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Impact of Antimicrobial Stewardship on Guideline-concordant initial antibiotic therapy for Community-Acquired Pneumonia: An Emergency Department Study

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Abstract

Background: Deviations from antibiotic guidelines remain public health issue for antimicrobial resistance in community-acquired pneumonia (CAP). In emergency department (ED) setting, antimicrobial stewardship interventions (ASI) have shown variable efficacy in addressing this issue.

Objective: To assess the impact of a combined educational and computerized ASI on prescribing concordance.

Methods: We conducted a prospective observational study in two French EDs (Center 1 and Center 2) between June and November 2022. Patients with CAP who required hospitalization were included. Phase 1 included data from both centers. In Phase 2, conducted only in Center 1, the intervention consisted of a 30-minute training session and deployment of a computerized pop-up alert. The primary outcome was the rate of guideline-concordant initial prescription with CAP guidelines.

Results: Among the 241 patients included, antibiotic guideline-concordant initial antibiotic prescription in Phase 1 was 72% at Center 1. The most frequent cause of non-concordance involved the use of monotherapy when dual therapy was recommended (55% of non-concordant prescriptions). In Phase 2, global concordance remained stable at 73%. We noted an increase in non-concordant monotherapy (71% of non-compliant prescriptions)**.**

Conclusion: Initial antibiotic prescribing for CAP in the ED shows persistent gaps in concordance with current guidelines, particularly in adjusting therapy to severity. A single-session educational and computerized ASI did not significantly improve prescription concordance. Further studies using controlled designs and sustained interventions are needed to assess effective strategies for improving antibiotic prescribing in the ED.

Key-words:

Community-acquired pneumonia (CAP); Emergency department; Antibiotic prescription concordance; Prescription assistance intervention; Antibiotic stewardship

Background

Community-acquired pneumonia (CAP) is a leading cause of infection-related death worldwide [1]. In France, its annual incidence is estimated at 5–12 per 1,000 adults, accounting for approximately 500,000 cases per year, with nearly one-third of adults diagnosed with CAP requiring hospitalization [2]. Mortality varies according to the causative pathogen, patient characteristics, comorbidities, and disease severity, reaching approximately 7% among hospitalized patients and up to 16% in pneumococcal pneumonia [3]. When microbiological investigations identify a pathogen, *Streptococcus pneumoniae* is the most commonly detected, followed by intracellular bacteria such as *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, and *Legionella pneumophila* [3].

In France, empirical antibiotic treatment depends on disease severity and the care setting, and may include β-lactam antibiotics, macrolides, or respiratory fluoroquinolones (RFQs, such as levofloxacin). These recommendations are reflected in national and international guidelines [4–6].

The emergency department (ED) is a key setting for antimicrobial stewardship, as antibiotic prescribing often occurs under diagnostic uncertainty and time constraints. Several antimicrobial stewardship interventions (ASI), including educational initiatives, clinical pathways, pharmacist-led interventions, and computerized decision support, have been evaluated in EDs, with variable effectiveness [7–9]. Combining complementary approaches, such as education and computerized decision support, may help improve prescribing by reinforcing clinical knowledge and providing recommendations at the point of care.

Despite the widespread availability of guidelines, adherence to recommended antibiotic treatment for CAP remains suboptimal [10-12]. In particular, unnecessary combination

76 therapy with a β-lactam plus a macrolide or RFQ is frequently prescribed for non-severe
77 hospitalized CAP [10-12]. Inappropriate antibiotic prescribing may expose patients to
78 avoidable adverse effects [13], increase healthcare costs [14], and contribute to antimicrobial
79 resistance [15].

80 To improve antibiotic prescribing for CAP, we assessed (i) concordance between initial
81 antibiotic prescriptions in the ED and the local institutional CAP treatment protocol and (ii)
82 changes in prescribing concordance following implementation of a targeted antimicrobial
83 stewardship intervention.

