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Nationwide survey of hospital antibiotic stewardship programs in France
Enquête nationale sur les programmes de bon usage des antibiotiques dans les
établissements de santé en France

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Contribution of authors

All authors contributed to the study design. The original English questionnaire was designed by MK, JS, JtO, MH; the translation of the questionnaire from English into French and its adaptation to the French setting was performed by CP; random selection of participating centers was made by FB and GT; dissemination of the survey was led by CP; statistical analyses were performed by MK; the article was written by FB, GT, and CP. All authors were involved in data interpretation and in the final review of the article.

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Disclosure of interests

The authors declare no conflict of interests.

Abstract

Objective. We aimed to evaluate the current state of antibiotic stewardship (ABS) in French public and private acute care hospitals.

Methods. We conducted a cross-sectional online questionnaire survey. The selection of participating hospitals was performed through a stratified random sampling procedure among all French public and private hospitals with acute care beds.

Results. 97/215 (45%) hospitals participated. A formal ABS program was implemented in 84% (80/95) of hospitals. A person officially in charge of this program (i.e., ABS program leader) was present in almost all participating hospitals (99%, 95/96) and s/he coordinated a multidisciplinary ABS team in 42% (40/96) of cases. The median time spent on ABS activities was 1.7, 1.6, and 0.8 hours/week/100 acute care beds for infectious disease (ID) specialists, pharmacists, and microbiologists respectively; 27% (7/26) of ID specialists/other clinicians, 58% (15/26) of pharmacists, and 80% (16/20) of microbiologists received no salary support for the stewardship activities conducted as part of the team. Local guidelines (94%, 88/94), electronic medical records (85%, 80/94), and an antibiotic restriction policy (92%, 82/89) were implemented in almost all hospitals. Reports on antibiotic consumption and local resistance rates were available in 100% (91/91) and 84% (76/91) of hospitals, respectively.

Conclusion. Despite the existence of national requirements, hospital ABS programs are not fully implemented in France, mainly because of inadequate institutional support and funding.

Résumé

Objectif. L'objectif était d'évaluer la mise en place des programmes de bon usage des antibiotiques (PBUA) dans les établissements de santé (ES) français.

Méthodes. Nous avons conduit une enquête avec un questionnaire en ligne. La sélection des ES a été effectuée après tirage au sort aléatoire stratifié sur le type d'établissement et sur le nombre de lits MCO.

Résultats. 97/215 (45 %) ES ont participé. Un PBUA était mis en place dans 84 % (80/95) des ES. Un référent en antibiothérapie était présent dans presque tous les établissements (99 %, 95/96) et il/elle coordonnait une équipe multidisciplinaire dans 42 % (40/96) des cas. Le temps médian consacré au PBUA par l'infectiologue, le pharmacien et le microbiologiste au sein de l'équipe multidisciplinaire était de 1,7, 1,6 et 0,8 heures/semaine/100 lits ; 27 % (7/26) des infectiologues, 58 % (15/26) des pharmaciens et 80 % (16/20) des microbiologistes (membres d'une équipe) ne recevaient aucun financement spécifique par l'établissement pour les activités du programme. Dans la grande majorité des ES, des recommandations (94 %, 88/94), un dossier informatisé (85 %, 80/94) et une restriction de la prescription de certains antibiotiques (92 %, 82/29) étaient en place. Les consommations d'antibiotiques et des données de résistance bactérienne étaient disponibles dans 100 % (91/91) et 84 % (76/91).

Conclusion. Les programmes de bon usage des antibiotiques ne sont pas encore déployés de manière optimale dans les ES français, en grande partie du fait d'un soutien institutionnel et de moyens insuffisants.

Keywords: antibiotic stewardship; implementation; hospital; quality indicators

Mots clés : bon usage des antibiotiques ; hôpitaux ; implémentation ; indicateurs qualité

1. Introduction

The World Health Organization described antimicrobial resistance as a “problem so serious that it threatens the achievements of modern medicine” [1]. A recent study conducted by the French public health agency (Santé Publique France) estimated that multidrug-resistant bacteria affect 158,000 persons annually in France, of whom 12,500 individuals die from such infections [2].

