospitalised patients with PCR-confirmed influenza during the seasonal study period were included.

Interventions

Mandatory surgical mask use (MSMU) was applied to healthcare professionals, visitors, accompanying persons, and patients, both during direct patient care and in shared common areas.

The exact delimitation of the periods during which each intervention was active was established based on the date of detection of the first NI cases and the operational definition of nosocomial infection. Accordingly, each intervention was assumed to become effective two days after its implementation. Pre-intervention (PIP) and intervention (IP) periods were therefore defined following this rule.

The first intervention (INT-1), applied exclusively in ward 7A (nephrology/renal transplant), was implemented on 17 December 2024. Its impact was assessed by comparing a PIP from 12 to 19 December 2024 with an IP from 20 to 25 December 2024.

The second intervention (INT-2), implemented in wards 7A–7D (7A – nephrology/renal transplant; 7B – vascular surgery/haematology; 7C – oncology; 7D – haematology), began on 23 December 2024. For this intervention, the PIP covered the period from 12 to 25 December 2024, and the IP extended from 26 December 2024 to 5 January 2025.

Third intervention (INT-3), implemented across all inpatient wards of the hospital, started on 3 January 2025. A PIP from 7 October 2024 to 5 January 2025 was compared with an IP extending from 6 January to 6 April 2025.

Outcome measures and statistical analysis

To address the main objective, two frequency measures were used to characterize the dynamics of NI according to hospital exposure and community epidemic pressure: (1) NI incidence rates per 10^4 patient-days, and (2) the proportion of nosocomial cases among the total number of hospitalised influenza cases.

Both measures were compared between the pre-intervention (PIP) and intervention (IP) periods. Each intervention was analysed at two complementary levels: its specific impact within the ward where it was implemented and its impact at the hospital level. For the latter, the IP was subdivided into wards with MSMU and wards without MSMU, allowing evaluation of the differential effect of the intervention within the same time period.

The incidence rate of NI per 10^4 patient-days was calculated using, as the numerator, the number of NI cases recorded in each intervention area and study period (PIP and IP), and as the denominator, the total number of patient-days for all admitted patients (cases and non-cases) in the evaluated wards and periods. For NI cases, only the patient-days up to the date of influenza diagnosis were counted, always within the corresponding period.

To estimate the magnitude of the association between the PIP and IP rates, rate ratio (RRt) with 95% confidence intervals (95% CI) were calculated, using the incidence rate observed during the IP as the exposure category and that of the PIP as the reference.

The proportion of NI cases among all hospitalised influenza cases (community and nosocomial) in each ward and period was calculated by dividing the number of NI cases by the total number of influenza cases. Comparisons between PIP and IP were performed using relative risk (RR) with 95% CI, with the PIP proportion as the reference.

Prevention program effectiveness (PPE) was estimate by calculating the prevention fraction among the exposed individuals (1–RRt or 1–RR, depending on the frequency measure used) with its 95% CI, according to the following formula: $PPE = (1 – RRt/RR) \times 100$.

For the first secondary objective, the frequency of NI cases was analysed according to patient characteristics, including exposure to MSMU, age, sex, and comorbidities (cardiovascular disease, asthma, chronic obstructive pulmonary disease, diabetes mellitus, obesity, chronic kidney disease, hypertension, liver disease, malignant neoplasm, haematologic disease, neuromuscular disease, and immunosuppression). Association between these variables and nosocomial origin was assessed using the chi-square test. The magnitude of association was estimated using odds ratios (ORs) with 95% CIs.

Variables showing statistical significance were subsequently included in a multivariable logistic regression model to estimate adjusted ORs (aOR) with their 95% CIs.

For the second secondary objective, the cumulative incidence of adverse clinical outcomes (prolonged length of stay [≥11 days], intensive care unit admission and all-cause mortality) was calculated according to case origin (nosocomial versus community-acquired). Associations between case origin and each outcome were analysed using the chi-square test, and ORs with 95% CI were estimated. Multivariable logistic regression model were then fitted to obtain aORs (95% CI), adjusting for previously identified risk factors.

Length of stay was defined as the number of days between the date of microbiological influenza diagnosis and the date of hospital discharge. Prolonged length of stay was defined as a durantion equal to or grater than the 75th percentile of the distribution (11 days).

