JAC Antimicrob Resist
doi:10.1093/jacamr/dlab105

JAC-Antimicrobial Resistance

Antibiotic stewardship in French nursing homes: a 2019 regional survey

Martin Belan[1], Nelly Agrinier[2,3], Damien Gonthier[2], Jean-Marc Boivin[2,3], Alexandre Charmillon[4,5], Virginie Chopard[6], Claudine Dif[7], Véronique Hansmann[8], Ouarda Pereira[7], Nathalie Thilly[2,9] and Céline Pulcini[1,2]*

[1]Infectious Diseases Department, Université de Lorraine, CHRU-Nancy, F-54000, Nancy, France; [2]Université de Lorraine, APEMAC, F-54000, Nancy, France; [3]CHRU-Nancy, INSERM, Université de Lorraine, CIC, Epidémiologie Clinique, F-54000, Nancy, France; [4]CHRU-Nancy, Infectious Diseases Department, in Charge of Mobile Infectiologie Team, F-54000, Nancy, France; [5]Grand Est Antibiotic Stewardship Network Coordinator, AntibioEst, F-54000, Nancy, France; [6]Observatoire du Médicament, des Dispositifs médicaux et de l'Innovation Thérapeutique Grand Est, F-54000, Nancy, France; [7]Direction Régionale du Service Médicale Grand Est, F-67000, Strasbourg, France; [8]Agence Régionale de Santé Grand Est, F-54000, Nancy, France; [9]Methodology—Promotion—Investigation Department, Université de Lorraine, CHRU-Nancy, F-54000, Nancy, France

*Corresponding author. E-mail: celine.pulcini@univ-lorraine.fr

Received 22 March 2021; accepted 28 June 2021

Background: Antibiotic resistance is a growing issue in nursing homes (NHs). Antibiotic stewardship (ABS) programmes can reduce antibiotic use in NHs, but few studies have assessed to what extent they are implemented in NHs.

Objectives: To describe ABS current practices and describe the opinion of NH stakeholders regarding ABS and opportunities for improvement in one French region.

Methods: We invited by e-mail the medical and nurse coordinators of all NHs of the Grand Est region, France, to participate in our survey in 2019. The online questionnaire included 35 questions covering four topics: NH characteristics, current ABS practices, attitudes towards ABS and opinions on strategies to promote ABS. A score evaluating implementation of core ABS elements was calculated using the current ABS practice responses.

Results: Out of 417 NHs, 75 (18%) participated in our survey. The three most implemented ABS activities were antibiotic consumption monitoring (65%), antibiotic plan documentation (56%) and antibiotic prescription guide distribution (54%). Audit and feedback, training sessions or identification of a local ABS leader ranged from 13% to 29%. Participants positively perceived ABS and most suggestions to improve ABS programmes in NH, with maximal interest in training, audit and feedback interventions. The median score for implementation of core ABS elements was 3.3 (IQR = 2.3–5.4; theoretical range 0–11), and the score distribution was not associated with any NH characteristic.

Conclusions: While there is still room for improvement, NHs had a positive attitude towards ABS strategies. Some regional and national initiatives to promote ABS in NHs exist and should be actively promoted.

Introduction

In Europe, in 2015, MDR bacterial infections were responsible for about 33 000 deaths and cost about 1.1 billion euros to the healthcare system of EU/European Economic Area countries.[1] The two major drivers for antibiotic resistance are the use of antibiotics and poor infection and control practices.[2] To tackle the global antibiotic resistance threat, antibiotic stewardship (ABS), which is defined as 'a coherent set of actions designed to use antibiotics responsibly' has been advocated since the late 1990s.[3] Primarily studied in the hospital setting, it has been shown that MDR bacterial infections or colonization can be reduced by the implementation of ABS programmes.[4]

Nursing homes (NHs), which are defined as facilities that provide 24/7 functional support for people who require assistance with activity of daily living and have identified health needs, also have antibiotic use and resistance issues.[5,6] The 2016 European point prevalence survey of healthcare-associated infections and antimicrobial use showed that 4.9% of long-term care facility residents were receiving antibiotics on the day of the survey with large

variations between countries (from 0.7% to 10.5%), including about one-third of prescriptions for prophylaxis.[7] In the USA, the CDC reports that up to 70% of NH residents receive antibiotics each year and that 40%–75% of prescribed antibiotics are inappropriate or unnecessary.[8] Moreover, living in a high antibiotic use NH (as compared with a low-use one) was associated with a 24% increased risk of experiencing any antibiotic-related adverse event (including *Clostridioides difficile* infections, infections with antibiotic-resistant bacteria or general adverse events).[9] Several interventional studies or reviews on the effectiveness of ABS programmes in NHs have been published recently,[10–18] and a meta-analysis of these studies concluded that ABS programmes in NHs can reduce antibiotic use by 14%.[19] In the USA, the CDC has developed core elements of ABS programmes that are specifically adapted to the NH context.[8]

