

Supplementary data

Appendix S1. Antibiotic use and resistance data in the Grand Est Region as compared to France, 2019

In France, a national agency (Santé publique France) is in charge of monitoring antibiotic use and resistance, with the following data available in nursing homes:

- antibiotic resistance for certain bacteria and antibiotics;
- antibiotic use, but only in NHs with an on-site pharmacy (those were excluded from our survey); no data is currently available for NH without an on-site pharmacy.

Antibiotic use in NH and hospitals in France, 2019.

	Nursing homes	Hospitals
Antibiotic use (DDD/1000 patient-days)	37	285

Antibiotic resistance data for 3 bacterial species (*E. coli*, *K. pneumoniae* and *S. aureus*) in 3 different settings (NHs, primary care and hospitals) in the Grand Est region as compared to France, 2019.

	Nursing homes		Primary care		Hospitals	
	Grand Est	France	Grand Est	France	Grand Est	France
<i>E. coli</i>						
3 rd generation cephalosporin-resistant	9.4	9.9	3.0	3.4		8.9
ESBL	7.7	8.7	2.9	3.0		6.7
Quinolone-resistant	21.2	19.1	12.2	11.4		19.2
<i>K. pneumoniae</i>						
3 rd generation cephalosporin-resistant	13.2	17.0	5.1	8.0		27.9
ESBL	12.5	15.7	4.8	7.7		22.2
Quinolone-resistant	15.3	20.2	8.7	11.0		30.8
<i>S. aureus</i>						
MRSA	45.3	36.4	11.4	9.3		14.9

Number are proportions in %; ESBL: extended spectrum beta-lactamase

For more information :

- <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-établissements-pour-personnes-agees-dependantes.-reseau-primo>
- <https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/resistance-aux-antibiotiques/documents/enquetes-etudes/surveillance-de-la-consommation-des-antibiotiques-et-des-resistances-bacteriennes-en-établissement-de-santé.-mission-spares-resultats-2019>
- <https://geodes.santepubliquefrance.fr>

Appendix S2. Examples of French regional or national initiatives promoting antibiotic stewardship in nursing homes (available in 2019)

Strategies	Initiatives
Organization support	<p>Antibiotic stewardship principles poster (Omédit & ARS Ile de France) :</p> <ul style="list-style-type: none"> - http://www.omedit-idf.fr/wp-content/uploads/2014/12/Depliant_sur_les_antibiotiques_en_EHPAD_grand_public.pdf <p>Commitment charter for antibiotic stewardship (CPias/DGS/DGOS) :</p> <ul style="list-style-type: none"> - http://www.cpias.fr/Ville/charter.html
Diagnosis management	<p>Diagnosis and treatment of frequent infectious diseases in nursing home residents (Omédit Centre Val de Loire) :</p> <ul style="list-style-type: none"> - Skin and soft tissue infections : http://www.omedit-centre.fr/portail/gallery_files/site/136/2953/5062/5144.pdf - Infectious diarrhea : http://www.omedit-centre.fr/portail/gallery_files/site/136/2953/5062/5131.pdf - Respiratory tract infections: http://www.omedit-centre.fr/portail/gallery_files/site/136/2953/5062/9800.pdf - Urinary tract infections : http://www.omedit-centre.fr/portail/gallery_files/site/136/2953/5062/5161.pdf -
Microbiological tests management	<p>Indications and non-indications for microbiological tests in nursing homes (Omédit Ile de France) :</p> <ul style="list-style-type: none"> - http://www.omedit-idf.fr/wp-content/uploads/2014/12/Le_bon_usage_des_antibiotiques_en_EHPAD.pdf <p>Good practices for microbiological tests (CPias Val de Loire) :</p> <ul style="list-style-type: none"> - https://rhc-arlin.pasman.fr/?page_id=1011
Antibiotic prescription guides	<p>Infection management and antibiotic prescriptions guidelines in nursing homes (Omédit Ile de France) :</p> <ul style="list-style-type: none"> - http://www.omedit-idf.fr/wp-content/uploads/2018/07/guide-antibios-V2018_VD.pdf <p>Antibiotic prescription guides :</p> <ul style="list-style-type: none"> - https://www.infectiologie.com/fr/outils-d-aide-a-la-prescription.html <p>Good practices for drug prescription in elderly patients (ARS Grand Est) :</p> <ul style="list-style-type: none"> - https://www.antibioest.org/wp-content/uploads/2018/11/Guide-bon-usage-du-m%C3%A9dicament-en-g%C3%A9riatrie.pdf <p>Antibiotic prescription guide for nursing homes (InfectioLille) :</p> <ul style="list-style-type: none"> - http://www.infectio-lille.com/Antibiotiques/Antibio-EHPAD-HdF-2018.pdf
Antibiotic resistance and stewardship educational content	<p>Antibiotic stewardship in nursing homes (CPias Nouvelle Aquitaine) :</p> <ul style="list-style-type: none"> - https://www.youtube.com/playlist?list=PLyBYWs9QAMH25n73kh2IfT1AEfStLhl7 - https://solidarites-sante.gouv.fr/IMG/pdf/depliant-recto_verso-3.pdf <p>Educational slideshow to understand mechanisms of antibiotic resistance in nursing homes (4th link) (Omédit Ile de France) :</p> <ul style="list-style-type: none"> - http://www.omedit-idf.fr/juste-prescriptionbon-usage/infectiologie/bon-usage-des-antibiotiques-en-ehpad/ <p>Urinary tract infection management in nursing homes (Omédit Bretagne) :</p> <ul style="list-style-type: none"> - https://www.omeditbretagne.fr/omeditelearning/infections_urinaires/SCO_0001/index.html <p>Educational slideshow to understand mechanisms of antibiotic resistance in nursing homes (AntibioEst) :</p> <ul style="list-style-type: none"> - https://www.antibioest.org/wp-content/uploads/2018/09/Antibiotiques_EHPAD_metz_2015.pdf <p>Common mistakes in urinary tract infection management in elderly patients (CPias/Omédit Normandie) :</p> <ul style="list-style-type: none"> - https://www.youtube.com/watch?v=stWQSksDafo