Statistical analyses were performed using IBM SPSS® Statistics Version 22.0 and Epidat 3.1. All tests were two-sided and a p-value <0.05 was considered statistically significant.

Results

During the study period, a total of 340 influenza cases were recorded at the participating centre, of which 57 (16.8%) were of nosocomial origin (NI) and 283 (83.2%) were community-acquired. The highest healthcare burden was observed between Week 52 of 2024 and Week 2 of 2025. Figure 1 shows the daily and weekly evolution of the number community-acquired and nosocomial influenza cases among hospitalised patients during the study period.

Table I presents NI rates per 10^4 patient-days, rate ratio (RRt) between periods, and prevention programme effectiveness (PPE), distinguishing between the impact in the intervention wards and at the hospital level, as well as the specific effect in wards with and without mandatory surgical mask use.

At the hospital level, the overall NI incidence rate was 30.4 during the first intervention (INT-1), 32.1 during the second intervention (INT-2), and 5.9 during the third intervention (INT-3). In the intervention wards, NI rates were 38.7 in the INT-1, 36.4 in the INT-2, and 27.6 in the INT-3. These comparisons yielded PPE estimates of 71.7% (95% CI -152.8 - 99.4) during INT-1, 71.4% (95% CI -79.7 - 99.3) during INT-2, and 69.9% (95% CI 45.0 - 83.5) during INT-3.

Table II shows the proportion of NI cases among all hospitalised influenza cases, together with relative risk (RR) between periods and estimated PPE. At the hospital level, the overall proportion of NI was 46.9% during INT-1, 35.5% during INT-2, and 16.8% during INT-3.

During the pre-intervention periods (PIP), the proportions of NI were 54.6%, 46.9%, and 31.7% for the first, second, and third interventions, respectively. During the corresponding intervention periods (IP), the proportions were 40.7%, 27.8%, and 6.9%. The estimated PPE was 25.3% (95% CI –35.2 - 58.8) during INT-1, 40.8% (95% CI 4.7 - 63.3) during INT-2, and 78.3% (95% CI 61.9 - 87.6) during INT-3.

In the multivariate analysis of risk factors associated with NI (Table III), exposure to MSMU showed an adjusted OR (aOR) of 0.17 (95% CI 0.09 - 0.32). Among comorbidities, chronic kidney disease showed an aOR of 1.99 (95% CI 1.03 - 3.87), and haematologic disease showed an aOR of 2.28 (95% CI 1.00 - 5.18).

Table IV summarises adverse clinical outcomes according to case origin. For prolonged hospital stay (≥11 days), the aOR was 1.99 (95% CI 1.02 - 3.88), for intensive care unit admission, the aOR was 1.34 (95% CI 0.43 - 4.19), and for all-cause mortality, the aOR was 4.57 (95% CI 1.49 - 14.02).

Discussion

The results of this study are consistent with the growing body of evidence supporting the use of surgical masks as an effective non-pharmacological measure to prevent and limit the transmission of respiratory infections in hospital settings, particularly during peaks of seasonal viral circulation. In the present analysis, the overall rate of nosocomial influenza (NI) showed a progressive decline across the three intervention periods from 30.4 per 10^4 patient-days during the first intervention to 32.1 per 10^4 during the second intervention followed by a marked reduction to 5.9 per 10^4 patient-days during the third, hospital-wide intervention. A similar pattern was observed in the overall proportion of NI cases, which decreased from 46.9% to 35.5% and subsequently to 16.8%.

Comparable reductions have been reported in previous studies. Ambrosch et al. documented a 50% reduction in NI incidence and up to an 85% reduction in nosocomial mortality following the implementation of a strict mask policy among healthcare workers [10], while Partridge et al. observed a significant reduction in respiratory viral infections among stem-cell transplant recipients under universal surgical mask use [11]. Systematic reviews and meta-analyses by Chen et al. and MacIntyre et al. further support the effectiveness of surgical masks in preventing respiratory infections [12-13]. In addition, existing evidence suggests that the impact of mask use may be greater in contexts with low or insufficient vaccination coverage and when combined with other infection prevention measures, such as hand hygiene, case isolation, and active surveillance [14-15].

