JAC Antimicrob Resist
https://doi.org/10.1093/jacamr/dlae189

JAC-Antimicrobial Resistance

Nursing home nurses' opinion profiles on the potential evolution of their role in antimicrobial stewardship and associated factors: a national cross-sectional study in France

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Received 20 May 2024; accepted 6 November 2024

Background: Antibiotic resistance is a major public health threat, especially in nursing homes (NHs). Nursing home nurses (NHNs) can play a crucial role in antimicrobial stewardship (AMS), but research on their opinions regarding potential expanded AMS roles is limited.

Objectives: To identify different profiles of NHNs according to their opinions on the potential evolution of their AMS roles and to study facilitators/barriers to implementing new AMS roles and the demographic and professional characteristics associated with these profiles.

Methods: Data were collected from a national cross-sectional online survey conducted from May to July 2022 among French NHNs. Profiles were identified via hierarchical clustering. Factors associated with the identified profiles were studied via Fisher's exact tests.

Results: Among the 922 participants included in the analysis, three distinct profiles were identified. NHNs 'more favourable to the evolution of the AMS role' (40% of the sample) expressed strong support for the potential evolution of their AMS role. NHNs 'moderately favourable to the evolution of the AMS role' (46%) were less prone to reinforce discussion with general practitioners about antibiotic prescription. NHNs 'less favourable to the evolution of the AMS role' (14%) showed little or no agreement regarding several potential new AMS roles. Being a head nurse was associated with more favourable opinions on the evolution of the AMS role as opposed to practicing in NHs connected to a hospital.

Conclusions: These findings could help healthcare managers and policy-makers tailor the implementation of these new roles among NHNs, if they prove effective and safe.

Introduction

Antimicrobial resistance (AMR) is one of the top public health threats of the 21st century.[1] In 2019, bacterial AMR resulted in approximately 1.27 million deaths worldwide[1,2] (7200 in France[3]). Although multiple causes have been reported, inappropriate use and overuse of antibiotics have been identified as major contributors to this problem.[4] Despite a gradual decrease in antibiotic consumption from 2011 to 2019 and a notable drop in 2020 due to the COVID-19 pandemic,[5,6] France remains the fifth largest consumer in Europe in 2022, 25% above the European average; antibiotics delivered in the outpatient setting represent 93% of total antibiotic consumption.[5]

The spectre of antibiotic resistance is particularly pronounced in nursing homes (NHs), where both the prevalence of infections and the use of antibiotics exceed those in the broader community, with residents often characterized by advanced age and multiple comorbidities.[7,8] It is estimated that fewer than 30% of antibiotic prescriptions in NHs globally are appropriate.[9] Antimicrobial stewardship (AMS), which promotes the responsible use of antibiotics, serves as a linchpin in the global fight against antibiotic resistance.[10] Nursing home nurses (NHNs)

may have considerable influence on AMS,[8,11] as they serve as primary caregivers and central communication channels between prescribers, residents and families. Although the reinforcement and expansion of NHNs' involvement in AMS is promising, NHNs' opinions towards these potential evolutions have been poorly studied.[12,13] It remains imperative to better delineate these potential expanded roles[12,14,15] and have a better understanding of NHNs' motivation towards them because motivation is a strong determinant of behaviour change.[16,17] A cross-sectional survey conducted in 2022 among French NHNs revealed a variety of opinions, with 40%–93% of respondents supporting strengthening and expanding their AMS roles, depending on the activity.[18] A more in-depth analysis of this variability in opinions is essential to inform a tailored and successful implementation of these potential changes.[19]

Building on these previous descriptive results, the objectives of this study were (i) to identify different profiles of French NHNs, according to their opinions on the potential evolution of their role in AMS; (ii) to study the facilitators of and barriers to the implementation of new AMS roles associated with the identified opinion profiles; and (iii) to determine the demographic and professional characteristics associated with these profiles.

Methods

French NH context

In France, NHs provide round-the-clock assistance and necessary medical care to medically stable elderly individuals who have experienced a loss of physical and/or mental autonomy in daily living activities. Approximately 7500 French NHs accommodate 728 000 residents (out of a total French population of 68.4 million); half of residents are severely or totally dependent.[20] The nonmedical staff of standard NHs is typically composed of (i) a head nurse, responsible for nursing care organization; (ii) several nurses, who have four main roles in nursing care in general (patient monitoring, administration of drugs, disease prevention and education),[21] several roles regarding infection management and AMS more specifically (e.g. detection of infectious clinical symptoms, collection of samples and management of their follow-up, antibiotic preparation and administration, monitoring of antibiotic effectiveness and tolerance, reporting all relevant information to the residents' GPs)[20]; and (iii) assistant nurses, responsible for hygiene and comfort care.[18] Since 2018, in France, nurses have been eligible to attain the status of an advanced practice registered nurse (APRN). After an additional 2 years of training, APRNs have enhanced their skills in clinical assessment and therapeutic care and are gradually integrating into NHs. French NHs often experience nonmedical understaffing, particularly at night, and high turnover.[18,20]

For medical staff, on the one hand, residents are usually managed by their own general practitioner (GP), who has a private practice and comes to the NH for regular visits or at nurse's request. As GPs are rarely onsite, NHNs play a key role in contacting GPs and reporting information to them. For example, when a resident presents symptoms compatible with an infection, NHNs often perform a clinical assessment and contact the GP by phone for guidance.[20] On the other hand, NHs must have a coordinating physician responsible for the organization and quality of care. When the resident's GP is unable, the coordinating physician may intervene in any procedure, including drug prescription.[22]

Study design and setting

This study utilized data collected during a national cross-sectional online survey conducted between 2 May and 10 July 2022 among French NHNs. The design of this survey has been described in a previous publication.[18] Briefly, a national exhaustive database[23] was used to identify French NHs with at least 20 beds and an available email address (7215 (96%) of the 7485 NHs identified). The directors of the NHs were then contacted by email to present the survey, requesting that they forward the online questionnaire to the nursing staff of their respective NHs.