The fight against antimicrobial resistance demands a multidisciplinary “One health” approach [3], and three strategies must be simultaneously implemented: antimicrobial stewardship, infection prevention and control (including vaccination), and measures to reduce the risk of bacterial spread in the environment [4].

Antibiotic stewardship (ABS) has been described as a coherent set of actions which promote the responsible use of antibiotics at the patient and population levels [5]. It has been demonstrated that hospital ABS programs improve patients’ outcomes while reducing antibiotic use and bacterial resistance [6-8].

In France effort has been made over the last two decades to fight bacterial resistance. National guidance for antibiotic stewardship programs in hospitals were issued by the French National Authority for Health (French acronym HAS) in 2008 [9], and since 2001 a national action plan aiming to curb antimicrobial resistance and to promote responsible use of antibiotics has been led by the Ministry of Health [10].

One of the cornerstones of these strategies was the mandatory identification of an ABS program leader in each hospital, who both leads the program and can be consulted by clinicians to guide and optimize antibiotic prescriptions. S/he can lead a multidisciplinary antibiotic stewardship team including various professionals (usually infectious disease [ID] specialists, pharmacists, and

microbiologists). The presence of an ABS program leader is mandatory in every French hospital and an ABS team is highly recommended by national authorities [11].

To facilitate and to monitor the implementation of ABS programs in hospitals, a composite indicator (ICATB combining organization, process, and outcome measures) was introduced a decade ago. An updated and expanded version of this indicator (ICATB2) is currently in place and is part of the mandatory certification of hospitals [12]. ICATB2 scores are however highly variable among hospitals, suggesting that ABS programs are still not optimally and uniformly implemented in France [13].

The aim of our study was to evaluate the current state of ABS programs in French public and private acute care hospitals and to make an inventory of the organizational characteristics and activities of these programs.

2. Methods

A systematically developed questionnaire to evaluate the current state of antimicrobial stewardship in hospitals was developed and administered in the Netherlands [17]. This project was transferred to ESGAP (ESCMID Study Group for Antimicrobial stewardship) that explored the implementation of ABS programs in four countries: France, Italy, Slovenia, and the Netherlands. We focus here on the cross-sectional survey conducted in France, which was also supported by the French Infectious Diseases Society (French acronym SPILF).

2.1 Study design

ABS program leaders from a random sample of French hospitals were invited by email to participate in a cross-sectional online questionnaire survey. The questionnaire was available from

November 2017 to February 2018 and was hosted on a survey tool platform (LimeSurvey, Version 2.6.4). Up to two reminders were sent in case of absence of response. Participation was not compensated, and anonymity was guaranteed during analysis and reporting of results. Ethical approval was not required according to French legislation.

2.2 Selection of hospitals

Participating hospitals were selected using a stratified random sampling procedure among all French public and private hospitals with acute care beds. The complete list of hospitals was obtained consulting various websites of the HAS [14, 15] and the French National Hospital Federation (French acronym FHF) [15], and using the database kindly provided by CPIAS Bretagne (Regional Infection prevention and control network). Hospitals with less than 50 acute care beds were considered not eligible, resulting in a total of 860 eligible hospitals.

Stratification was based on 1) the type of hospital (teaching public hospitals; non-teaching public hospitals; cancer institutes; not-for-profit private hospitals; for-profit private hospitals); 2) the number of acute care beds (\geq or $<$ median number of beds, calculated for public hospitals, not-for-profit hospitals, and for-profit hospitals).

A stratified random sampling procedure (<https://www.randomizer.org/>) selected 25% of hospitals for each category, resulting in 215 hospitals. The procedure is detailed in Figure 1.