In the analysis of risk factors, mandatory surgical mask use (MSMU) was independently associated with a lower likelihood of developing NI. In contrast, comorbidities such as chronic kidney disease and haematologic diseases were associated with a significantly increased risk. No differences were identified by age, sex, or other comorbidities, suggesting that vulnerability to NI is concentrated in patients with specific clinical profiles. These findings are consistent with previous studies such as those by Fullana Barceló et al. [16] and Mangas-Moro et al. [5], which indicate that NI more frequently affects immunocompromised patients or those with chronic conditions, reinforcing the importance of maintaining preventive measures during periods of high viral circulation, especially in vulnerable populations.

In this study, NI cases were associated with a greater risk of adverse clinical outcomes than community-acquired influenza cases, supporting the usefulness of NI cases as a prognostic marker. A prolonged hospital stay was associated with an adjusted OR (aOR) of 1.99, intensive care unit (ICU)

admission with an aOR of 1.34, and mortality with an aOR of 4.57. These results are consistent with previous studies describing longer hospitalisation and higher mortality among patients with hospital-acquired influenza, with a consequent impact on healthcare burden and resources [5, 16-17]. Nonetheless, these outcomes may be influenced not only by the nosocomial origin of infection but also by the baseline severity and clinical vulnerability of hospitalised patients.

During the sustained management phase following the acute phase of the COVID-19 pandemic, a debate has emerged regarding the need to incorporate the systematic use of surgical masks as part of basic personal protective equipment in daily patient care. This discussion is particularly relevant in hospital settings, not only because asymptomatic individuals with respiratory viral infections may act as sources of transmission, but also because mask use has been shown to reduce the incidence of respiratory infections in both hospitals and the community [18]. Furthermore, studies such as that by Most et al. documented an immediate increase in respiratory viral infections following the discontinuation of universal masking [19], reinforcing the relevance of maintaining this measure in certain contexts. In line with this, recent recommendations advocate broader—although not necessarily universal—use of surgical masks depending on clinical and epidemiological risk [20-21]. The findings presented here provide empirical evidence supporting this approach.

This study has several limitations. First, it was conducted in a single hospital, which may limit the generalizability of the results. Second, adherence to mask use was not systematically evaluated, which could have influenced the observed effectiveness. Although these limitations could introduce biases, the magnitude of the observed effect and its consistency with the literature support the internal validity of the findings. To minimize selection bias, all hospitalised patients with PCR-confirmed influenza were consecutively included without exclusion criteria. To reduce information bias, case classification as nosocomial was based on standardised temporal criteria, and clinical information was extracted from electronic records by trained personnel.

An important limitation of the analysis is the inability to estimate a robust prior temporal trend. According to the methodology described by López-Bernal et al. [22], trend analysis requires a substantial number of observations to distinguish random variation from a true temporal pattern. Moreover, implementation of the intervention coincided with the abrupt increase in the seasonal influenza peak, making it difficult to separate the underlying trend from the seasonal components. Therefore, the model focused on estimating the immediate change associated with the intervention, assuming a constant prior trend—an approach recommended for short series or those with low variability. As a strength, the stepped implementation of MSMU across different wards and at different times during the epidemic period provided a unique opportunity to compare incidence rates in detail, adding methodological robustness and internal validity. In future analyses, incorporating an economic evaluation could help estimate the sustainability of this measure.

Conclusions

The results of this study indicate that the implementation of mandatory surgical mask use during seasonal influenza peaks may represent an effective measure to reduce nosocomial influenza and its impact on patients and the healthcare systems. Adoption of this preventive measure should be considered in advance of periods of high community viral circulation, especially in hospital wards caring for patients with renal and haematologic diseases. Finally, mask-use policies in healthcare settings should be adapted to the local epidemiological situation and structurally integrated into hospital infection prevention and control programmes.

Abbreviations

NI – Nosocomial Influenza

INT-1 – First intervention

INT-2 – Second intervention

INT-3 – Third intervention

IP – Intervention period

PIP – Pre-intervention period

PPE – Prevention program effectiveness

CKD – Chronic kidney disease

ICU – Intensive Care Unit

PCR – Polymerase chain reaction

IR – Incidence rate

OR – Odds ratio

aOR – Adjusted odds ratio

RR – Relative risk

RRt – Rate ratio

95% CI – 95% confidence interval

SPSS – Statistical Package for the Social Sciences

MSMU – Mandatory Surgical Mask Use

Declarations

Ethics approval and consent to participate

The study protocol was approved by the institutional ethics committee (Approval Code: A/2025/15) and was conducted in accordance with the principles of the Declaration of Helsinki. As routinely collected and anonymized clinical data were used, individual informed consent was not needed.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the present study are available from the corresponding author upon request.