Less than 10 questionnaire surveys have assessed to what extent ABS programmes are implemented in NHs.[7,20–25] More than half of them were conducted in the USA, where ABS programmes have been mandatory in NHs since 2016, with only one of these surveys having been performed in the last 4 years.[23] In Europe, two surveys exploring beliefs towards antimicrobial resistance and stewardship were conducted in Ireland and Belgium, with the 2016 ECDC HALT point-prevalence survey providing some information on ABS activities in 1788 NHs in 26 European countries.[7,26,27] No data are available for France on this topic to the best of our knowledge.

Our objective was to describe current ABS practices as well as opportunities for improvement in nursing homes in one French region, using a questionnaire survey.

Methods

NH context in France

In France, NH residents are usually aged 65 years or older and may stay temporarily, but more frequently permanently, in the NHs. They need constant supervision and nursing care, but they are medically stable and do not need invasive medical procedures or constant medical care. Residents are free to choose their own GP, who is not an employee of the NH present on site and is frequently the same GP they had while living in the community. Some NHs are hospital-based NHs (18.8% in France, National Health Insurance data) and thus benefit from the hospital services such as on-site pharmacy, laboratory or imaging; in that case, their ABS activities are those of the hospital they are related to. However, most French NHs are community-based NHs and do not usually have on-site pharmacy or biology/imaging services. In these NHs, residents can also choose their community pharmacy, biology or radiology provider but some NHs have a partnership with a specific community pharmacy or biology laboratory. On-site NH employees include nurses and nurse assistants, and usually one medical coordinator and one nurse coordinator in charge of the organization of residents' healthcare. Regarding antibiotic resistance, in the Grand Est region, in 2019, ESBL-producing Enterobacteriaceae represented respectively 7.7% and 12.5% of *Escherichia coli* and *Klebsiella pneumoniae* clinical samples from NH residents, and 45.3% of *Staphylococcus aureus* isolates were MRSA (further details on antibiotic use and resistance are available in Appendix S1, available as Supplementary data at *JAC-AMR* Online).[28]

French NHs do not have any mandatory requirement to implement ABS programmes. There are however regional or national initiatives promoting ABS in NHs in France (Appendix S2).

Survey questionnaire

We first performed a literature review of published surveys about ABS programmes in NHs,[20–26,29–31] as well as core elements of NH ABS programmes.[8,18] The draft questionnaire was then reviewed by the scientific committee composed of infectious diseases specialists, public health specialists, GPs (taking care of NH residents) and representatives of several regional health authorities or organization's that all officially supported the survey (Agence régionale de santé Grand Est; AntibioEst (the regional ABS network, in place since 2003); Direction régionale du service médical Grand Est; Observatoire des médicaments, dispositifs médicaux et innovations thérapeutiques Grand Est). The questionnaire was validated during a scientific committee meeting and pilot-tested with 10 NH medical coordinators.

The final questionnaire (Appendix S3) included 35 questions covering four main topics: NH characteristics, current ABS practices (including core elements of NH ABS programmes), attitudes towards ABS and suggestions for improvement. Most questions were close-ended questions and some of them were evaluated using a 5-point

Table 1. Characteristics of participating NHs, Grand Est region, north-eastern France, 2019

Characteristics	Responses (*n*/*N*)	%/median (IQR)
NHs with:		
medical coordinator	63/72	88
nurse coordinator	70/72	97
Number of residents	72/75	72 (60–81)
Full-time equivalents:		
medical coordinator	66/75	0.4 (0.3–0.5)
nurses	69/75	4 (3.5–5)
nurse assistants	63/75	18 (14–21)
Number of GPs taking care of NH residents	67/75	15 (8.5–22.5)
Partnership with:		
local/regional hospital	9/72	12
community pharmacy	60/72	83
biology laboratory	59/72	82
NHs part of a larger group	29/72	40
Computerized medical records:		
yes, for all data	55/71	78
yes, for some data	15/71	21
no	1/71	1
Computerized medication prescribing:		
yes, for all drug prescriptions	50/71	70
yes, for some prescriptions	16/71	23
no	5/71	7
Computerized antibiotic prescribing:		
yes, for all antibiotic prescriptions	52/71	73
yes, for some prescriptions	12/71	17
no	7/71	10
Professionals responding to the survey:		
medical coordinator	38/71	53
nurse coordinator	13/71	18
both	16/71	23
other	4/71	6

Likert scale, ranging from 0 (no interest/impact) to 5 (maximal interest/impact).