Questionnaire

The survey questionnaire was developed by a multidisciplinary team (a nurse, a public health specialist with initial training as a pharmacist and expertise in antibiotic therapy and AMS, an epidemiologist and a public health project manager) on the basis of the results of a former qualitative study conducted by the same research group.[20] The questionnaire was then presented to a panel of experts (an infectious disease specialist, a GP working in NHs, two pharmacists and two nurses) for their assessment, and pilot tested with three NHNs for length and clarity.

The questionnaire included 43 items divided into four sections (Document S1, available as Supplementary data at *JAC* Online): (i) opinions on the potential reinforcement of the current AMS role of NHNs (i.e. roles that are currently possible but could be performed more frequently/systematically); (ii) opinions on the potential development of new AMS roles (e.g. performing pulmonary clinical examination, ordering microbiological laboratory tests, initiating antibiotic treatment for some specific infections and evaluating the appropriateness of empirical antibiotic therapy); (iii) facilitators of and barriers to these potential new AMS roles; and (iv) demographic and professional characteristics (gender, age group, diploma, professional experience, nursing home status and location).

In the first three sections, the participants indicated their level of agreement with each item using a five-point Likert scale (ranging from *strongly disagree* to *strongly agree*, including *do not know/no opinion*).

Statistical analysis

First, a descriptive analysis was performed on all the items from the database to screen for missing values, using numbers and percentages. For the subsequent analyses, participants with at least one missing value were excluded.

To identify different profiles of French NHNs according to their opinions on the potential evolution of their role in AMS (objective 1), a hierarchical clustering analysis (HCA) was performed, including all five-point Likert scale items pertaining to opinions on the potential reinforcement of the current AMS role and on the potential development of new AMS roles ($n = 22$ items). Prior to conducting the HCA, multiple correspondence analysis was employed as a pre-processing step to reduce the dimensionality of the data and transform categorical variables into continuous variables (factorial coordinates).[24,25] The Ward method was used to identify clusters according to the degree of similarity between individuals in the same cluster, and the minimum lost inertia was used to identify the optimal number of clusters.[26] To describe the identified profiles, bivariate analyses were performed between these profiles and each item related to opinions on reinforcing the current AMS role and developing new AMS roles (recoded on a three-point Likert scale: *agree*, *disagree*, *do not know/no opinion*). Fisher's exact tests were used, and the Bonferroni correction (by adjusting *P* values) was applied to account for the increased risk of a type I error when multiple statistical tests were performed.[27]

To study the facilitators of and barriers to the implementation of new AMS roles associated with the identified opinion profiles (objective 2), bivariate analyses were performed between the identified profiles and each of the 14 items related to opinions towards facilitators of and barriers to potential new AMS roles, which were recoded using a three-point Likert scale: *agree*, *disagree*, *do not know/no opinion*. Fisher's exact tests were used, and *P* values were via the Bonferroni correction to account for multiple comparisons, which consists of multiplying the *P* value by the number of tests performed.[27]

To study the demographic and professional characteristics associated with the identified opinion profiles (objective 3), bivariate analyses were performed between the identified profiles and the participants' demographic and professional characteristics: gender (*female*, *male*); age (*18–34*, *35–54*, *55 years or more*), number of years of practice as a nurse (*<5*, *5–9*, *10 years or more*), number of years of practice as a nurse in NHs (*<5*, *5–9*, *10 years or more*), diploma (*nurse*, *head nurse*, *specialist nurse*, i.e. *APRN*, *infection prevention and control nurse or anaesthetist nurse*), status of the NH in practice (*public with connection to a hospital*, *public without connection to a hospital*, *private not-for-profit*, *private for-profit*) and location (*urban*, *suburban*, *rural*).

A *P* value of <0.05 for two-sided tests was considered significant. All the statistical analyses were performed via RStudio (RStudio V 4.3.2, Boston, USA).

Results

Sample characteristics

Out of the 7215 NHs contacted, a total of 1090 NHNs participated. In total, 922 (85%) completed the questionnaire (i.e. no missing values) and were included in the analysis. The participants' demographic and professional characteristics are described in Table 1 (column 'Overall'). The majority of the participants (69%) had been practicing as nurses for at least 10 years; 44% were head nurses. A total of 55% of participants were practicing public NHs, 29% were practicing in private not-for-profit NHs, and 16% were practicing for-profit NHs.

NHNs' profiles according to their opinions on the potential evolution of their role in AMS

The HCA identified three profiles of NHNs based on their opinions on the potential reinforcement of the current AMS role and on the potential development of new AMS roles. All but one of the 22 opinion items included in the HCA were significantly associated with the identified profiles with a percentage of agreement that decreased from the profile 'more favourable to the evolution of the AMS role' to the profile 'less favourable to the evolution of the AMS role' (Tables 2 and 3).