2.3 Questionnaire development

The questionnaire included 46 questions, Supplementary material 1.docx grouped into four sections: hospital characteristics, organization and institutional support of ABS program, hospital resources, and ABS activities. The questionnaire was developed by a multidisciplinary group of experts (n=5, infectious disease specialists, intensivists, and epidemiologists) following a literature review; it included organization, process, and outcome indicators such as those developed by the

Transatlantic Taskforce on Antimicrobial Resistance (TATFAR). It was first used for the aforementioned nationwide survey among Dutch hospitals [17]; then it was translated into French, with some adaptation to national specificities concerning organization of healthcare facilities and ABS programs. This French questionnaire was pilot tested among six selected ESGAP and SPILF members, to check for clarity and conciseness.

2.4 Evaluation of salary support

For the evaluation of salary support of ABS teams and members, two standards currently available in France were considered:

- i) 0.3 full time equivalent (FTE)/400 acute care beds for the ABS program leader;
- ii) 2.7 FTE/400 acute care beds for the whole team, divided as follows:
 - 1.4 FTE/400 acute care beds for infection specialists (ID specialists or other clinicians);
 - 1 FTE/400 acute care beds for pharmacists;
 - 0.24 FTE/400 acute care beds for microbiologists.

The first standard was derived from the ICATB2 [12] and the second from a nationwide survey conducted in 2015 by the Task force on antimicrobial resistance coordinated by the ministry of Health [18].

2.5 Statistical analysis

Descriptive analyses presenting frequencies, percentages, medians, and means were performed using IBMSPSS software (version 23.0, Chicago, IL, USA). Differences between groups of hospitals were explored using the Chi-square test.

3. Results

3.1 Participants and response rate

Ninety-seven hospitals participated in the survey, with an overall response rate of 45% (97/215). Ten out of 15 (67%) teaching public hospitals, 50/87 (57%) non-teaching public hospitals, 14/20 (70%) not-for-profit and 23/93 (25%) for-profit private hospitals participated in the survey. The median number of acute care beds among participating hospitals was 250 (IQR 110-372).

The response rate of public hospitals (59%, 60/102) was significantly higher than the response rate of private ones (33%, 37/113) ($p < 0.001$). Among the respondents, 89% (86/97) completed the whole questionnaire while 11% (11/97) partially replied. The characteristics of participating hospitals are detailed in Table 1.

3.2 Organization, accountability, and institutional support of ABS program (Table 2)

A formal ABS program was implemented in 84% (80/95) of hospitals; in 68% (65/95) an annual report on ABS activities was produced. A committee in charge of the ABS program (e.g., drug and therapeutic committee) was present in 90% (85/95) of hospitals. Funding for ABS activities (other than for human resources) was provided by the hospital board in 18% (17/96) of cases. In 12% (11/94) of hospitals, a senior executive administrative officer with accountability for ABS leadership was officially named by the hospital board.

A person formally in charge of the ABS program (i.e., ABS program leader) was present in almost all participating hospitals (99%, 95/96) and s/he coordinated a multidisciplinary ABS team in 42% (40/96) of cases. This team coordinated the ABS program at several locations within the hospital group in 63% (25/40) of cases. The hospital board officially endorsed the activities of the ABS team in 85% (34/40) of cases. The median year of creation of the ABS team was 2010 (range: 2000-2017). At least one ID specialist, one microbiologist, and one pharmacist were present in the ABS

team in 68% (27/40), 80% (32/40), and 95% (38/40) of cases, respectively. At least one clinician (a medical physician with a clinical activity involving direct contact with patients) was present in 83% (33/40) of ABS teams.

When implicated in the ABS teams, the median time spent on ABS activities was 1.7, 1.6, and 0.8 hours/week/100 acute care beds for ID specialists, pharmacists, and microbiologists, respectively. This translated into 0.19, 0.18, and 0.09 FTE/400 acute care beds (annual paid hours for a full-time hospital consultant = 1,820 [35 hours x 52 calendar weeks]) [18].

The ABS program leader was an ID specialist, another clinician or a pharmacist in respectively 42% (39/94), 26% (24/94), and 16% (15/94) of cases. The ABS program leader was a clinician in 72% (68/94) of cases. The ABS program leader declared having received specialized training in antimicrobial stewardship in 80% (74/93) of cases; ABS activities were included in his/her job contract in 51% (47/93) of cases.