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Patients and Methods

2.1 Study design

The study was conducted in two phases. **Phase 1** consisted of a prospective, observational cohort study conducted in two centers (Center 1: Emergency Department, Hôpital Européen Georges Pompidou Assistance Publique - Hôpitaux de Paris, France and Center 2: Emergency Department, Center hospitalier Universitaire, Nice, France) to assess concordance of initial antimicrobial prescriptions for CAP with current guidelines. Phase 1 lasted 77 days at Center 1 (from June 20 to September 17, 2022) and 60 days at Center 2 (from June 20 to August 18, 2022).

Phase 2 consisted of an antimicrobial stewardship program conducted in Center 1 to try and improve concordance of initial antibiotic prescriptions for CAP in the ED. Phase 2 lasted 70 days (from September 18 to November 16, 2022).

Due to organizational issues, the implementation of the antibiotic stewardship program could not be carried out within Center 2. Thus, the post-intervention phase was conducted only in Center 1.

In each phase, antibiotic treatment was left to the discretion of the ED physician, as was the choice of tools (biological, microbiological, or radiological) used for the diagnosis of CAP.

Eligible patients were identified via daily electronic extraction from hospital records and based on PMSI "*Programme de Médicalisation des Systèmes d'Information*" (French Hospital Discharge Database) coding (**Additional files 1**). Patients admitted within the previous 24 hours for whom a pneumonia code had been assigned were screened. Those who were aged 18 years or older, presented to the ED with a diagnosis of CAP confirmed, *and* hospitalised were included. Patients treated as outpatients, transferred to another hospital, dying before

admission, or with alternative diagnoses were excluded. To ensure completeness and accuracy a bedside patient check was conducted in Center 1 for the first 15 days of the study. For Center 2, inclusions were based solely on PMSI data extraction.

2.2 Antimicrobial stewardship intervention

At the end of Phase 1, a targeted stewardship intervention was implemented in Center 1 and included two components:

- A 30-minute in-person educational session on CAP antibiotic management delivered to ED physicians (residents and senior physicians), supported by summary material distributed by email.
- A computerized prescribing support tool in the form of an automated pop-up message integrated into the electronic prescription system.

The intervention was designed before the baseline Phase 1 data were available. It was developed to address a clinically perceived overuse of macrolide combination therapy. Spiramycin was the macrolide most commonly used in the participating ED. When a macrolide (spiramycin) was prescribed, prescribers were required to complete a short questionnaire indicating whether CAP was suspected and specifying the rationale for macrolide use (severe pneumonia, β-lactam failure after 48 hours, or suspected intracellular pathogen).

2.3 Assessment of antibiotic concordance

Antibiotic concordance was assessed using the local institutional CAP treatment guideline developed by the Commission of Antimicrobial Agents (COMAI). This document synthesized

recommendation from the French (2010, 2022), British (2015), and North American (2019) guidelines [4,16,17]. Local CAP guideline was summarized into a document available on hospital's intranet at least 12 months before study initiation. (**Additional file 2**).

It constituted the local standard for initial antibiotic prescription during the study period.

Treatment was considered concordant when:

- monotherapy was used in non-severe CAP,
- combination therapy (β-lactam plus macrolide or fluoroquinolone) was prescribed in severe CAP,
- macrolide or RFq therapy was introduced after 48 hours in case of β-lactam treatment failure.

Severe CAP was defined according to mixed clinical, radiological and biological criteria from American and British recommendations [16, 17]: One of the two criteria among: Acute respiratory failure; shock. Or 3 following criteria among: respiratory rate > 30 cycles/min ; PaO2/FiO2 of less than 250 ; Multilobar infiltrates ; Confusion GCS < 15 ; Uremia ; Leukopenia < 4000/mm^3 ; Thrombocytopenia < 100,000/mm^3 ; Hypothermia < 36°C ; hypotension responding to fluid resuscitation.

When data were incomplete, an adjudication committee including an infectious diseases specialist, an internist, and an emergency physician reviewed the medical records to determine treatment adequacy. Treatment was determined to be non-compliant if the therapy deviated from the monotherapy or dual therapy recommendation based on the CAP severity level. Antibiotic dosages were not assessed.