NHNs 'more favourable to the evolution of the AMS role' (40% of the sample) exhibited the highest level of agreement, with more than half of them agreeing on the potential evolution of their AMS roles, regardless of the item. For example, regarding their current roles (Table 2), almost all of these NHNs agreed to be more involved in the management of the biological analyses follow-up, the monitoring of antibiotic effectiveness and tolerance and to discuss about the relevance of the drug formulation more with the GP. The lowest percentage of agreement (62%) was about discussing more with the GP about the relevance of the molecule choice. Regarding potential new AMS roles (Table 3), almost all NHNs in this profile would agree to order laboratory tests on their own in case of suspected infection, to change the drug formulation or administration route of the antibiotic(s) prescribed depending on the patient's condition and to prescribe infection prevention and control measures. Approximately 70% would agree to perform pulmonary clinical examination, initiate antibiotic treatment for some specific infections or change the empirical treatment prescribed by the GP if necessary, after receiving the antibiotic susceptibility test results.

NHNs 'moderately favourable to the evolution of the AMS role' (46% of the sample) were mostly favourable for strengthening and expanding their AMS roles. However, fewer than half of the respondents agreed to discuss the relevance of the chosen molecule or the other elements of the prescription (e.g. dose and duration) more with the GP (Table 2). Additionally, as part of potential new AMS roles, to perform pulmonary clinical examination, initiate or change antibiotic treatment (Table 3).

Compared with those of the other profiles, NHNs 'less favourable to the evolution of the AMS role' (14% of the sample) were less supportive of changes in their AMS roles. Fewer than half agreed to discuss the relevance of the decision to prescribe an antibiotic more with the GP, and only a minority agreed to discuss the choice of the molecule or the other elements of the prescription (e.g. dose and duration) more (Table 2). Regarding potential new AMS roles, in this profile, little or no agreement was found for several proposals, notably with respect to the initiation or modification of antibiotic treatment, the prescription of respiratory physiotherapy or the performance of pulmonary clinical examinations (Table 3).

Associations between the identified opinion profiles and facilitators of and barriers to NHNs' potential new AMS roles

Opinions regarding the facilitators of potential new AMS roles explored in the study varied significantly across the three identified profiles, except for better communication and collaboration between different health professionals (Table 4). NHNs 'moderately favourable to the evolution of the AMS role', and more markedly those 'less favourable to the evolution of the AMS role' less often agreed that training, legal developments, optimization of work organization, access to AMS tools or introduction of APRNs can facilitate the implementation of new AMS roles.

Opinions about the barriers to potential new AMS roles explored in the study varied significantly across the three identified profiles, with the exception of concerns related to a lack of knowledge and frequent interruptions in workflow (Table 5). NHNs 'moderately favourable to the evolution of the AMS role' and, more markedly, those 'less favourable to the evolution of the AMS role' more often agreed that a lack of time, lack of staff resources, unfavourable opinions of residents/families or from NH directors/managers and a lack of interest in antibiotics were barriers to potential new AMS roles. Conversely, NHNs 'more favourable to the evolution of the AMS role' more often perceived GPs' unfavourable opinion as a barrier.

Associations between the identified opinion profiles and NHNs' characteristics

The demographic and professional characteristics of the NHNs that were significantly associated with the identified opinion profiles were gender, diploma, NH status and location (Table 1). Being a head nurse and practicing in a private for-profit NH were associated with belonging to the 'more favourable to the evolution of the AMS role' profile. Conversely, practicing in a public NH with a connection to a hospital was associated with belonging to the 'less favourable to the evolution of the AMS role' profile.

Table 1. Nursing home nurses' demographic and professional characteristics and associations with the identified profiles[a] (*n*, % column)

Characteristics		Overall (*N* = 922[b]; 100%)	Profile 1 'More favourable' (*N* = 367; 40%)	Profile 2 'Moderately favourable' (*N* = 424; 46%)	Profile 3 'Less favourable' (*N* = 131; 14%)	*P* value[c]
Demographic characteristics						
Gender	Female	833 (90.3%)	326 (88.8%)	395 (93.2%)	112 (85.5%)	**0.015**
	Male	89 (9.7%)	41 (11.2%)	29 (6.8%)	19 (14.5%)	
Age (years)	18–34	245 (26.6%)	93 (25.3%)	118 (27.8%)	34 (25.9%)	0.636
	35–54	547 (59.3%)	226 (61.6%)	247 (58.2%)	74 (56.5%)	
	≥55	130 (14.1%)	48 (13.1%)	59 (13.9%)	23 (17.6%)	
Professional characteristics						
Number of years of practice as nurse (years)	<5	111 (12.0%)	44 (12.0%)	52 (12.3%)	15 (11.5%)	0.618
	5–9	176 (19.1%)	61 (16.6%)	89 (21.0%)	26 (19.8%)	
	≥10	635 (68.9%)	262 (71.4%)	283 (66.7%)	90 (68.7%)	
Number of years of practice as nurse in NHs (years)	<5	281 (30.5%)	108 (29.4%)	130 (30.7%)	43 (32.8%)	0.385
	5–9	259 (28.1%)	93 (25.3%)	128 (30.2%)	38 (29.0%)	
	≥10	382 (41.4%)	166 (45.2%)	166 (39.1%)	50 (38.2%)	
Diploma	Nurse	496 (53.8%)	175 (47.7%)	238 (56.1%)	83 (63.4%)	**0.014**
	Head nurse	406 (44.0%)	184 (50.1%)	177 (41.8%)	45 (34.3%)	
	Specialist nurse	20 (2.2%)	8 (2.2%)	9 (2.1%)	3 (2.3%)	
Characteristics of the NH						
Status	Public with connection to a hospital	240 (26.0%)	73 (19.9%)	125 (29.5%)	42 (32.1%)	**0.001**
	Public without connection to a hospital	266 (28.9%)	105 (28.6%)	125 (29.5%)	36 (27.5%)	
	Private not-for-profit	271 (29.4%)	121 (33.0%)	107 (25.2%)	43 (32.8%)	
	Private for-profit	145 (15.7%)	68 (18.5%)	67 (15.8%)	10 (7.6%)	
Location	Urban	179 (19.4%)	77 (21.0%)	69 (16.3%)	33 (25.2%)	**0.035**
	Suburban	368 (39.9%)	130 (35.4%)	186 (43.9%)	52 (39.7%)	
	Rural	375 (40.7%)	160 (43.6%)	169 (39.8%)	46 (35.1%)	