Physicians in charge of helping implementing ABS actions in their own wards (i.e., antibiotic champions), in close collaboration with the ABS program leader/team, were absent in most hospitals (77%, 72/94).

Twenty-seven per cent (7/26) of ID specialists/other clinicians, 58% (15/26) of pharmacists, and 80% (16/20) of microbiologists who were in an ABS team received no salary support from the institution for ABS activities. Four per cent (1/26) of ID specialists/other clinicians, 4% (1/26) of pharmacists, and 15% (3/20) of microbiologists had a salary support superior or equal to the corresponding staffing standard indicated by the Task Force (see methods for definitions). Thirty-one per cent (10/32) of ABS program leaders who were in an ABS team had no salary support and 50% (16/32) had a salary support superior or equal to the ICATB2 standard (Table 2).

Considering the salary support for the whole ABS team (Table 2), 21% (7/34) of ABS teams did not receive any salary support; 62% (21/34) of ABS teams had a salary support superior or equal to the standard required in ICATB2 (0.3 FTE/400 acute care beds); and 12% (4/34) had a salary support superior or equal to that recommended by the 2015 task force (2.7 FTE/400 acute care beds).

3.3 Antibiotic stewardship resources and activities (Tables 3 and 4, and Supplementary material 2.docx, Supplementary material 3.docx)

IT support (Table 3)

Electronic medical records were implemented in most hospitals (85%, 80/94). Information technology (IT) personnel was specifically allocated to supporting ABS activities in 1/94 hospital (1%). IT service could be consulted for ABS activities if needed in 53% of cases (50/94).

Local guidelines (Table 3)

Local guidelines were available in 94% (88/94) of hospitals and were based on local antibiotic susceptibility data in 53% (47/88) of cases. Guidelines were mostly available on the Intranet (85%, 75/88) and/or through a printed pocket version (35%, 31/88).

Antibiotic formulary (Table 3)

A local antibiotic formulary was available in 98% (92/94) of hospitals and it could mainly be consulted on the intranet (76%, 70/92) and/or through a printed pocket version (42%, 39/82). A list of restricted antibiotics was available in 76% (70/92) of antibiotic formularies.

Antibiotic prescription policy (Table 4)

A restriction policy for selected antibiotics was implemented in 92% (82/89) of hospitals. Monitoring was mainly performed using antibiotic order forms (76%, 62/82).

A written policy for documentation of indication of all antibiotic prescriptions was available in 45% (42/94) of hospitals. Daily care bundles and checklists for antibiotic use were used in 9% (8/88) of hospitals.

Bedside ID consultations (Table 4)

Bedside ID consultations were performed in 54% (48/89) of hospitals. The most frequent indications were prosthetic joint infections (77%, 37/48) and infective endocarditis (65%, 31/48). Quality indicators (e.g., performance of an echocardiography in case of *Staphylococcus aureus* bacteremia) for one or more of these conditions were monitored in 60% (29/48) of hospitals. Quality indicators concerning the management of fungal invasive infections were monitored in 24% (7/29) of hospitals.

Monitoring and audits for ABS actions (Table 4)

Systematic monitoring and audits mostly concerned surgical antibiotic prophylaxis (49%, 43/88), while actions aiming at optimizing diagnostic investigations, adaptation of dosing using therapeutic drug monitoring, IV-to-oral switch, and duration of treatment were present in 7% (6/88), 10% (9/88), 15% (13/88), and 16% (14/88) of cases, respectively.

Considering monitoring (the activity of repeated measurement and reporting to ensure that stewardship goals are met) and audits (a longitudinal measurement of the quality of antibiotic use) separately, audits were more frequently performed than monitoring for the majority of these ABS activities (Table 4).

The timing, frequency, and categories of patients involved in these activities are detailed in Supplementary material 2.docx et Supplementary material 3.docx

Reporting and feedback (Table 4)

Reports on consumption of antibiotics and local resistance rates were available in 100% (91/91) and 84% (76/91) of hospitals, respectively. Defined daily doses (DDD) were the most frequent unit of measure used to assess the quantity of prescribed antibiotics (91%, 83/91). Point-prevalence surveys assessing the quality of antibiotic use were conducted in 67% (58/87) of hospitals; point-prevalence surveys were conducted at least once a year in 53% (31/58) of cases. Feedback of point-prevalence surveys or results of audits were provided to prescribers in 82% (72/88) of cases.