155 2.4 Data collection

156 Data were recorded from the ED medical records by a non-prescribing investigator (VC) using
157 a clinical report form validated by the ethics committee (CER-MIT: Ethics Committee for
158 Infectious and Tropical Diseases). The collected data included: age, sex, comorbidities and
159 medical history, clinical findings, hospitalization-related biological data, microbiological
160 findings, radiographic results, concomitant treatments, therapeutic interventions (including
161 antibiotics), hospitalization location, and length of stay. These data allowed calculation of
162 severity and comorbidity scores including: Pneumonia Severity Index, CURB-65, NEWS-2,
163 Charlson Comorbidity Index, and q-SOFA. Data were entered into an ACCESS database and
164 stored on secure hospital servers.

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166 2.5 Objectives and outcome measures

167 The primary objective was to assess the concordance of antibiotic prescription in the ED with
168 current local institutional guidelines for CAP. Secondary objectives were: *i)* to assess the
169 impact of a targeted antimicrobial stewardship program on antibiotic prescription
170 concordance, with a specific focus on inappropriate prescription of antibiotic combinations
171 for non-severe CAP; and *ii)* to assess patient outcomes according to initial antibiotic
172 prescriptions.

173 The primary outcome measure was the rate of concordance of antibiotic prescription with
174 guidelines based on patient comorbidities and disease severity. Secondary endpoints were the
175 concordance rate during implementation of the antibiotic stewardship program, in-hospital
176 mortality, and incidence of *Clostridioides difficile* infection.

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2.6 Statistical analysis

Results were expressed as the percentage of prescriptions that complied with guidelines. Categorical variables were compared using χ^2 or Fisher's exact tests, and continuous variables using Student's t-test or Mann–Whitney tests as appropriate. A p value <0.05 was considered statistically significant. As this was a prospective observational study with no control group and no aim to demonstrate superiority, no prior sample size calculation was required.

2.7 Ethics

The study was submitted to and approved by the CER-MIT one month before the start of enrolment [31/05/2022 No. 2022-0506]. The study was also registered in accordance with the reference method MR-004 (2022 MR-004–006) published by the French Data Protection Authority (CNIL). Information for patients regarding the use of their medical data was available i) on the medical report from the ED and ii) on the hospital website.

Results

Study population

During the 2-phase study period, 384 patients were screened across both centers, and 241 were included: 161 in Center 1 (Phase 1: 80; Phase 2: 81) and 80 in Center 2. **(Figure 1).** Baseline clinical characteristics and microbiological data are presented in **Table 1**. During Phase 1, patients in Center 2 appeared more severely ill than those in Center 1, with higher respiratory rates, lower oxygen saturation on room air, and higher NEWS-2 scores. Microbiological documentation was available in approximately 40% of cases in both centers. Sputum cultures were obtained in fewer than half of patients, while urinary antigen testing for *Legionella pneumophila* and *Streptococcus pneumoniae* was performed in around 70% of cases and blood cultures in 58–66% **(Table 1).**

Chest radiography was performed in more than 80% of patients, confirming pneumonia in 78–90% of cases. Chest CT scans were more frequently performed in Center 2 than in Center 1 during Phase 1 (50% vs. 31%, p = 0.02). Most patients were admitted to a medical ward (Center 1 Phase 1: 88%; Phase 2: 91%; Center 2: 92%).

Guideline-concordance of initial antibiotic prescriptions in phase 1

In Phase 1, monotherapy was prescribed in 65% of patients in Center 1 and 74% in Center 2 **(Table 2)**. The most prescribed monotherapy was amoxicillin-clavulanic acid, with a trend toward more prescriptions in Center 2 (*80% vs. 68%, p = 0.18*), followed by third-generation cephalosporins (^{3rd}GC). Dual therapy was prescribed in 36% of patients in Center 1 and 26% in Center 2. The most common combination regimen was a third-generation cephalosporin plus

a macrolide, which was prescribed less frequently in Center 2 than in Center 1 (62% vs. 86%, p = 0.03) **(Table 2)**.