Competing interests

The authors declare that they have no competing interests.

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This study did not receive specific funding from public agencies, commercial entities, or nonprofit organizations. The authors are active professionals within the Spanish Public Health System and conduct their clinical and research activities in the hospital where the study was carried out.

Declaration of the use of generative artificial intelligence and AI-assisted technologies in the writing process

During the preparation of this manuscript, the author states that generative artificial intelligence tools (Microsoft Copilot) were used to support writing and linguistic revision, under human supervision and validation. All intellectual decisions, analyses, interpretations of the results, and scientific writing were performed by the authors. After using this tool, the author reviewed and edited the content as needed and assumes full responsibility for the final version of the manuscript.

Authors' contributions

GPP, FGS, PGR, GFL, and RFSA contributed equally to this work. The remaining authors participated in data collection, analysis, methodological supervision, or critical revision of the manuscript. All the authors read and approved the final version of the manuscript.

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Tables

Table I. Incidence rate of nosocomial influenza cases per 10^4 patient-day in the corresponding wards and study periods, rate ratio between periods, and effectiveness of the prevention program according to the

implemented intervention.

	Rate*10^4 (n/pt)	RRt (95%CI)	Prevention Programme Effectiveness % (95%CI)
First intervention (7A):			
Impact on Ward 7A			
Global	223.9 (6/268)		
Pre-intervention period (PIP)	318.5 (5/157)	1	-
Intervention period (IP)	90.1 (1/111)	0.28 (0.01-2.53)	71.7% (-152.8-99.4)
Impact on Total			
Global	30.4 (23/7555)		
Pre-intervention period (PIP)	25.5 (12/4711)	1	
Intervention period (IP)	38.7 (11/2844)	1.52 (0.67-3.44)	-
Wards without mandatory use	36.7 (10/2728)	1	
Wards with mandatory use	86.2 (1/116)	2.35 (0.05-16.53)	-
Second intervention (7A, 7B, 7C y 7D)			
Impact on Wards 7A-7D			
Global	99.8 (19/1903)		
Pre-intervention period (PIP)	168.9 (18/1066)	1	
Intervention period (IP)	12.0 (1/837)	0.07 (0.00-0.45)	92.9% (55.2-99.8)
Impact on Total			
Global	32.1 (43/13045)		
Pre-intervention period (PIP)	30.4 (23/7555)	1	

Intervention period (IP)	36.4 (20/5490)	1.20 (0.66-2.19)	-
Wards without mandatory use	41.0 (19/4636)	1	
Wards with mandatory use	11.7 (1/854)	0.29 (0.01-1.80)	71.4% (-79.7-99.3)
Third intervention (all wards)			
Global	5.9 (57/97507)		
Pre-intervention period (PIP)	91.8 (43/46849)	1	.
Intervention period (IP)	27.6 (14/50658)	0.30 (0.17-0.55)	69.9% (45.0-83.5)

n: number of nosocomial influenza cases in the period and area of intervention; pt: person-time (total patient-day in a given period and intervention area); PIP: pre-intervention period; IP: intervention period; RRt: rate ratio; 95% CI: 95% confidence interval; Ward 7A: Nephrology and Renal Transplantation; Ward 7B: Vascular Surgery and Haematology; Ward 7C: Oncology; Ward 7D: Haematology.

Table II. Proportion of nosocomial influenza cases among all hospitalised influenza cases in the corresponding wards and study periods, risk ratio between periods, and effectiveness of the prevention program according to the implemented intervention.