Surveyed NHs

We targeted all community-based NHs in the Grand Est region in north-eastern France (5 555 186 inhabitants in 2016).[32] NHs with an on-site pharmacy were excluded from our survey since they were most likely to be hospital-based and benefit from existing ABS programmes present in the hospital.

Survey administration

AntibioEst sent an e-mail to all eligible NHs, including an invitation letter (mentioning all organizations supporting the survey), a weblink to the online survey (available on SurveyMonkey®) and a PDF version of the questionnaire. When possible, a joint reply by both the medical and nurse coordinators was recommended. Each NH could either reply to the survey online or send the completed PDF by e-mail or postal mail.

The survey opened on 4 June 2019 and was closed on 30 November 2019. Up to three reminders were sent to NHs. Non-responding NHs were also contacted by phone after the second reminder. They were asked if they had received the e-mail invitation and encouraged to participate in the survey; their contact details were also double checked. No incentives were provided, except feedback on the results of the survey.

Data analysis

Firstly, we performed a descriptive analysis of the results using Excel®. Categorical variables are presented as numbers and percentages and continuous variables as medians and IQR. Based on responses from the current ABS practices section, we designed an 11-point score to reflect the ABS core elements' implementation level of each NH (see Appendix S4 for details). NHs were then categorized in four groups according to their 11-point ABS score, corresponding to the four quartiles of the score distribution, and we tested the association between NHs' characteristics and the ABS group, using Fisher's Exact test for categorical variables and ANOVA for continuous variables. This analysis was performed on SAS® version 9.4 (SAS Institute Inc., Cary, NC, USA).

Ethics statement

This study did not modify the medical care of residents, and complete anonymity was respected during the analyses. An ethics committee's approval was therefore not required, according to French law.

Results

Characteristics of participating nursing homes (Table 1)

Out of 417 community-based NHs, 75 (18%) participated in our survey. The medical coordinator replied on his/her own in more

Table 2. Current ABS strategies implemented in participating NHs

Strategy	Responses (*n*/*N*)	Responses (%)
Professional responsible for coordinating infection/antibiotic management activities in the NH	16/72	22
Written protocols for the infection diagnosis process:		
for physicians	12/71	17
for nurses	27/71	38
none	44/71	60
Written protocols to guide the indication; sampling; interpretation; therapeutic management for:		
urinary dipsticks	29/68; 33/67; 25/64; 11/64	43; 49; 39; 17
urine cultures	39/70; 47/69; 21/65; 14/66	56; 68; 32; 21
blood cultures	17/66; 20/63; 8/61; 6/61	26; 32; 13; 10
Therapeutic guide (paper or electronic) for antibiotic prescribing for common infections	38/71	54
Prescribers being informed about the regional ANTIBIOTEL service	16/71	23
NH policy recommending documenting the antibiotic plan at initiation in the medical record (indication, dosing and duration)	39/70	56
NH policy recommending systematic reassessment of each antibiotic treatment:		
yes, at 48–72 h	24/71	34
yes, at 7 days	9/71	13
none	42/71	59
NHs having organized training sessions about infection management and/or antibiotic prescribing in the past 3 years:		
yes, for medical staff	16/70	23
yes, for nursing staff	20/70	29
none	45/70	64
NHs having organized internal audits on antibiotic use and/or infection management in the past 3 years	9/70	13
NHs having access to their antibiotic consumption data (at least annually)	47/72	65
NHs having access to their bacteriological data (at least annually)	26/72	36

than half of the cases (53%, 38/71), with 23% (16/71) of joint replies by both medical and nurse coordinators.

Almost all responding NH had a nurse coordinator (97%, 70/72) and/or a medical coordinator (88%, 63/72). The median number of GPs who took care of at least one resident in each NH was 15 (IQR: 8.5–22.5). The median (IQR) number of full-time equivalents working in NHs was 0.4 (0.3–0.5) for the medical coordinator, 4 (3.5–5) for nurses and 18 (14–21) for nurse assistants; the median number of residents was 72 (60–81) per NH. Forty percent (29/72) of NHs were part of a larger group of NHs, and most of them had a partnership with a community pharmacy (83%, 60/72) or a biology laboratory (82%, 59/72). All but one NH had computerized medical records and 73% (52/71) had computerized antibiotic prescribing.

Current ABS practices

Core elements of ABS programmes were overall present in less than half of participating NHs (Table 2). Among the listed ABS activities, 3% (2/72) of surveyed NHs did not have any in place.

Twenty-two percent (16/72) had designated a professional responsible for coordinating infection/antibiotic management activities in the NH. His/her roles were to help manage infection treatment (12/16), to promote ABS (10/16), to help with infection diagnosis (8/16) and/or to monitor antibiotic resistance (4/16). Half of these professionals were the medical coordinator of the NH, with a nurse being responsible in some cases (4/16).