Education (Table 5)

Educational activities on ABS were organized for junior physicians and senior physicians in 66% (58/88) and 40% (35/88) of cases, respectively. Education for residents was mandatory in 53% (31/58) of cases, whereas education for senior specialists was made available on a voluntary basis in 97% of cases (34/35). Topics included in these educational activities mainly focused on antibiotic streamlining, antimicrobial resistance, and specific infective syndromes.

4. Discussion

To the best of our knowledge this is the first survey systematically investigating all crucial aspects of ABS programs in a large representative nationwide sample of French public and private acute care hospitals.

The performance of several ABS measures in a sample of French hospitals was previously evaluated in a global survey in 2012 [19], but results were presented pooled for all European countries. A 2016 study involving 65 French hospitals investigated human resources dedicated to ABS and highlighted that these resources were not adequate, mainly due to a lack of institutional and national support [18]. More recently, a large survey specifically explored the role of pharmacists in ABS in public and private hospitals in France [20]. Another recent study performed

in the southwestern region of France (Nouvelle Aquitaine) evaluated the measures performed in 234 hospitals and the functioning of the multidisciplinary ABS team [21]. All these studies confirmed the need for human resources to implement ABS programs in France.

Due to the stratified random sampling used to select participating hospitals, our sample included a wide range of healthcare facilities (public and private, teaching and non-teaching hospitals, not-for-profit and for-profit clinics). It is remarkable that a large proportion of small hospitals and non-teaching hospitals participated.

ABS programs and identification of an official ABS program leader in French hospitals are requirements for accreditation standards [11]. Our results confirmed that the great majority of participating hospitals had both. Furthermore, monitoring of antibiotic consumption, microbiological susceptibility reports, and antibiotic formularies containing the list of restricted molecules were available in almost all hospitals. Guidelines for the treatment of common infections were also available in most hospitals, but they were based on local susceptibility data in only half of them. These results demonstrate that some core actions included in ICATB2 [12] have been implemented in France (Table 2), suggesting that the implementation of ICATB2 had a strong and positive impact on the implementation of ABS programs in France.

Comparing our findings with the results of the global survey conducted in 2012 [18] (even if sampling methodologies differed), the presence of an ABS program in France seems higher than in the pooled European countries (84% vs 66%). The presence of local guidelines, antibiotic formulary, and restriction policy was similar in both studies (98% in our survey vs 94% in the 2012 survey, 95% vs 94%, 88% vs 92%).

Nonetheless, considering the core elements and checklist items recommended for all hospital ABS programs worldwide [22] and the indicators validated by the TATFAR [16], our results highlight that several actions not included in the ICATB2 score are still not fully implemented.

It has been shown that ABS teams significantly improve the quality of antibiotic prescriptions [19] and are cost effective [23]. We observed that multidisciplinary ABS teams were present in less than half of surveyed hospitals, and this result is consistent with the survey conducted in southwestern France (multidisciplinary ABS team present in 50% of cases) [21]. As advocated by the 2015 Task force [11], it is now time to move from a single ABS program leader to a full multidisciplinary ABS team.

Another element identified as suboptimal in our survey is the support provided by the hospital board to the ABS program: a senior manager officially in charge of the ABS program or a budget specifically allocated to ABS activities (excluding human resources) was present in only a minority of hospitals. Other interesting findings concerned financial support. First of all, a considerable proportion of ABS team members (ranging from 21% to 44% for the various professional categories) were not able to quantify salary support or time spent in ABS activities; the majority of ABS team members, particularly pharmacists (58%) and microbiologists (80%), received no salary support for their time spent on ABS activities; salary support was equal or superior to the standard recommended in ICATB2 (0.3 FTE/400 acute care beds) for only 62% of ABS teams; and finally only a minority of hospitals (12%) achieved the staffing standard objectives suggested by the 2015 Task Force [18].