Bold values indicate statistical significance at the 5% level.

NH, nursing home.

[a]Profiles identified via hierarchical clustering analysis, utilizing 22 five-point Likert scale items pertaining to nurses' opinions on the potential reinforcement of the current antimicrobial stewardship role and on the potential development of new antimicrobial stewardship roles.

[b]Participants who fully completed the questionnaire were included in the analysis, while one participant with outlier data was removed.

[c]Fisher's exact test (difference between the three profiles).

Discussion

Key findings

This national cross-sectional survey revealed three distinct profiles of French NHNs on the basis of their opinions regarding the potential reinforcement of their current role or development of new roles in AMS. The first profile (40%) consisted of those who expressed strong support for the potential evolution of their AMS role and included a higher percentage of head nurses. The second profile (46%) consisted of those who were moderately supportive of the potential evolution of their AMS role, especially with respect to reinforcing discussion with GPs about the antibiotic prescription (molecule, dose and duration), and performing some new activities (pulmonary clinical examination, initiation or modification of antibiotic treatment). The third profile (14%) included those who were less supportive of the potential evolution of their AMS role, with little or no agreement on several potential new AMS roles. NHNs from the last two profiles reported fewer facilitators and more barriers to the potential evolution of their AMS role.

Comparison with the literature and implications for practice

NH staff members' lack of motivation and resistance to change have been identified as barriers to the implementation of full AMS programmes in NHs.[28,29] In this respect, the large proportion of NHNs 'more favourable to the evolution of the AMS role' found in the present study is an encouraging result if these changes were implemented to improve AMS in NHs. Head nurses were more likely to belong to this profile, which is consistent with the results of a previous American study.[13] In that study, directors of nursing and nurses with leadership roles reported a higher degree of agreement about the fact that they can handle the challenges associated with new AMS goals (4.2 and 4.3 versus 3.6, respectively, on a five-point scale).[13] These results suggest that

Table 2. Profiles of nursing home nurses according to their opinions on the potential reinforcement of their current roles in antimicrobial stewardship[a] (*n*, % column)