	Nosocomial Cases % (n/N)	RR (95%CI)	Prevention Programme Effectiveness % (95%CI)
First intervention (7A):			
Impact on Ward 7A			
Global	100.0 (6/6)		
Pre-intervention period (PIP)	100.0 (5/5)	-	
Intervention period (IP)	100.0 (1/1)	-	-
Impact on Total			
Global	46.9 (23/49)		
Pre-intervention period (PIP)	54.6 (12/22)	1	
Intervention period (IP)	40.7 (11/27)	0.75 (0.45-1.35)	25.3% (-35.2-58.8)
Wards without mandatory use	38.5 (10/26)	1	
Wards with mandatory use	100.0 (1/1)	2.60 (1.60-4.23)	-
Second intervention (7A, 7B, 7C y 7D)			
Impact on Wards 7A-7D			
Global	82.6 (19/23)		
Pre-intervention period (PIP)	85.7 (18/21)	1	
Intervention period (IP)	50.0 (1/2)	0.58 (0.14-2.36)	41.7% (-135.8-85.6)
Impact on Total			
Global	35.5 (43/121)		
Pre-intervention period (PIP)	46.9 (23/49)	1	
Intervention period (IP)	27.8 (20/72)	0.59 (0.37-0.95)	40.8% (4.7-63.3)

Wards without mandatory use	27.1 (19/70)	1	
Wards with mandatory use	50.0 (1/2)	1.84 (0.44-7.76)	-
Third intervention (all wards)			
Global	16.8 (57/340)		
Pre-intervention period (PIP)	31.7 (43/136)	1	
Intervention period (IP)	6.9 (14/204)	0.22 (0.12-0.38)	78.3% (61.9-87.6)

%: percentage; n: number of nosocomial influenza cases; N: number of total influenza cases (community-acquired + nosocomial); PIP: pre-intervention period; IP: intervention period; RR: risk ratio; 95% CI: 95% confidence interval. Ward 7A: Nephrology and Renal Transplantation; Ward 7B: Vascular Surgery and Haematology; Ward 7C: Oncology; Ward 7D: Haematology.

Table III. Risk factors associated with nosocomial influenza during the 2024-2025 season (*n*=340).

	Nosocomial Influenza %(*n/N*)	OR (95%CI)	*P*	aOR (95%CI)	*P*
MUSM					
Yes	6.8 (14/205)	0.16 (0.08-0.30)	<0.001	0.17 (0.09-0.32)	<0.001
No	31.9 (43/135)	1		1	
Sex					
Male	16.7 (28/168)	0.99 (0.56-1.74)	0.962	-	-
Female	16.9 (29/172)	1			
Age (years)					
≥ 65	16.2 (33/204)	0.90 (0.51-1.60)	0.722	-	-
< 65	17.6 (24/136)	1			
Cardiovascular disease					
Yes	17.2 (26/151)	1.06 (0.60-1.88)	0.841	-	-
No	16.4 (31/189)	1			
Asthma					
Yes	14.7 (5/34)	0.84 (0.31-2.28)	0.735	-	-
No	17.0 (52/306)	1			
COPD					
Yes	9.8 (5/51)	0.49 (0.19-1.31)	0.149	-	-
No	18.0 (52/289)	1			
Diabetes Mellitus					
Yes	18.3 (17/93)	1.16 (0.62-2.16)	0.646	-	-
No	16.2 (40/247)	1			
Obesity					
Yes	17.2 (10/58)	1.04 (0.49-2.21)	0.915	-	-
No	16.7 (47/282)	1			
Chronic kidney disease					

Yes	23.8 (20/84)	1.85 (1.00-3.41)	0.046	1.99 (1.03-3.87)	0.041
No	14.5 (37/256)	1		1	
Hypertension					
Yes	18.7 (36/193)	1.38 (0.77-2.48)	0.286	-	-
No	14.3 (21/147)	1			
Liver disease					
Yes	21.7 (5/23)	1.42 (0.50-3.98)	0.508	-	-
No	16.4 (52/317)	1			
Cancer					
Yes	24.6 (17/69)	1.89 (0.99-3.59)	0.050	1.60 (0.78-3.27)	0.199
No	14.8 (40/271)	1		1	
Haematological disease					
Yes	33.3 (13/39)	2.92 (1.40-6.11)	0.003	2.28 (1.00-5.18)	0.050
No	14.6 (44/301)	1		1	
Neuromuscular disease					
Yes	4.3 (1/23)	0.21 (0.03-1.61)	0.099	-	-
No	17.7 (56/317)	1			
Immunosuppression					
Yes	14.3 (1/7)	0.82 (0.10-6.98)	0.859	-	-
No	16.8 (56/333)	1			

MSMU: mandatory surgical mask use; COPD: chronic obstructive pulmonary disease; %: percentage of nosocomial origin; *n*: number of nosocomial influenza cases; *N*: number of patients in each category; OR: odds ratio; 95%CI: confidence interval; *P*: level of statistical significance; aOR: adjusted odds ratio for nosocomial influenza risk factors (mandatory surgical mask use, chronic kidney disease, and haematological disease).