More than half (54%, 38/71) of the responding NHs provided a therapeutic guide for antibiotic prescribing in common infections (e.g. urinary, respiratory or skin infections) but protocols dealing with the diagnosis and microbiological tests were overall less frequently available [ranging from 10% (6/61) for therapeutic management for blood cultures to 68% (47/69) for urine cultures sampling]. Twenty-three percent (16/71) of NHs informed prescribers about ANTIBIOTEL, a free regional phone line offering advice from infectious diseases specialists. Recording indication, dosing and duration when prescribing antibiotics was requested in more than half of the NHs. There was no systematic reassessment of treatment at 48–72 h nor at 7 days in 59% of them (42/71).

Training sessions about infection management and/or antibiotic prescribing had been offered in the past 3 years for medical staff and nursing staff in respectively 23% (16/70) and 29% (20/70) of the responding NHs, but only a few (9/70, 13%) performed an internal audit and feedback to evaluate practices on antibiotic use and/or infection management. About two-thirds (47/72) of NHs had access to their antibiotic consumption data (at least annually) but only one-third (26/72) had access to bacteriological data. Some respondents reported other ongoing initiatives, such as ABS discussions at the regional geriatric committee and facilitating communication between physicians and the nursing staff.

Attitudes toward ABS and suggestions for improvement (Table 3)

Overall, most items were perceived as useful by the participants. Medical and nursing staff (including coordinators) were considered as being the most relevant persons to influence antibiotic prescriptions. Administrative directors, residents or their relatives were viewed as having little influence on antibiotic prescriptions.

Table 3. Perceptions and improvement interventions regarding ABS in nursing homes

	Respondents (*n*)	Median score (IQR)
Perceptions of ABS in NHs		
Antibiotic stewardship is of major public health importance	52	5 (4–5)
I wish antibiotic stewardship would become a priority objective in my facility in the coming years	54	4 (4–5)
The following persons could influence antibiotic prescribing in my facility:		
medical coordinator	54	5 (4–5)
residents' GPs	54	5 (4–5)
nurse coordinator	53	4 (3–5)
other prescribers (dentists, other specialists)	54	4 (2–5)
nursing staff	53	3 (3–4)
biologists	52	3 (1–4)
community pharmacists	53	3 (1–4)
residents' relatives	53	2 (1–3)
administrative director	53	1 (0–3)
residents	52	1 (0–2)
Improvement interventions suggested		
An antibiotic stewardship commitment poster displayed in my NH	51	3 (2–4)
Training sessions about antibiotic stewardship targeting:		
residents' GPs	53	5 (4–5)
medical coordinator	53	5 (3–5)
nurses	53	4 (3–5)
nurse coordinator	53	4 (3–5)
nurse assistants	53	2 (1–3)
residents' relatives	52	2 (1–3)
residents	52	1.5 (0.75–2.25)
Training sessions about microbiology test addressing:		
indication	54	4 (3–5)
sampling	54	4 (3–5)
interpretation	54	4 (3–5)
Antibiotic prescription guides distribution	53	4 (4–5)
Documentation of an antibiotic plan (indication, dosing and duration) in the patient record	52	4 (4–5)
Design of indicators assessing the appropriateness of antibiotic prescriptions	54	4 (3–5)
Design of indicators assessing the appropriateness of microbiological tests	53	4 (3–5)
Audit implementation	54	3 (3–4)
Feedback about quantity of antibiotic use in the NH to medical and nursing staff with comparison to other NHs	54	4 (3–4)
Feedback about resistance data of the NH to medical and nursing staff with comparison to other NHs	52	4 (3–4)

Each item was rated on a 5-point Likert scale from 0 (totally disagree, minimum interest/impact) to 5 (totally agree, maximum interest/impact).

Table 4. Comparison of nursing homes' characteristics according to the quartiles' group of the ABS implementation score[a]