Items		Overall (*N* = 922; 100%)[b]	Profile 1 'More favourable' (*N* = 367; 40%)	Profile 2 'Moderately favourable' (*N* = 424; 46%)	Profile 3 'Less favourable' (*N* = 131; 14%)	*P* value[c]
Regarding the clinical assessment of residents and the performance of additional tests, could these roles be reinforced?						
Perform a urine dipstick screening test on her or his own initiative	Agree	873 (94.7%)	357 (97.3%)	407 (96.0%)	109 (83.2%)	**<0.001**
	Disagree	40 (4.3%)	6 (1.6%)	16 (3.8%)	18 (13.7%)	
	No opinion	9 (1.0%)	4 (1.1%)	1 (0.2%)	4 (3.1%)	
Manage the follow-up[d] of biological analyses (blood tests, urine tests, etc.)	Agree	825 (89.5%)	355 (96.7%)	383 (90.3%)	87 (66.4%)	**<0.001**
	Disagree	89 (9.6%)	11 (3.0%)	40 (9.4%)	38 (29.0%)	
	No opinion	8 (0.9%)	1 (0.3%)	1 (0.2%)	6 (4.6%)	
When the GP prescribes an antibiotic, should the NHN be enabled to discuss more with him or her about…?						
The relevance of the decision to prescribe an antibiotic	Agree	668 (72.4%)	321 (87.5%)	287 (67.7%)	60 (45.8%)	**<0.001**
	Disagree	222 (24.1%)	40 (10.9%)	117 (27.6%)	65 (49.6%)	
	No opinion	32 (3.5%)	6 (1.6%)	20 (4.7%)	6 (4.6%)	
The relevance of the molecule choice	Agree	382 (41.4%)	229 (62.4%)	135 (31.8%)	18 (13.7%)	**<0.001**
	Disagree	478 (51.8%)	120 (32.7%)	252 (59.4%)	106 (81.0%)	
	No opinion	62 (6.7%)	18 (4.9%)	37 (8.7%)	7 (5.3%)	
The relevance of the drug formulation (orodispersible form, tablet, IV…)	Agree	895 (97.1%)	363 (98.9%)	419 (98.8%)	113 (86.2%)	**<0.001**
	Disagree	25 (2.7%)	3 (0.8%)	5 (1.2%)	17 (13.0%)	
	No opinion	2 (0.2%)	1 (0.3%)	0 (0.0%)	1 (0.8%)	
The relevance of other elements of the prescription (e.g. dose and duration)	Agree	404 (43.8%)	239 (65.1%)	139 (32.8%)	26 (19.9%)	**0.003**
	Disagree	455 (49.3%)	110 (30.0%)	247 (58.2%)	98 (74.8%)	
	No opinion	63 (6.8%)	18 (4.9%)	38 (9.0%)	7 (5.3%)	
In the case of prescription of an antibiotic and its monitoring, could these roles be reinforced?						
Monitor antibiotic effectiveness	Agree	875 (94.9%)	358 (97.5%)	402 (94.8%)	115 (87.8%)	**0.013**
	Disagree	42 (4.6%)	8 (2.2%)	20 (4.7%)	14 (10.7%)	
	No opinion	5 (0.5%)	1 (0.3%)	2 (0.5%)	2 (1.5%)	
Monitor adverse events	Agree	884 (95.9%)	356 (97.0%)	410 (96.7%)	118 (90.1%)	0.059
	Disagree	36 (3.9%)	11 (3.0%)	14 (3.3%)	11 (8.4%)	
	No opinion	2 (0.2%)	0 (0.0%)	0 (0.0%)	2 (1.5%)	
After 48–72 h, contact the GP to reassess the initial antibiotic treatment with the results of additional tests	Agree	805 (87.3%)	348 (94.8%)	373 (88.0%)	84 (64.1%)	**<0.001**
	Disagree	96 (10.4%)	16 (4.4%)	40 (9.4%)	40 (30.5%)	
	No opinion	21 (2.3%)	3 (0.8%)	11 (2.6%)	7 (5,3%)	
In terms of prevention and education on the use of antibiotics, could these roles be reinforced?						
Educate residents and their relatives on the appropriate use of antibiotics and/or infection prevention and control	Agree	782 (84.8%)	334 (91.0%)	357 (84.2%)	91 (69.4%)	**<0.001**
	Disagree	108 (11.7%)	24 (6.5%)	53 (12.5%)	31 (23.7%)	
	No opinion	32 (3.5%)	9 (2.5%)	14 (3.3%)	9 (6.9%)	
Train assistant nurses on the appropriate use of antibiotics and/or infection prevention and control	Agree	774 (83.9%)	342 (93.2%)	348 (82.1%)	84 (64.1%)	**<0.001**
	Disagree	126 (13.7%)	20 (5.4%)	65 (15.3%)	41 (31.3%)	
	No opinion	22 (2.4%)	5 (1.4%)	11 (2.6%)	6 (4.6%)	
Train animator staff on infection prevention and control	Agree	548 (59.4%)	266 (72.5%)	229 (54.0%)	53 (40.5%)	**<0.001**
	Disagree	317 (34.4%)	82 (22.3%)	167 (39.4%)	68 (51.9%)	
	No opinion	57 (6.2%)	19 (5.2%)	28 (6.6%)	10 (7.6%)	

Bold values indicate statistical significance at the 5% level.

GP, general practitioner; NHN, nursing home nurse; IV, intravenous.

[a]Profiles identified via hierarchical clustering analysis, utilizing 22 five-point Likert scale items pertaining to nurses' opinions on the potential reinforcement of the current antimicrobial stewardship role and on the potential development of new antimicrobial stewardship roles.

[b]Participants who fully completed the questionnaire were included in the analysis, while one participant with outlier data was removed.

[c]Fisher's exact test with *P* values adjusted using Bonferroni correction.

[d]Collect results and contact the GP in case of abnormal results.

Table 3. Profiles of nursing home nurses according to their opinions on the potential development of new antimicrobial stewardship roles[a] (*n*, % column)