Overall, antibiotic prescriptions were concordant with guidelines in 72% of patients in Center 1 (58/80) **(Table 3).** Among the 22 non-concordant prescriptions, the main reason was use of monotherapy when combination therapy was recommended (12/22, 55%) (**Table 4)**. Similar concordance rates were observed in Center 2 (72%). No cases of non-concordance were related to continuation of β-lactam therapy after 48 hours of treatment failure.

Impact of the antibiotic stewardship intervention

The educational session in Center 1 was attended by 12 of the 18 ED physicians (67%), including 9 residents and 3 senior physicians.

Although overall guideline-concordant initial antibiotic prescription remained unchanged (**Table 3**), the distribution of non-concordant prescriptions shifted after the intervention. The proportion of non-concordant monotherapy, corresponding to potential undertreatment of severe CAP, increased from 55% (12/22) to 71% (15/21), whereas non-concordant combination therapy, corresponding to overtreatment of non-severe CAP, decreased from 45% (10/22) to 29% (6/21) (**Table 4).** The stewardship intervention had no significant impact on in-hospital mortality (7.5% vs. 7.4%, p = 0.98) or on the incidence of *Clostridioides difficile* infection. **(Table 1).**

Discussion

The implementation of a multimodal antimicrobial stewardship intervention including in-person education session and computerized prescribing support tool was not associated with an increase of guideline-concordance of initial antibiotic prescription in the emergency department that remained unchanged (72% vs 73%). Although this rate is higher than that reported in several previous studies, non-concordant prescriptions remained frequent. For example, concordance rates of 52% in a French university hospital cohort and around 30% in a North American study have been previously reported [6,10]. These findings confirm that improving adherence to antibiotic recommendations remains challenging even in settings with easy access to clinical guidelines.

In our study, the most frequent cause of non-concordance was the use of monotherapy in patients with severe pneumonia. This finding suggests that either the severity of illness was underestimated or that prescribers did not fully integrate stratified therapeutic recommendations into their decisions. Conversely, a smaller proportion of patients received combination therapy despite guideline recommendations for monotherapy, reflecting a tendency toward overtreatment in non-severe cases. These findings highlight the challenges of translating guideline-defined stratification into daily clinical practice. For example, in a large, randomized trial there were no significant difference in 90-day mortality between between β-lactam monotherapy, β-lactam–macrolide combinations, or fluoroquinolone therapy [12].

Interestingly, prescribing patterns shifted, with an increase in inappropriate monotherapy and a decrease in unnecessary combination therapy. These findings suggest that the intervention may have influenced prescribing behaviour without reducing the overall frequency of

prescribing errors. Similar observations have been reported in emergency department stewardship programmes, for example in a French emergency department, they observed a reduction on unnecessary antimicrobial prescription and inappropriate spectrum while other dimensions of prescribing remained unchanged [18].

Our results need to be interpreted in the context of previous antimicrobial stewardship interventions conducted in the emergency department, which have used heterogeneous interventions and definitions of appropriate prescribing. In a study specifically addressing pneumonia in the ED, the implementation of a clinical decision support tool integrated into the electronic sepsis order set and reported an increase in appropriate antibiotic selection [19] In other study, using mobile health tools, continuous access to decision-support content improved long-term CAP guideline-concordance [20]. In contrast, our intervention combined a single 30-minute educational session with a targeted prescribing prompt triggered by macrolide prescription, rather than a decision-support system covering the full antibiotic prescribing process.

Several factors may explain the limited overall impact of the intervention. First, ED prescribing is influenced by time pressure, workflow constraints, clinician autonomy and local prescribing culture, all of which may affect the uptake of clinical decision-support interventions [8]. Moreover, the effectiveness of stewardship programs has been shown to critically depend on contextual factors, including, clinician engagement, and continuing support [21, 22]. This suggests that effective and durable change may require sustained interventions combining integrated tools and performance feedback.