	Q1, *N* = 18 (25.0%)				Q2, *N* = 17 (23.6%)				Q3, *N* = 19 (26.4%)				Q4, *N* = 18 (25.0%)				
	N	%/med.	Q1	Q3	*N*	%/med.	Q1	Q3	*N*	%/med.	Q1	Q3	*N*	%/med.	Q1	Q3	*P*[b]
Pricing fee[37]																	0.23
global option	6	33.3			9	52.9			4	21.1			5	27.8			
partial option	12	66.7			8	47.1			15	78.9			13	72.2			
Part of a larger group of NH																	0.82
no	9	50.0			11	64.7			12	63.2			11	61.1			
yes	9	50.0			6	35.3			7	36.8			7	38.9			
Medical coordinator																	0.24
no	5	27.8			1	5.9			2	10.5			1	5.6			
yes	13	72.2			16	94.1			17	89.5			17	94.4			
Nurse coordinator																	0.48
no	1	5.6			1	5.9			0	0.0			0	0.0			
yes	17	94.4			16	94.1			19	100.0			18	100.0			
Partnership with a local hospital																	0.30
no	16	88.9			16	100.0			14	77.8			15	83.3			
yes	2	11.1			0	0.0			4	22.2			3	16.7			
Partnership with a community pharmacy																	0.58
no	4	22.2			2	12.5			3	16.7			1	5.6			
yes	14	77.8			14	87.5			15	83.3			17	94.4			
Partnership with a biology laboratory																	0.76
no	4	22.2			3	18.8			2	11.1			2	11.1			
yes	14	77.8			13	81.3			16	88.9			16	88.9			
Absence of partnership with any of the previous structure																	0.55
no	16	88.9			14	87.5			17	94.4			18	100.0			
yes	2	11.1			2	12.5			1	5.6			0	0.0			
Computerized medical files																	0.82
no	0	0.0			0	0.0			0	0.0			1	5.6			
yes, partially	4	22.2			3	18.8			3	15.8			5	27.8			
yes, completely	14	77.8			13	81.3			16	84.2			12	66.7			
Computerized drug prescriptions																	0.46
no	2	11.1			0	0.0			1	5.3			2	11.1			
yes, partially	3	16.7			2	12.5			7	36.8			4	22.2			
yes, completely	13	72.2			14	87.5			11	57.9			12	66.7			
Computerized antibiotic prescriptions																	0.51
no	3	16.7			0	0.0			1	5.3			3	16.7			
yes, for some prescriptions	2	11.1			3	18.8			5	26.3			2	11.1			
yes, for all prescriptions	13	72.2			13	81.3			13	68.4			13	72.2			
FTE medical coordinator	18	0.3	0.0	0.5	13	0.4	0.3	0.5	18	0.4	0.4	0.5	17	0.4	0.3	0.5	0.64
FTE nurses	18	3.8	3.0	4.3	14	5.0	3.8	5.0	19	4.0	3.6	5.0	18	4.5	4.0	5.8	0.58
FTE nurse assistants	17	17.6	15.0	21.0	13	17.8	14.0	20.3	17	18.0	14.0	21.0	16	18.0	13.3	20.2	0.80
GPs working in NH	17	12.0	8.0	20.0	14	14.5	5.0	23.0	18	14.5	10.0	17.0	18	20.0	9.0	30.0	0.63
Number of residents	18	68.5	59.0	79.0	17	77.0	75.0	88.0	18	65.5	60.0	78.0	17	67.0	58.0	80.0	0.64

med., median.
[a]Quartiles of the ABS implementation score: Q1 = 0–2.3; Q2 = 2.3–3.3; Q3 = 3.3–5.4; Q4 = 5.4–7.7.
[b]Fisher's Exact test for binary variables and ANOVA test for continuous variables.
Q1, first quartile; Q3, third quartile; FTE, full time equivalent.

The interventions that were perceived as being the most useful were training sessions for physicians, the distribution of antibiotic prescription guides and documenting an antibiotic plan.

ABS implementation score

The median score of ABS implementation was 3.3 (IQR = 2.3–5.4) (11 representing the maximum number of ABS core elements implemented). Quartiles of ABS implementation

Table 5. Comparison of ABS core elements implementation in the surveyed nursing homes to previously published surveys