Items		Overall (*N*=922; 100%)[b]	Profile 1 'More favourable' (*N*=367; 40%)	Profile 2 'Moderately favourable' (*N*=424; 46%)	Profile 3 'Less favourable' (*N*=131; 14%)	*P* value[c]
Regarding the clinical assessment of residents and the performance of additional tests, could the NHN perform these new roles?						
Perform pulmonary clinical examination	Agree	393 (42.6%)	255 (69.5%)	119 (28.1%)	19 (14.5%)	**<0.001**
	Disagree	489 (53.0%)	100 (27.2%)	281 (66.3%)	108 (82.4%)	
	No opinion	40 (4.3%)	12 (3.3%)	24 (5.7%)	4 (3.1%)	
Collect a urine sample, according to pre-established criteria, to perform a urine culture in case of suspected urinary tract infection. This test would be performed by the nurse on his/her own initiative, without an initial medical prescription[d]	Agree	873 (94.7%)	362 (98.6%)	405 (95.5%)	106 (80.9%)	**<0.001**
	Disagree	45 (4.9%)	5 (1.4%)	16 (3.8%)	24 (18.3%)	
	No opinion	4 (0.4%)	0 (0.0%)	3 (0.7%)	1 (0.8%)	
Order biological and microbiological laboratory tests (urine tests, blood tests) on his/her own, according to pre-established criteria, in case of suspected infection	Agree	743 (80.6%)	358 (97.6%)	333 (78.5%)	52 (39.7%)	**<0.001**
	Disagree	163 (17.7%)	7 (1.9%)	80 (18.9%)	76 (58.0%)	
	No opinion	16 (1.7%)	2 (0.5%)	11 (2.6%)	3 (2.3%)	
Regarding the prescription of antibiotics/specific procedures, could the NHN perform these new roles?						
Initiate antibiotic treatment for certain infections (urinary tract, pulmonary and skin infections) after receiving the AST	Agree	401 (43.5%)	267 (72.8%)	130 (30.7%)	4 (3.1%)	**<0.001**
	Disagree	500 (54.2%)	97 (26.4%)	279 (65.8%)	124 (94.6%)	
	No opinion	21 (2.3%)	3 (0.8%)	15 (3.5%)	3 (2.3%)	
Change the empirical antibiotic treatment prescribed by the GP after receiving the AST	Agree	384 (41.7%)	263 (71.7%)	119 (28.1%)	2 (1.5%)	**<0.001**
	Disagree	522 (56.6%)	101 (27.5%)	295 (69.5%)	126 (96.2%)	
	No opinion	16 (1.7%)	3 (0.8%)	10 (2.4%)	3 (2.3%)	
Change the drug formulation (orodispersible form, tablet, IV...)	Agree	718 (77.9%)	359 (97.8%)	317 (74.8%)	42 (32.0%)	**<0.001**
	Disagree	193 (20.9%)	6 (1.6%)	102 (24.0%)	85 (64.9%)	
	No opinion	11 (1.2%)	2 (0.5%)	5 (1.2%)	4 (3.1%)	
Change the administration route (e.g. switch from IV to oral)	Agree	699 (75.8%)	357 (97.3%)	310 (73.1%)	32 (24.4%)	**<0.001**
	Disagree	211 (22.9%)	10 (2.7%)	106 (25.0%)	95 (72.5%)	
	No opinion	12 (1.3%)	0 (0.0%)	8 (1.9%)	4 (3.1%)	
Prescribe respiratory physiotherapy	Agree	575 (62.4%)	298 (81.2%)	249 (58.7%)	28 (21.4%)	**<0.001**
	Disagree	323 (35.0%)	63 (17.2%)	159 (37.5%)	101 (77.1%)	
	No opinion	24 (2.6%)	6 (1.6%)	16 (3.8%)	2 (1.5%)	
Prescribe infection prevention and control measures (e.g. additional precautions)	Agree	867 (94.0%)	365 (99.5%)	407 (96.0%)	95 (72.5%)	**<0.001**
	Disagree	43 (4.7%)	2 (0.5%)	13 (3.1%)	28 (21.4%)	
	No opinion	12 (1.3%)	0 (0.0%)	4 (0.9%)	8 (6.1%)	
Regarding the surveillance of antibiotic use and resistance, could the NHN perform this new role?						
Contribute to the production of an annual surveillance report on infections and the use/resistance of antibiotics in the NH	Agree	572 (62.0%)	287 (78.2%)	241 (56.8%)	44 (33.6%)	**<0.001**
	Disagree	297 (32.2%)	67 (18.3%)	151 (35.6%)	79 (60.3%)	
	No opinion	53 (5.8%)	13 (3.5%)	32 (7.5%)	8 (6.1%)	

Bold values indicate statistical significance at the 5% level.

AST, antibiotic susceptibility testing; GP, general practitioner; NH, nursing home; NHN, nursing home nurse; IV, intravenous.

[a]Profiles identified via hierarchical clustering analysis, utilizing 22 five-point Likert scale items pertaining to nurses' opinions on the potential reinforcement of the current antimicrobial stewardship role and on the potential development of new antimicrobial stewardship roles.

[b]Participants who fully completed the questionnaire were included, while one participant with outlier data was removed.

[c]Fisher's exact test with *P* values adjusted using Bonferroni correction.

[d]GP would order the urine culture a posteriori to regularize the situation with the laboratory.

NHNs who are favourable to the evolution of the AMS role could be empowered to promote AMS efforts in their facility, and this finding is consistent with the core element for AMS in NHs 'accountability' recommended by the Centers for Disease Control and Prevention.[30]

However, NHNs reported many barriers to the evolution of their AMS roles. In particular, NHNs that are more favourable to such an evolution more often perceive GPs' unfavourable opinion as a barrier. This might be explained by the fact that they are more often in contact with GPs and, as highlighted in qualitative

Table 4. Facilitators to nursing home nurses' potential new antimicrobial stewardship roles and their associations with the identified profiles[a] (*n*, % column)