As we had to use a questionnaire as similar as possible to the one used for the European survey, we unfortunately could not explore the time spent by each ABS program leader (in the absence of a multidisciplinary ABS team) on ABS activities and the salary support they received for these activities. Assuming that hospitals with multidisciplinary ABS teams are possibly the most involved in ABS activities, it is quite probable that an ABS program leader working on his/her own without an ABS team may have even less institutional support. Supporting this assumption, the survey

performed in Southwestern France showed that 85% of ABS program leaders did not have any specific salary support [21].

Considering the specific ABS activities, our results showed low levels of regular or continuous monitoring (15% or less for all stewardship activities). Occasional (i.e. audits) or incidental actions (i.e. request from the prescriber) were more frequent. The activities less frequently monitored are those targeting the optimization of diagnostic investigations and the adaptation of dosing based on therapeutic drug monitoring. This last result is consistent with a previous French survey which highlighted that therapeutic drug monitoring (TDM) for some molecules (e.g., beta-lactams) is only available in a minority of hospitals [24]. Therefore, ABS programs need to facilitate the implementation of TDM and its correct use.

Other actions were not sufficiently performed: presence of a documentation policy (<50%); availability of bedside ID consultations (54%); education on ABS (mainly focused on residents and only available in some hospitals); presence of antibiotic champions in charge of helping ABS implementation in their wards (23%). There is clear room for improvement for all these elements.

Comparing our results with the nationwide Dutch survey included in the European project conducted by ESGAP [17], antibiotic formularies and local guidelines, as well as a restriction policy are similarly present in both countries (93% in the Netherlands vs 98% in France, 93% vs 94%, 91% vs 92%). In contrast to France, ABS teams are present in almost all Dutch hospitals (94% vs 42%); activities targeting stewardship objectives such as timely IV to oral switch, discontinuation, adaptation of dosing after TDM, and optimization of diagnostic investigations are also more widespread in Dutch hospitals (55% vs 15%, 37% vs 16%, 65% vs 10%, 35% vs 7%).

Our study has several limitations. It is possible that our results give an optimistic view of ABS program implementation, as the response rate was 45% and participating hospitals were probably the ones most interested in ABS. Moreover, participation was significantly higher in public than in

private hospitals. However, to reduce this selection bias we randomly included all categories of public and private acute care hospitals, with a stratification based on facility type and number of beds. The study design (cross-sectional survey) is at risk of social desirability bias, even though preserving anonymity of respondents might have limited such bias. Finally, our results present self-reported data, which might not always reflect real practices.

5. Conclusion

Despite all measures implemented at the national level to promote ABS in France, hospital ABS programs are not yet sufficiently implemented, mainly because of inadequate institutional support. The inclusion of new indicators in ICATB could be a way to strengthen ABS programs over the next years. Furthermore, as hospital accreditation is currently based on ICATB2 total score and as only this value is publicly reported, it would be useful to identify particularly essential indicators as mandatory for all hospitals (e.g., staffing standards for ABS teams), with external auditing of the declared score and public reporting of results, as already advised by the 2015 Task Force [11].

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Figure 1. Methods for the selection of hospitals eligible to participate in the survey
Figure 1. Méthodes pour la sélection des hôpitaux éligibles pour participer à l'enquête