Antibiotic plan and reassessment	72h antibiotic reassessment : nurse check list (Omédit Centre Val de Loire) : <ul style="list-style-type: none"> - http://www.omedit-centre.fr/portail/gallery_files/site/136/2953/5062/7999.pdf
Audit and feedback about antibiotic use and resistance	National point prevalence survey for healthcare associated infections and antibiotic use in nursing homes in 2016 in France (Santé Publique France) : <ul style="list-style-type: none"> - https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/infections-associees-aux-soins/documents/rapport-synthese/enquete-nationale-de-prevalence-des-infections-associees-aux-soins-et-des-traitements-antibiotiques-en-établissements-d-hebergement-pour-personnes <p>Examples of regional audits and surveys evaluating antibiotic consumption and appropriateness in nursing homes :</p> <ul style="list-style-type: none"> - Grand Est (2016) : http://www.medqual.fr/index.php/eppad/sensibilisation-sur-le-bon-usage-des-antibiotiques/medecins - Occitanie (2018) : https://cpias-occitanie.fr/wp-content/uploads/2019/02/Rapport-quizz-ATB-EHPAD_def.pdf <p>PRIMO national mission for antibiotic resistance surveillance in nursing homes and the community (Cpias Pays de la Loire and Grand Est) :</p> <ul style="list-style-type: none"> - https://medqualville.antibioresistance.fr/

ARS : agence régionale de santé ; CPIas : centre d'appui pour la prévention des infections associées aux soins ; DGS : direction générale de la santé ; DGOS : direction générale de l'offre de soins ; Omédit : observatoires des médicaments, dispositifs médicaux et innovations thérapeutiques

Appendix S3. Questionnaire of the AntibioEHPAD survey (translated from French to English)

Antibiotic stewardship in nursing homes

A) Preliminary questions :

1. Nursing home (NH) name : ; Location:

NH identification number: ; Email adress :

2. The tarification fee of your NH is :

- a partial option without on-site pharmacy
- a partial option with on-site pharmacy
- a global option without on-site pharmacy
- a global option with on-site pharmacy

B) Infection management :

3. Have you identified a professional responsible for coordinating infection/antibiotic management activities in your nursing home ?

- YES
- NO

If yes, role(s) of this professional (several answers possible) :

- Infection diagnosis counseling
- Infection treatment counseling
- Promoting antibiotic stewardship activities
- Antibiogram Resistance data monitoring
- Other ; specify :

Profession of this professional :

Dedicated time for infection/antibiotic management activities : FTE (full-time equivalent)

4. Do you have written protocols to guide the infection diagnosis process ? (several answers possible)

- YES for physicians
- YES for nurses
- NO

5. Do you have written protocols for:

	Urine dipstick	Urine culture	Blood culture
Indications	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no
Sampling	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no
Interpretation	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no
Therapeutic management	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no

6. Do you provide a therapeutic guide (paper or electronic) to support antibiotic prescriptions' decisions (indication, molecule, dosing, duration) for common infections (urinary, pulmonary or skin) to the physicians of your NH ? (several answers possible)

NO

YES ; if yes, specify : Antibioguide

Antibioville

Antibioclic

Other ; specify :

7. Do you communicate to the prescribers of your NH the information about ANTIBIOTEL (regional free advices from infectious diseases specialists available on the phone)?

YES

NO

8. Do you have a NH policy recommending prescribers to document the antibiotic plan at initiation in the medical record (indication, dosing and duration) ?