Items		Overall (*N* = 922; 100%)[b]	Profile 1 'More favourable' (*N* = 367; 40%)	Profile 2 'Moderately favourable' (*N* = 424; 46%)	Profile 3 'Less favourable' (*N* = 131; 14%)	*P* value[c]
Regarding the implementation of new roles in antibiotic stewardship, could these be considered as potential key facilitators?						
Training on infectious diseases, antibiotic pharmacology and recommendations on the appropriate use/prescription of antibiotics, particularly in the elderly	Agree	876 (95.0%)	362 (98.6%)	407 (96.0%)	107 (81.7%)	**<0.001**
	Disagree	40 (4.3%)	4 (1.1%)	16 (3.8%)	20 (15.2%)	
	No opinion	6 (0.7%)	1 (0.3%)	1 (0.2%)	4 (3.1%)	
Revision of the nursing roles in the law	Agree	826 (89.6%)	352 (95.9%)	386 (91.0%)	88 (67.2%)	**<0.001**
	Disagree	74 (8.0%)	12 (3.3%)	24 (5.7%)	38 (29.0%)	
	No opinion	22 (2.4%)	3 (0.8%)	14 (3.3%)	5 (3.8%)	
Optimization of work organization	Agree	805 (87.3%)	337 (91.8%)	364 (85.9%)	104 (79.4%)	**0.009**
	Disagree	82 (8.9%)	24 (6.5%)	37 (8.7%)	21 (16.0%)	
	No opinion	35 (3.8%)	6 (1.6%)	23 (5.4%)	6 (4.6%)	
Provision of and/or access to information/decision support tools (antibiotic guidelines, protocols, computerized care records, telemedicine)	Agree	853 (92.5%)	360 (98.1%)	401 (94.5%)	92 (70.2%)	**<0.001**
	Disagree	51 (5.5%)	5 (1.4%)	16 (3.8%)	30 (22.9%)	
	No opinion	18 (2.0%)	2 (0.5%)	7 (1.7%)	9 (6.9%)	
Better communication and collaboration between different healthcare professionals (GP, pharmacist, infection prevention and control nurse, assistant nurse)	Agree	882 (95.7%)	358 (97.6%)	405 (95.5%)	119 (90.8%)	0.221
	Disagree	25 (2.7%)	7 (1.9%)	10 (2.4%)	8 (6.1%)	
	No opinion	15 (1.6%)	2 (0.5%)	9 (2.1%)	4 (3.1%)	
Introduction of advanced practice registered nurses in nursing home	Agree	798 (86.6%)	329 (89.6%)	371 (87.5%)	98 (74.8%)	**0.006**
	Disagree	85 (9.2%)	30 (8.2%)	33 (7.8%)	22 (16.8%)	
	No opinion	39 (4.2%)	8 (2.2%)	20 (4.7%)	11 (8.4%)	

Bold values indicate statistical significance at the 5% level.

GP, general practitioner.

[a]Profiles identified via hierarchical clustering analysis, utilizing 22 five-point Likert scale items pertaining to nurses' opinions on the potential reinforcement of the current antimicrobial stewardship role and on the potential development of new antimicrobial stewardship roles.

[b]Participants who fully completed the questionnaire were included in the analysis, while one participant with outlier data was removed.

[c]Fisher's exact test with *P* values adjusted using Bonferroni correction.

studies, may have low confidence in GPs' openness to their professional opinion and experienced contentious interactions with GPs.[31] Interprofessional tensions and communication barriers impair the implementation of AMS programmes in NHs;[28] further research is needed to identify effective strategies to improve communication among NH staff, especially between NHNs and GPs, and enhance internal interprofessional collaboration.[28]

Other barriers to the evolution of AMS roles frequently reported by NHNs, and even more so by those 'less favourable to the evolution of the AMS role', were a lack of time and nursing staff resources. These results are consistent with those of previous studies[17,28,29,32] and suggest that any changes to the AMS role would need to be accompanied by organizational changes to provide a supportive and enabling environment.[32] Conversely, to help them develop new AMS roles, the majority of NHNs, particularly those in the 'more favourable' profile, emphasized the need for training and access to AMS tools, which have been described as facilitators for implementing new AMS roles in nursing.[13,17,29,33–37] The present study suggests that NHNs may need specific training and tools regarding the prescription of antibiotics and the performance of pulmonary clinical examinations. Previous studies highlighted the need for interdisciplinary educational and training initiatives, which could be provided in collaboration with local/regional experts (e.g. acute-care hospital AMS teams).[28]

Finally, this study highlights the diversity of profiles among NHNs. As mentioned above, some NHNs agreed to reinforce or develop new ABS roles of any kind; others were less prone to this. NHNs 'moderately favourable to the evolution of the AMS role' differed from those 'more favourable to the evolution of the AMS role' in that they were more reluctant to be involved in antibiotic treatment management and to perform pulmonary clinical examinations, emphasizing the need for training and tools on these topics, as mentioned above. NHNs 'less favourable to the evolution of the AMS role' gathered NHNs with little or no agreement to develop almost all the new AMS roles proposed in the study. The latter more frequently reported a lack of interest in antibiotics compared to NHNs from the other profiles, suggesting that interventions at the individual level may be necessary to change their beliefs and enhance their motivation to change, in

Table 5. Barriers to nursing home nurses' potential new antimicrobial stewardship roles and their associations with the identified profiles[a] (*n*, % column)