ABS core elements	Survey results	Literature results
Management leadership		Formal written support from leadership: 28% (Morrill[21]) Financial support for ABS: 15% (Morrill[21])
Accountability and responsibilities	Identification of an NH professional responsible for coordinating infection/antibiotic management activities in the NH: 22%	Formal ABS policies: 23% (Malani[22]), 59.5% (Van Schooneveld[24]) ABS committee: 16% (Donlon[20])
Available expertise on infection management	Infectious diseases specialist counselling: 23%	Infectious diseases specialist counselling: 54% (Morrill[21]) Pharmacist guidance or expertise on antibiotic use: 89% (Morrill[21])
Education and practical training	Education and practical training: • designed for physicians: 23% • designed for nursing staff: 29%	Education and practical training: 63.2% (Fu[23]), 56.8% (Van Schooneveld[24]), 35.5% (Yang[25]), 20.7% (HALT-3[7]) • designed for physicians: 7% (Donlon[20]), 90% (Morrill[21]), 7.1% (Van Schooneveld[24]) • designed for nursing staff: 78% (Morrill[21]) • designed for residents and family: 71% (Morrill[21])
Other actions aiming at responsible antibiotic use	Guidelines for appropriate use: 54% Antibiotic plan and reassessment: 56%–34% (48–72 h); 13% (Day 7) Written protocols for infection diagnosis: • designed for physicians: 17% • designed for nursing staff: 38%	Guidelines for appropriate use: 28% (Donlon[20]), 79.8% (Yang[25]), 39.4% (HALT-3[7]) Antibiotic plan and reassessment: 45%–38% (48–72 h) (Morrill[21]) Therapeutic formulary: 23% (Donlon[20]), 65.7% (Fu[23]), 36% (Malani[22]), 19.4% (Morrill[21]), 27.4% (Yang[25]) Pre-approval form: 12% (Donlon[20]), 10.8% (Van Schooneveld[24]), 25% (Yang[25]) List of restricted antibiotics: 19% (Fu[23]), 24% (HALT-3[7]) Antibiotic de-escalation: 49% (Fu[23])
Monitoring and surveillance	Antibiotic use: 65% Resistance data: 36%	Antibiotic use: 16% (Donlon[20]), 91.4% (Fu[23]), 52% (Malani[22]), 92% (Morrill[21]), 81% (Van Schooneveld[24]), 81.5% (Yang[25]) Antibiograms: 12% (Donlon[20]), 58% (Malani[22]), 89% (Morrill[21]), 76% (Van Schooneveld[24]) Individual prescribers' antibiotic use: 10.8% (Van Schooneveld[24]) Antibiotic costs: 32.4% (Van Schooneveld[24])
Reporting and feedback		Antibiotic use: 10% (Donlon[20]), 68.9% (Fu[23]), 75% (Morrill[21]) Clinical case review: 80.7% (Fu[23]), 90% (Malani[22]), 81.1% (Van Schooneveld[24])

score were as follows: Q1 = 0–2.3, Q2 = 2.3–3.3, Q3 = 3.3–5.4, Q4 = 5.4–7.7.

No significant association was found between NH characteristics and the four quartiles of ABS implementation score (Table 4).

Discussion

This survey shows that ABS programmes are insufficiently implemented in French NHs, even though the medical and nurse coordinators who participated in this survey seemed aware this is a public health priority. Most suggestions were favourably perceived when asking about ABS opportunities. No specific NH characteristic associated with the level of implementation of ABS activities at NH level could be identified.

Overall, only 2/72 (3%) surveyed NHs did not have any ABS activity in place. In a recent Belgian survey, only 23% of the 39 participating facilities had an ABS programme in place.[26] Table 5 compares our results with the literature, with most of the studies listed in this table conducted in the USA, as ABS programmes are mandatory in NH in that country. However, the European context can be different, even among countries, as described in a recent article conducted in the Netherlands, Norway, Poland and Sweden.[33] The ABS core elements most often implemented in both our region and the literature were monitoring of antibiotic consumption, availability of guidelines for antibiotic prescribing, documentation of the antibiotic plan and reassessment of antibiotic prescriptions. These strategies also obtained the highest scores in our evaluation of perceptions of ABS interventions, probably because they are relatively easy to implement and are not very time or money consuming. Conversely, available expertise on infection management and training strategies were poorly implemented in our region as compared with previously published

surveys. This is quite surprising, as AntibioEst has been offering both services for free for years. Specific efforts must therefore be made to make NHs aware of existing national or regional initiatives and tools (Appendix S2). We did not assess management leadership and financial support, but these items had low implementation rate in NHs in the literature.[21]

We did not find any significant association between the level of ABS core elements' implementation and NH characteristics, possibly due to lack of power. A recent survey of six NHs in the USA suggested that facilities with training, feedback, benchmarking activities and the presence of a local leader for infection prevention and control had lower rates of antibiotic consumption.[34] This was confirmed by Fu *et al.*[23] who found that in 861 NHs in the USA the presence of a certified infection prevention and control leader, being part of a for-profit group of NHs or participating in a health quality programme were associated with more comprehensive ABS programmes. In our survey, only 22% of responding NHs had an identified professional in charge of infection/antibiotic management as compared with 59.4% of NHs having an on-site care worker in charge of infection prevention and control in the 2016 French national survey.[35] Many reviews about ABS in NHs have emphasized the importance of having a local leader within the facility to lead the change from within.[13,15,17]

This study brings original findings, but it has some limitations. The response rate was quite low (18%), despite several reminders, as in several other published NHs surveys.[23–26] Therefore, we cannot exclude a selection bias, as it is likely that the responding NHs were more aware of the antibiotic resistance issue, meaning that our results might present an optimistic perspective on the true ABS situation in our region. A social desirability bias is also possible, but most replies reported a suboptimal situation, which makes this bias quite unlikely. We also could not collect information about non-responding NHs' characteristics, to assess if respondents were representative of all NHs in our region. However, when comparing the full-time equivalents for medical and nurse coordinators with a 2015 national survey, similar results were found.[36] Finally, although we asked both medical and nurse coordinators to reply jointly to the questionnaire, this was the case in less than a quarter of cases, which may limit the validity of some replies.