This study has several limitations. First, guideline-concordance was assessed with the local COMAI consensus protocol, so the observed concordance rate should be interpreted as

adherence to the locally established empirical treatment rather than a direct measure of concordance with any single international guideline. Then, we restricted our analysis to initial antibiotic prescriptions in the ED, without assessing treatment duration, dosage or later modifications based on microbiological results. Third, Phase 1 included two centers, whereas phase 2 was conducted only in Center 1 because the intervention could not be implemented in Center 2. Thus, the post-intervention phase was conducted over a relatively short period, without repeated training sessions or follow-up. Furthermore, seasonal variation in pathogen circulation may have influenced clinical presentations and prescribing practices. In addition, some baseline characteristics differed between Phase 1 and Phase 2 (proportion of nursing-home residents ; prior antibiotic therapy). These differences may have influenced the results independently of the intervention. Given the small size and limited events, we did not plan subgroup-ajusted analysis. These baseline differences should therefore be considered when interpreting the comparison between study periods.

Despite these limitations, our findings underline the complexity of improving antimicrobial prescribing in routine clinical practice. Future stewardship strategies in the emergency department should integrate sustained educational efforts, rapid diagnostic tools, and system-level decision-support interventions [20, 22]. Multidisciplinary collaboration will likely be essential to achieve durable improvements in antibiotic prescribing.

Conclusion

In conclusion, poor guideline-concordance of initial antibiotic prescription for CAP diagnosed in the ED is common. To improve antibiotic prescribing quality in this clinical setting, additional

efforts are needed to raise prescriber awareness, provide training, and implement targeted interventions.

List of abbreviation

(CAP): community-acquired pneumonia; (ASI): antimicrobial stewardship interventions; (ED): emergency department; (RFQ): respiratory fluoroquinolones; (COMAI): Commission of Antimicrobial Agents

Declarations

Ethics approval and consent to participate

The study was reviewed and approved by the Ethics Committee for Infectious and Tropical Diseases (CER-MIT) on May 31, 2022 (approval number: 2022-0506), prior to the start of patient enrolment. The study was conducted in accordance with the relevant institutional and national ethical guidelines and regulations, including the principles of the Declaration of Helsinki and its subsequent amendments.

The processing of personal data was registered in accordance with the French Data Protection Authority (CNIL) reference methodology MR-004 (registration number: 2022 MR-004-006). Patients were informed about the use of their medical data through information provided in the emergency department medical report and on the hospital website and were given the opportunity to object to the use of their data. In accordance with French regulations applicable to research conducted under the MR-004 methodology, individual informed consent was not required. No individual informed consent was therefore obtained.

Clinical trial number: not applicable

Data availability

The datasets generated during the current study are not publicly available due regulatory reasons but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Funding

This study was conducted as part of our routine work.

Transparency declarations

None to declare.

Author contributions

V.C., R.C., J.C., JL.M., M.C., E.L., D.L., participated in the conceptualization and design of the study. V.C., J.C., D.L., participated in the analysis of study data. V.C., R.C., J.C., M.C., E.L., D.L., participated in interpretation of the results. All authors were involded in the drafting and review of the manuscript and approved the final version for submission.