Table IV. Prolonged stay, intensive care unit (ICU) admission and deaths according to the origin (nosocomial vs community-acquired) of influenza cases admitted to the hospital during the 2024–2025 season (weeks 44–09).

	Nosocomial Influenza (*n*=57)	Community-acquired Influenza (*n*=283)	OR (95%CI)	aOR (95%CI)
Prolonged stay ≥11 days; *n* (%)	23 (40.4)	64 (22.6)	2.32 (1.27-4.21)	1.90 (1.00-3.64)
ICU admission; *n* (%)	5 (8.8)	18 (6.4)	1.42 (0.50-3.98)	1.36 (0.44-4.22)
Deaths; *n* (%)	9 (15.8)	10 (3.5)	5.12 (1.98-13.25)	5.09 (1.68-15.36)

ICU: intensive care unit; n: number of cases; %: percentage; OR: odds ratio; 95%CI: confidence interval; aOR: adjusted odds ratio for mandatory surgical mask use, chronic kidney disease and haematological disease

Figures

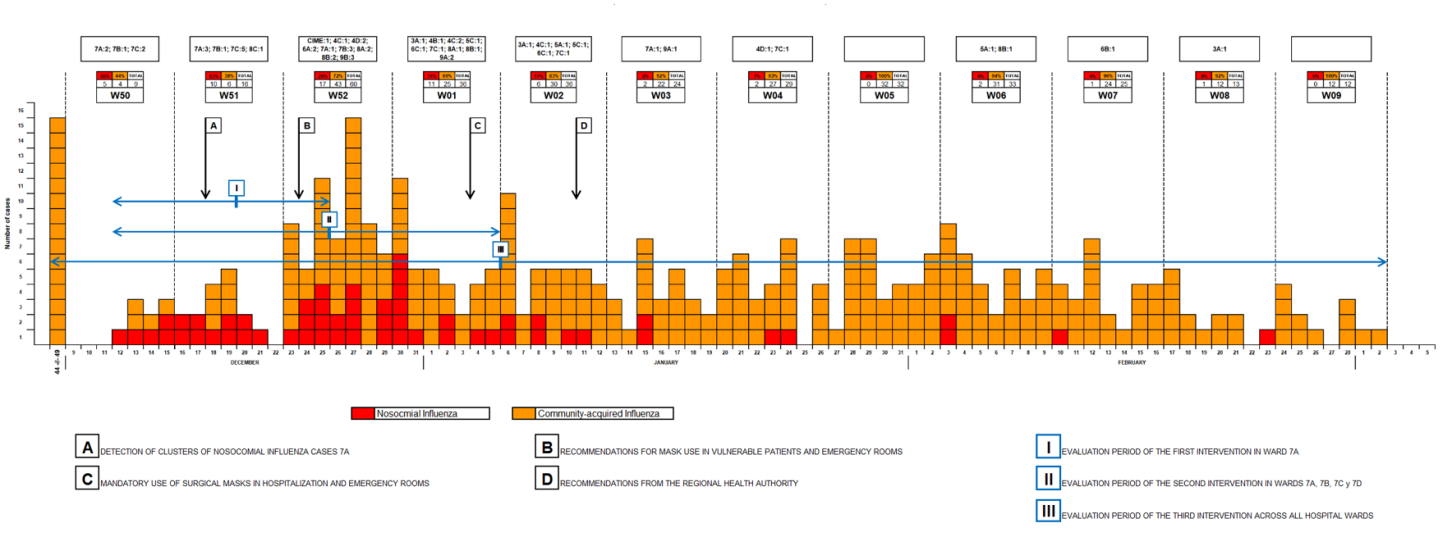


Figure 1

Daily and weekly trend of community-acquired and nosocomial influenza cases among hospitalised patients at the participating centre by day and epidemiological week during the 2024–2025 season (Weeks 40 of 2024 to 09 of 2025)