Items		Overall (*N* = 922; 100%)[b]	Profile 1 'More favourable' (*N* = 367; 40%)	Profile 2 'Moderately favourable' (*N* = 424; 46%)	Profile 3 'Less favourable' (*N* = 131; 14%)	*P* value[c]
Regarding the implementation of new roles in antimicrobial stewardship, could these be considered as the main potential barriers?						
Lack of knowledge/information about antibiotics and infections	Agree	653 (70.8%)	257 (70.0%)	307 (72.4%)	89 (67.9%)	>0.900
	Disagree	250 (27.1%)	104 (28.3%)	110 (25.9%)	36 (27.5%)	
	No opinion	19 (2.1%)	6 (1.6%)	7 (1.7%)	6 (4.6%)	
Lack of time to perform new antimicrobial stewardship roles	Agree	809 (87.7%)	302 (82.3%)	383 (90.3%)	124 (94.6%)	**0.004**
	Disagree	106 (11.5%)	62 (16.9%)	38 (9.0%)	6 (4.6%)	
	No opinion	7 (0.8%)	3 (0.8%)	3 (0.7%)	1 (0.8%)	
Lack of nursing staff resources	Agree	855 (92.7%)	326 (88.8%)	405 (95.5%)	124 (94.6%)	**0.047**
	Disagree	62 (6.7%)	38 (10.4%)	18 (4.3%)	6 (4.6%)	
	No opinion	5 (0.5%)	3 (0.8%)	1 (0.2%)	1 (0.8%)	
Frequent interruptions in the nurses' workflow	Agree	841 (91.2%)	327 (89.1%)	392 (92.5%)	122 (93.1%)	>0.900
	Disagree	72 (7.8%)	37 (10.1%)	29 (6.8%)	6 (4.6%)	
	No opinion	9 (1.0%)	3 (0.8%)	3 (0.7%)	3 (2.3%)	
GPs' unfavourable opinion	Agree	671 (72.8%)	283 (77.1%)	308 (72.6%)	80 (61.1%)	**0.001**
	Disagree	157 (17.0%)	64 (17.4%)	67 (15.8%)	26 (19.8%)	
	No opinion	94 (10.2%)	20 (5.5%)	49 (11.6%)	25 (19.1%)	
Unfavourable opinions of residents or their relatives	Agree	313 (33.9%)	111 (30.2%)	151 (35.6%)	51 (38.9%)	**<0.001**
	Disagree	479 (52.0%)	227 (61.9%)	199 (46.9%)	53 (40.5%)	
	No opinion	130 (14.1%)	29 (7.9%)	74 (17.5%)	27 (20.6%)	
Nursing home directors' unfavourable opinion	Agree	253 (27.4%)	95 (25.9%)	120 (28.3%)	38 (29.0%)	**<0.001**
	Disagree	528 (57.3%)	248 (67.6%)	222 (52.4%)	58 (44.3%)	
	No opinion	141 (15.3%)	24 (6.5%)	82 (19.3%)	35 (26.7%)	
Lack of interest about antibiotics	Agree	69 (7.5%)	22 (6.0%)	28 (6.6%)	19 (14.5%)	**<0.001**
	Disagree	783 (84.9%)	329 (89.6%)	365 (86.1%)	89 (67.9%)	
	No opinion	70 (7.6%)	16 (4.4%)	31 (7.3%)	23 (17.6%)	

Bold values indicate statistical significance at the 5% level.

GP, general practitioner.

[a]Profiles identified via hierarchical clustering analysis, utilizing 22 five-point Likert scale items pertaining to nurses' opinions on the potential reinforcement of the current antimicrobial stewardship role and on the potential development of new antimicrobial stewardship roles.

[b]Participants who fully completed the questionnaire were included in the analysis, while one participant with outlier data was removed.

[c]Fisher's exact test with *P* values adjusted using Bonferroni correction.

addition to organizational changes. Indeed, some NHNs may perceive AMS to be a lower priority than other nursing practice activities.[38,39] Increasing NHNs' awareness of the benefits of AMS for residents may increase their engagement in AMS, as NHNs desire to 'do good for the patient',[40] and caring and advocating for residents are strong motivators for nurses to adhere to AMS principles.[41]

Strengths and limitations

To the best of our knowledge, this original nationwide cross-sectional study is the first in the international literature to provide a broad view of NHNs' opinions on their AMS role and its potential evolution. The identification of three distinct profiles of NHNs and their associated factors provides concrete suggestions to help implement such potential evolution while considering the variability of these opinions. However, this study has several limitations. First, compared with the entire population of NHNs (national 2019 data),[42] participants were representative of French NHNs based on sex and NH status but were more likely to be head nurses (44% versus approximately 10%). Given that being a head nurse was associated with more favourable opinions on the evolution of the AMS role, this selection bias may have led to an overestimation of the proportion of NHNs belonging to the 'more favourable to the evolution of the AMS role' profile. In addition, participants were probably more interested in AMS than nonparticipants were. Second, to identify the NHN profiles and their associated factors, data from the 922 respondents (85%) who fully completed the questionnaire were analysed. As the excluded participants did not complete items about their demographic and professional characteristics, we could not verify the existence of potential selection bias. Finally, given the objectives of our study, we did not perform a psychometric validation of the questionnaire.

Conclusions

This study identified three distinct profiles among French NHNs regarding the potential evolution of their AMS roles. A large proportion of respondents strongly supported the evolution of these roles and could play a leading role in promoting and overseeing AMS activities in NHs, provided organizational changes, training and enhanced interprofessional collaboration. Others were more reluctant to expand their role and could benefit from individual-level interventions to shift their beliefs and increase their motivation towards AMS. If such an evolution proves effective in improving the quality of infection management while ensuring safety for residents, these findings could assist healthcare managers and policy-makers in tailoring the implementation of these new roles among NHNs.

Acknowledgements

The authors thank Benoît Lalloué for his help in performing the statistical analysis. The authors also thank the nursing home directors and all the nurses who agreed to participate in the study, the expert committee for reviewing the survey questionnaire and the nursing home nurses who tested it. We are grateful to the regional infection prevention and control centre (CPias Grand Est) and the regional antibiotic stewardship centre (Centre Régional en Antibiothérapie du Grand Est AntibioEst) for disseminating the survey to nursing homes by email and for their support.

Funding

This work was performed out as part of our routine work. Participation in the study was entirely voluntary and not compensated in any form. The survey was completely anonymous (both at the respondent and NH levels); thus, approval from the French data protection authority [Commission Nationale de l'Informatique et des Libertés (CNIL)] was not needed. This study was granted approval by the ethics committee of the University Hospital of Nancy.

Transparency declarations

None of the authors have conflicts of interest to declare.

Supplementary data

Document S1 is available as Supplementary data at *JAC* Online.

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