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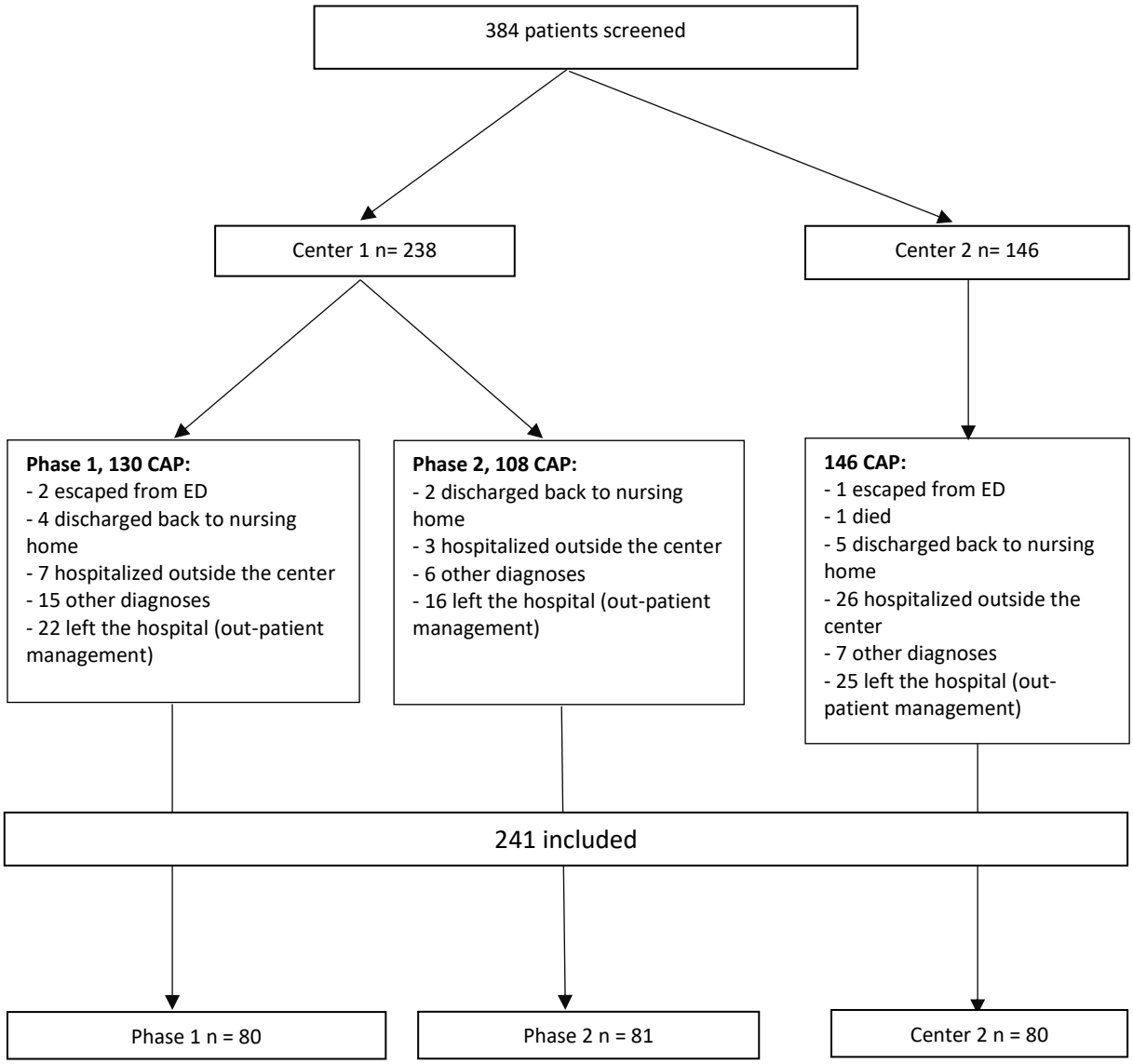


Figure 1. Flow chart

Table 1. Patient characteristics (Center 1 = HEGP; Center 2 = Nice)

Notes: * comparison between phases 1 and 2 in Center 1. ** comparison between Centers 1 and 2 in phase 1. All scores were calculated on the day of admission to the emergency department.

[α]Acute respiratory distress signs : respiratory rate > 30 cycles/min ; recruitment of accessory respiratory muscles ; thoraco-abdominal sway.