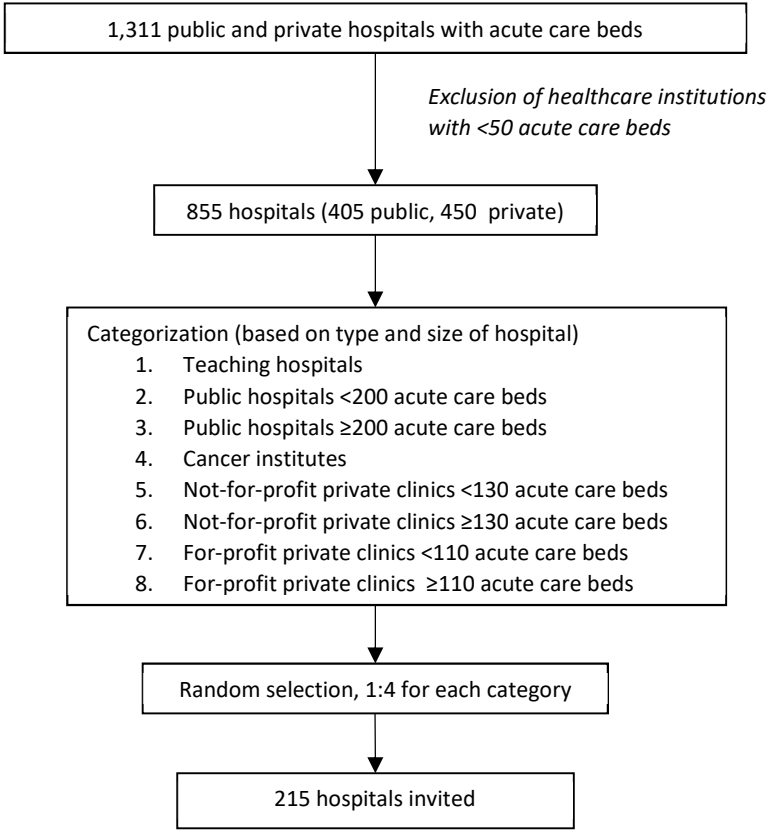


Table 1. Characteristics of participating hospitals**Tableau 1.** Caractéristiques des établissements de santé participant à l'enquête

CHARACTERISTICS	n/N (%)
Type of hospital	
Teaching hospital	10/97 (10)
Non-teaching public hospital	50/97 (52)
For-profit private clinics	23/97 (24)
Not-for-profit private clinics	14/97 (14)
Hospitals part of a larger group of institutions*	
Yes	25/96 (26)
No	71/96 (74)
Presence of residency programs	
Internal medicine	32/96 (33)
Infectious diseases	20/96 (21)
Microbiology	30/96 (31)
Pharmacy	43/96 (45)
None of these	43/96 (45)
Presence of specialist	
Infectious disease physician	48/97 (50)
Microbiologist	63/97 (65)
Pharmacist	94/97 (97)

N: number of respondents.

**: e.g., Paris hospital group (French acronym AP-HP)*

Table 2. Percentage of hospitals achieving the objectives of ABS programs

Tableau 2. Pourcentage d'hôpitaux qui atteignent les objectifs des programmes de bon usage

<i>ICATB2 indicators</i>		<i>% of hospitals achieving objective</i>	<i>Other indicators not included in the ICATB2</i>	<i>% of hospitals achieving objective</i>
Organization	Formal ABS program (ATB01)	84	Report on ABS activities	68
	ABS program leader (ATB02-ATBM3)	99	ABS team	42
	Organizational structure of ABS program (ATB03)	90	Senior executive officer with accountability for ABS	12
			Clinician leader of ABS team	72
		ABS activities included in the contract of the ABS program leader	51	
Resources	IT connection between electronic medical records, microbiology, and pharmacy data (ATBM1)	84	IT service support	54
	ABS program leader with an antimicrobial stewardship training (ATBM4)	80	Budget for ABS activities (excluding human resources)	18
	Salary support for the ABS program leader 0.3 FTE/400 acute care beds (ATBM5)	50	Salary support for ID specialists/other clinicians as leader of the team (1.4 FTE/400 acute care beds)	4
	Education of senior physicians (ATBM6)	40	Salary support for pharmacists in the team (1 FTE/400 acute care beds)	4
	Education of residents (ATBM6)	66	Salary support for microbiologists in the team (0.24 FTE/400 acute care beds)	15
Antibiotic champions in charge of helping implement ABS actions in their wards			23	
Actions	List of restricted antibiotics (ATBA1)	76	Antibiotic formulary	98
	Guidelines (ATBA2)	94	Written policy for documentation of the indication of antibiotic prescriptions	45
	Measure of antibiotic use	100	ID bedside consultations	53