In conclusion, French NHs have started to implement strategies to improve antibiotic use, with NHs' stakeholders having a favourable attitude towards ABS, but there is still large room for improvement. Defining ABS core elements for NHs at national level in France would certainly be helpful. Regional health authorities, with the support of regional ABS networks, could then take a leading role in implementing these elements. The inventory of practical tools we published recently might be a starting point to stimulate sharing of best practices.[18]

Acknowledgements

We would like to thank all participating nursing homes. We are also grateful to Christine Barthélémy (AntibioEst), Yosra Mouelhi (Université de Lorraine) and Loïc Simon (CPias Grand Est) for their help with the questionnaire distribution.

Funding

This study was carried out as part of our routine work.

Transparency declarations

None to declare.

Supplementary data

Appendices S1 to S4 are available as Supplementary data at *JAC-AMR* Online.

References

1 AMR Insights. Antimicrobial Resistance: Tackling the Burden in the European Union. https://www.amr-insights.eu/antimicrobial-resistance-tackling-the-burden-in-the-european-union/.

2 ECDC. Factsheet for Experts - Antimicrobial Resistance. https://www.ecdc.europa.eu/en/antimicrobial-resistance/facts/factsheets/experts.

3 Dyar OJ, Huttner B, Schouten J *et al.* What is antimicrobial stewardship? *Clin Microbiol Infect* 2017; **23**: 793–8.

4 Baur D, Gladstone BP, Burkert F *et al.* Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and Clostridium difficile infection: a systematic review and meta-analysis. *Lancet Infect Dis* 2017; **17**: 990–1001.

5 Sanford AM, Orrell M, Tolson D *et al.* An international definition for 'nursing home'. *J Am Med Dir Assoc* 2015; **16**: 181–4.

6 Suetens C, Latour K, Kärki T *et al.* Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European point prevalence surveys, 2016 to 2017. *Euro Surveill* 2018; **23**: pii=1800516.

7 Ricchizzi E, Latour K, Kärki T *et al.* Antimicrobial use in European long-term care facilities: results from the third point prevalence survey of healthcare-associated infections and antimicrobial use, 2016 to 2017. *Euro Surveill* 2018; **23**: pii=1800394.

8 CDC. Core Elements of Antibiotic Stewardship for Nursing Homes. https://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html.

9 Daneman N, Bronskill SE, Gruneir A *et al.* Variability in antibiotic use across nursing homes and the risk of antibiotic-related adverse outcomes for individual residents. *JAMA Intern Med* 2015; **175**: 1331–9.

10 Feldstein D, Sloane PD, Feltner C. Antibiotic stewardship programs in nursing homes: a systematic review. *J Am Med Dir Assoc* 2018; **19**: 110–6.

11 Falcone M, Paul M, Yahav D *et al.* Antimicrobial consumption and impact of antimicrobial stewardship programmes in long-term care facilities. *Clin Microbiol Infect* 2019; **25**: 562–9.

12 Nicolle LE. Antimicrobial stewardship in long term care facilities: what is effective? *Antimicrob Resist Infect Control* 2014; **3**: 6.

13 Morrill HJ, Caffrey AR, Jump RLP *et al.* Antimicrobial stewardship in long-term care facilities: a call to action. *J Am Med Dir Assoc* 2016; **17**: 183.e1–16.

14 Katz MJ, Gurses AP, Tamma PD *et al.* Implementing antimicrobial stewardship in long-term care settings: an integrative review using a human factors approach. *Clin Infect Dis* 2017; **65**: 1943–51.

15 Crnich CJ, Jump R, Trautner B *et al.* Optimizing antibiotic stewardship in nursing homes: a narrative review and recommendations for improvement. *Drugs Aging* 2015; **32**: 699–716.

16 Dyar OJ, Pagani L, Pulcini C. Strategies and challenges of antimicrobial stewardship in long-term care facilities. *Clin Microbiol Infect* 2015; **21**: 10–9.

17 Fleming A, Browne J, Byrne S. The effect of interventions to reduce potentially inappropriate antibiotic prescribing in long-term care facilities: a systematic review of randomised controlled trials. *Drugs Aging* 2013; **30**: 401–8.

18 Belan M, Thilly N, Pulcini C. Antimicrobial stewardship programmes in nursing homes: a systematic review and inventory of tools. *J Antimicrob Chemother* 2020; **75**: 1390–7.