YES

NO

9. Do you have a NH policy recommending systematic reassessment of each antibiotic course ? (several answers possible)

YES at h48-72

YES at day 7

NO

10. Have you organized a training session about infection management and/or antibiotic prescribing in the past 3 years ? (several answers possible)

YES for medical staff

YES for nursing staff

NO

11. Have you organized an internal audit on antibiotic use and/or infection management in the past 3 years ?

YES

NO

12. Do you have access to your antibiotic use data (at least annually) ?

- YES
- NO

13. Do you have access to your bacteriological resistance data (at least annually) ?

- YES
- NO

14. Do you have other strategies to promote antibiotic stewardship ?

- YES ; specify :
- NO

C) Antibiotic stewardship perceptions

Rate each proposition on a 5-point scale with :

- 0 : total disagreement , no interest/effect
- 5 : total agreement, maximum interest/effect

Items	Responses
15. Antibiotic stewardship is a major public health issue	0 1 2 3 4 5
16. I wish antibiotic stewardship would become a priority in my NH in the coming years	0 1 2 3 4 5
17. The following persons could influence antibiotic prescribing in my NH : 1. the residents	0 1 2 3 4 5
2. the residents' relatives	0 1 2 3 4 5
3. the medical coordinator	0 1 2 3 4 5
4. the nurse coordinator	0 1 2 3 4 5
5. the residents' GPs	0 1 2 3 4 5
6. other prescribers (dentists, other specialists)	0 1 2 3 4 5
7. nursing staff	0 1 2 3 4 5
8. administrative director	0 1 2 3 4 5
9. biologist from the biology laboratory	0 1 2 3 4 5
10. community pharmacists	0 1 2 3 4 5
11. Other (specify) :	0 1 2 3 4 5

D) Improvement opportunities

Rate on a 5-point scale each proposition according to the potential improvement on antibiotic use in your NH with :

- 0 : no effect
- 5 : maximum effect

Items	Responses
18. An antibiotic stewardship commitment poster displayed in my NH	0 1 2 3 4 5
19. Educational sessions about antibiotic stewardship targeting :	
1. Residents'GPs	0 1 2 3 4 5
2. Nurses	0 1 2 3 4 5
3. Nurse assistants	0 1 2 3 4 5
4. Residents	0 1 2 3 4 5
5. Residents' relatives	0 1 2 3 4 5
6. Medical coordinator	0 1 2 3 4 5
7. Nurse coordinator	0 1 2 3 4 5
8. Other (specify) :	0 1 2 3 4 5
20. Educational sessions about microbiological testing focusing on :	
1. Indication	0 1 2 3 4 5
2. Sampling	0 1 2 3 4 5
3. Interpretation	0 1 2 3 4 5
21. Antibiotic prescription guide distribution	0 1 2 3 4 5
22. Documentation of an antibiotic plan (indication, dosing and duration) in the patient's medical file	0 1 2 3 4 5
23. Design of indicators assessing the appropriateness of antibiotic prescriptions	0 1 2 3 4 5
24. Design of indicators assessing the appropriateness of microbiological tests	0 1 2 3 4 5
25. Internal audit addressing antibiotic use	0 1 2 3 4 5
26. Feedback about antibiotic use in the NH to medical and nursing staff with comparison to other NHs	0 1 2 3 4 5
27. Feedback about resistance data of the NH to medical and nursing staff with comparison to other NHs	0 1 2 3 4 5

Other suggestions to improve antibiotic stewardship in your NH (free text) :

.....
.....
.....

E) NH characteristics

28. Is your NH part of a larger group of nursing homes ?

- NO
 YES ; specify :

29. The following positions of your NH are filled (several answers possible) :

- medical coordinator
 nurse coordinator
 none

30. Your NH is engaged in a partnership with (several answers possible)) :

- a local/regional hospital
 a community pharmacy
 a biology laboratory
 none

31. Care workers employed in your NH :

/__/_ medical coordinator full time equivalent (FTE)
/__/_ nurses FTE /__/_ nurse assistants FTE

32. Physicians taking care of residents in your NH :

/__/_ (number of) general practitioners

33. IT tools :

1. Residents' medical files are computerised :
 no yes, partially yes, completely
2. Drug prescriptions are computerised :
 no yes, partially yes, systematically
3. Systemic antibiotic prescriptions are computerised :
 no yes, partially yes, systematically

34. Survey completion date :/...../.....

35. Professionals answering the survey :

- Medical coordinator
 Nurse coordinator

- Both
- Other ; Specify :.....

Appendix S4. Design of the antibiotic stewardship implementation score

The second part of our questionnaire was focused on current infection management and antibiotic stewardship practices in nursing homes and consisted of eleven items (questions 3 to 13, Appendix B). We designed an 11-point aggregated score for each facility based on the answers to these questions.

One point was allocated to each item, and if several positive answers were possible for a specific item, the result was the number of positive answers divided by the maximal number of possible positive answers for the concerned item. For example, in question 10, we asked if training on infection management and/or antibiotic prescribing had been offered in the last 3 years in the nursing home with 3 options for replying : 1. Yes for nursing staff, 2. Yes for medical staff or 3. No. If only the first or the second option was ticked, then the score was 0.5 (1/2) for the concerned item ; if both the first and the second options were ticked, then the score was 1 ; and if the answer was no, then the score was 0.

A global aggregated score for each facility was then calculated, ranging theoretically from 0 to 11 (with 11 representing the maximum level of antibiotic stewardship implementation).