		Center 1 ***Phase 1*** **(n = 80)**	**Center 1** ***Phase 2*** **(n = 81)**	***P****	**Center *2*** ***(n = 80)***	***p***
Age, median [IQR], Yr		80.5 [70.0 ; 89.2]	83.0 [74.0 ; 89.0]	0.47	81.0 [71.5 ; 89.0]	0.49
Male, n (%)		42 (52%)	43 (53%)	0.94	40 (50%)	0.75
Nursing home resident, N (%)		20 (25%)	10 (12%)	**0.04**	9 (11%)	**0.024**
Hospitalization, N (%)						
	In previous 30 days	9 (11%)	10 (12%)	0.83	9 (11%)	1
	To medical ward	70 (88%)	74 (91%)	0.43	74 (92%)	0.29
	To ICU	10 (12%)	7 (9%)	-	6 (7.5%)	-
In-hospital mortality, N (%)		6 (7.5%)	6 (7.4%)	0.98	10 (12%)	0.29
Comorbid conditions						
	Heart disease N (%)	13 (16%)	17 (21%)	0.44	8 (10%)	0.24
	Cardiac insufficiency N (%)	7 (8.8%)	7 (8.6%)	0.98	8 (10%)	0.79
	Chronic respiratory disease N (%)	25 (31%)	25 (31%)	0.96	31 (39%)	0.32
	Diabetes N (%)	17 (21%)	13 (16%)	0.4	18 (22%)	0.85
	Peripheral vascular disease N (%)	8 (10%)	5 (6.2%)	0.37	5 (6.2%)	0.39
	Stroke N (%)	11 (14%)	8 (9.9%)	0.45	9 (11%)	0.63
	Haemopathy N (%)	5 (6.2%)	6 (7.4%)	0.77	6 (7.5%)	0.75
	Immunosuppression N (%)	9 (11%)	12 (15%)	0.5	13 (16%)	0.36

	Liver disease N (%)	3 (3.8%)	0 (0%)	0.12	0 (0%)	0.25
	Chronic kidney disease N (%)	8 (10%)	15 (19%)	0.12	14 (18%)	0.17
	Active solid tumour N (%)	12 (15%)	13 (16%)	0.85	6 (7.5%)	0.13
	Dementia N (%)	27 (34%)	22 (27%)	0.36	30 (38%)	0.62
Charlson Comorbidity Index, median [IQR]		6.00 [4.00 ; 7.00]	6.00 [5.00 ; 7.00]	0.26	6 [4.00;7.00]	0.93
Pneumonia Severity Score, median [IQR]		107 [90.0 ; 130]	112 [91.0 ; 133]	0.37	113 [96.5 ; 133]	0.41
CURB-65 score median [IQR]		2.00 [1.00 ; 2.25]	2.00 [1.00 ; 2.00]	0.8	2.00 [2.00 ; 3.00]	0.085
NEWS 2 score, median [IQR]		6.50 [3.00 ; 9.00]	6.00 [6.00 ; 10.0]	0.12	8 [6.00 ; 10.00]	**<0.001**
qSOFA score ≥ 2, N (%)		12 (15%)	12 (15%)	0.97	17 (21%)	0.3
Clinical characteristics						
	Glasgow Coma Scale score, median [IQR]	15.0 [14.0 ; 15.0]	15.0 [15.0 ; 15.0]	0.25	15 [14 ; 15]	0.49
	Respiratory rate, /min median [IQR]	18.0 [16.8; 24.0]	20.0 [17.0; 25.0]	0.18	21 [20.0 ; 28]	**<0.001**
	SpO2 (room air), mean [IQR]	92.0 [88.0; 95.2]	91.0 [88.0; 95.0]	0.91	89 [85 ; 90]	**<0.01**
	Oxygen flow, l/min median [IQR]	2.00 [0; 5.25]	3.00 [2.00; 4.00]	0.27	4 [2 ; 6]	0.28
	Acute respiratory distress signs[α], N (%)	16 (20%)	21 (26%)	0.37	17 (21%)	0.85
Microbiology, N (%)	Available	33 (40%)	34 (42%)	0.70	31 (39%)	0.74
	Bacterial	22/33	17/34	-	22/31	-
	Viral	11/33	10/34	-	6/31	-
	Co-infection	5/33	7/34	-	3/31	-
	NA	47 (60%)	47 (58%)	-	49 (61%)	-
	Negative	55	57	0.82	52	0.8