19 Wu JH-C, Langford BJ, Daneman N *et al*. Antimicrobial stewardship programs in long-term care settings: a meta-analysis and systematic review. *J Am Geriatr Soc* 2019; **67**: 392–9.

20 Donlon S, Roche F, Byrne H *et al*. A national survey of infection control and antimicrobial stewardship structures in Irish long-term care facilities. *Am J Infect Control* 2013; **41**: 554–7.

21 Morrill HJ, Mermel LA, Baier RR *et al*. Antimicrobial stewardship in Rhode Island long-term care facilities: current standings and future opportunities. *Infect Control Hosp Epidemiol* 2016; **37**: 979–82.

22 Malani AN, Brennan BM, Collins CD *et al*. Antimicrobial stewardship practices in Michigan long-term care facilities. *Infect Control Hosp Epidemiol* 2016; **37**: 236–7.

23 Fu CJ, Mantell E, Stone PW *et al*. Characteristics of nursing homes with comprehensive antibiotic stewardship programs: results of a national survey. *Am J Infect Control* 2020; **48**: 13–8.

24 Van Schooneveld T, Miller H, Sayles H *et al*. Survey of antimicrobial stewardship practices in Nebraska long-term care facilities. *Infect Control Hosp Epidemiol* 2011; **32**: 732–4.

25 Yang M, Vleck K, Bellantoni M *et al*. Telephone survey of infection-control and antibiotic stewardship practices in long-term care facilities in Maryland. *J Am Med Dir Assoc* 2016; **17**: 491–4.

26 Kidd F, Dubourg D, Heller F *et al*. Antimicrobial stewardship in long-term care facilities in Belgium: a questionnaire-based survey of nursing homes to evaluate initiatives and future developments. *Antimicrob Resist Infect Control* 2016; **5**: 7.

27 Fleming A, Bradley C, Cullinan S *et al*. Antibiotic prescribing in long-term care facilities: a qualitative, multidisciplinary investigation. *BMJ Open* 2014; **4**: e006442.

28 Santé Publique France. Surveillance de la Résistance Bactérienne aux Antibiotiques en Soins de Ville et en Établissements pour Personnes Âgées Dépendantes. Mission Primo. Résultats. 2019. https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/resistance-aux-antibiotiques/documents/enquetes-etudes/surveillance-de-la-resistance-bacterienne-aux-antibiotiques-en-soins-de-ville-et-en-etablissements-pour-personnes-agees-dependantes.-reseau-primo.

29 O'Fallon E, Harper J, Shaw S *et al*. Antibiotic and infection tracking in Minnesota long-term care facilities. *J Am Geriatr Soc* 2007; **55**: 1243–7.

30 Jump RLP, Heath B, Crnich CJ *et al*. Knowledge, beliefs, and confidence regarding infections and antimicrobial stewardship: a survey of Veterans Affairs providers who care for older adults. *Am J Infect Control* 2015; **43**: 298–300.

31 Scales K, Zimmerman S, Reed D *et al*. Nurse and medical provider perspectives on antibiotic stewardship in nursing homes. *J Am Geriatr Soc* 2017; **65**: 165–71.

32 La Croissance, déjà Faible, de la population du Grand Est Ralentit: Insee Analyses Grand Est. https://www.insee.fr/fr/statistiques/3679426.

33 Van Buul LW, Monnier AA, Sundvall P-D *et al*. Antibiotic stewardship in European nursing homes: experiences from the Netherlands, Norway, Poland, and Sweden. *J Am Med Dir Assoc* 2020; **21**: 34–40.

34 Carter RR, Montpetite MM, Jump RLP. Mixed-methods pilot study to assess perceptions of antimicrobial stewardship in nursing homes. *J Am Geriatr Soc* 2017; **65**: 1073–8.

35 Prév'Ehpad: Infections Associées aux Soins et Traitements Antibiotiques en Établissements D'Hébergement pour Personnes Âgées Dépendantes, Résultats Nationaux. 2016. https://www.santepubliquefrance.fr/les-actualites/2017/prev-ehpad-infections-associees-aux-soins-et-traitements-antibiotiques-en-etablissements-d-hebergement-pour-personnes-agees-dependantes-resultat.

36 Ministère des Solidarités et de la Santé. Le Personnel et les Difficultés de Recrutement dans les Ehpad. https://drees.solidarites-sante.gouv.fr/etudes-et-statistiques/publications/etudes-et-resultats/article/le-personnel-et-les-difficultes-de-recrutement-dans-les-ehpad.

37 FAQ Forfait Global. https://solidarites-sante.gouv.fr/IMG/pdf/faq_forfait_global.pdf.