Legionella urinary antigen, N (%)	Positive	1 (1.3%)	0	-	2 (2.5%)	
	Not performed	24 (30%)	24 (30%)	-	26 (32.5%)	
Pneumococcal urinary antigen, N (%)	Negative	51	49	0.7	47	0.5
	Positive	5 (6.25%)	8 (10%)		8 (13%)	
	Not performed	24 (30%)	24 (30%)	-	25 (31%)	
SARS-COV 2 PCR, N (%)	Negative	69	71	0.79	74	0.19
	Positive	11 (14%)	10 (12%)		6 (7.5%)	
	Not performed	0	0		0	
Sputum culture, N (%)	Negative	4	0	0.06	1	0.20
	Positive	14 (18%)	14 (17%)	-	8 (10%)	
	Salivary	16	9	-	11	
	Not performed	46 (57%)	58 (72%)	-	60 (75%)	
Blood culture, N (%)	Positive	2 (2.5%)	3 (4%)	1	48	0.63
	Negative	51	44	-	4 (6.2%)	
	Not performed	27 (34%)	34 (42%)	-	28 (35%)	
***C. difficile* infection, N (%)**		0 (0%)	1 (1.2%)	1	1 (1.2%)	1
Radiology, N (%)						
Chest X-ray	Performed	71/80 (89%)	67/81 (82%)	0.27	63/80 (79%)	0.09
	Not performed	9	14		17	
	Evocative of pneumonia	56/71 (79%)	60/67 (90%)		49/63 (78%)	
CT-scan	Performed	25/80 (31%)	23/81 (28%)	0.69	40/80 (50%)	**0.02**
	Not performed	55	58		40	
	Evocative of pneumonia	20/25 (80%)	21/23 (91%)		37/40 (93%)	

Table 2. Antibiotic regimen (Center 1 = HEGP; Center 2 = Nice)
Notes: *comparison between phases 1 and 2 in Centre 1. **comparison between Centres 1 and 2 in phase 1

		Center 1 ***Phase 1*** **(n = 80)**	**Center 1** ***Phase 2*** **(n = 81)**	***p****	**Center *2*** ***(n = 80)***	***p***
Antimicrobial regimen						
	Prior antibiotic therapy < 72h	25 (31%)	12 (15%)	**0.01**	12 (15%)	**0.01**
	Suspected beta-lactam allergy	5 (6.2%)	1 (1.2%)	0.12	2 (2.5%)	0.44
Monotherapy, N (%)		51/80 (64%)	53/81 (65%)	0.82	59/80 (74%)	0.17
	Amoxicillin	1/51 (2%)	6/53 (11%)	0.11	3/59 (5%)	0.62
	Amoxicillin-clavulanic acid	35/51 (68%)	29/53 (55%)	0.14	47/59 (80%)	0.18
	Piperacillin-tazobactam	2/51 (4%)	3/53 (6%)	1	2/59 (3%)	1
	3rd gen Cephalosporin	8/51 (16%)	14/53 (26%)	0.18	7/59 (12%)	0.59
	Cefepim	1/51 (2%)	0	0.49	0	0.49
	Respiratory Fq	3/51 (6%)	1/53 (2%)	0.35	0	0.10
	Macrolide	1/51 (2%)	0		0	0.49
Dual therapy, N (%)		29/80 (36%)	28/81 (32%)	0.82	21/80 (26%)	0.17
	3rd gen cephalosporin + macrolide	25/29 (86%)	23/28 (82%)	0.73	13/21 (62%)	**0.03**
	3rd gen cephalosporin + respiratory Fq	0	1/28 (4%)	0.49	1/21 (5%)	0.42
	Other dual therapy without coverage of "atypical" pathogens	4/29 (14%)	4/28 (14%)	1	7/21 (33%)	0.19

554 **Table 3.** Primary endpoint
555

	Center 1 ***Phase 1*** **(n = 80)**	**Center 1** ***Phase 2*** **(n = 81)**	***p***
Guideline-concordant initial antibiotic prescription, N (%)	58 (72%)	59 (73%)	0.96

556

557 **Table 4.** Non-concordance with treatment guidelines
558 (Phase 1 = before intervention; Phase 2 = during intervention)
559 Notes: Intervention corresponds to combined intervention comprising an educational session and a
560 computerized prescribing support tool
561

Type of non-concordance	**Phase 1, n (%)**	**Phase 2, n (%)**
Monotherapy when combination therapy was indicated	12/22 (55%)	15/21 (71%)
Combination therapy when monotherapy was indicated	10/22 (45%)	6/21 (29%)
Total non-concordant prescriptions	**22/80 (28%)**	**21/81 (26%)**

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