(ATBA6)			
Susceptibility reports (ATBA8)	84	Monitoring and audits on surgical prophylaxis	49
Feedback (ATBA9-10, ATBA12-13)	82	Monitoring and audits on timely IV-to-oral switch	13
Monitoring and audits on compliance with guidelines (ATB11a)	29	Monitoring and audits on therapeutic drug monitoring	10
Monitoring and audits on treatment duration (ATB11c)	16	Monitoring and audits on appropriate use of diagnostic tools	7
Monitoring and audits on antibiotic streamlining/de-escalation (ATB11d)	32	Conducting point-prevalence surveys	67

ICATB2=composite indicator of ABS program, ABS=antibiotic stewardship, IT=information technology, ID=Infectious diseases, FTE=full-time equivalent

Table 3. Hospital resources for antibiotic stewardship programs**Tableau 3.** Ressources pour les programmes de bon usage des antibiotiques

IT SUPPORT	n/N (%)	GUIDELINES AND FORMULARY	n/N (%)
Type of medical record		Local guidelines	88/94 (94)
- Medical record on paper	14/94 (15)	- Based on local antimicrobial susceptibility	47/88 (53)
- Electronic Medical Record (EMR)	80/94 (85)	Topics included in local guidelines	
- Both paper and EMR	0	- IV-to-oral switch	27/94 (29)
Type of available medical data in the EMR		- Antibiotic streamlining/de-escalation	68/94 (72)
- Clinical data	77/80 (96)	- Dose optimization (TDM)	24/94 (26)
- Medication data	79/80 (99)	- Discontinuation of antibiotic therapy	26/94 (28)
- Laboratory data (e.g., chemistry)	76/80 (95)	- Surgical prophylaxis	80/94 (85)
- Microbiology data	72/80 (90)	- None of these	4/94 (4)
- Radiology data	60/80 (75)	Access to local guidelines	
Available IT support for ABS program		- Internet	10/88 (11)
- Official IT support (in FTE)	1/94 (1)	- Intranet	75/88 (85)
- IT support is available if needed	50/94 (53)	- Mobile application	4/88 (5)
- No IT support available	43/94 (46)	- Pocket guide	31/88 (35)
IT support for specific ABS activities		- Printed version in physicians' room	13/88 (15)
- Selection of specified patient categories	22/51 (43)	- Other	4/88 (4)
- Data reporting	43/51 (84)	Antibiotic formulary	
- Point prevalence survey	38/51 (75)	- Containing the list of restricted drugs	70/92 (76)
- Decision support (i.e., clinical rules)	9/51 (18)	Access to the antibiotic formulary	
- Other	7/51 (14)	- Internet	2/92 (2)
		- Intranet	70/92 (76)

-	Mobile application	1/92 (1)
-	Pocket guide	39/92 (42)
-	Printed version in physicians' room	11/92 (12)
-	Other	13/92 (14)

N: number of respondents.

EMR=Electronic Medical Record, ABS=antibiotic stewardship, IT=information technology,
FTE=full-time equivalent, TDM=therapeutic drug monitoring, IV=intravenous.

Table 4. Antibiotic stewardship programs activities**Tableau 4.** Activités des programmes de bon usage des antibiotiques

ANTIBIOTIC PRESCRIPTION	n/N (%)	ABS ACTIVITIES	n/N (%)
Restriction policy	82/89 (92)	Advice on compliance with guidelines	
- Preauthorization	23/82 (28)	- Systematically (monitoring and audits)	26/89 (29)
- Post-authorization	18/82 (22)	○ monitoring	13/89 (15)
- Formulary restriction	0	○ audits	15/89 (17)
- Antibiotic order forms	62/82 (76)	- Occasionally upon clinicians' request	26/89 (29)
- Computerized alert	25/82 (30)	- No advice	14/89 (16)
- Check for diagnostic tests	17/82 (21)		
- Mandatory bedside consultation	3/82 (4)	Advice on timely IV-to-oral switch	
- Automatic antibiotic discontinuation	11/82 (13)	- Systematically (monitoring and audits)	13/88 (15)
- Post prescription review	32/82 (39)	○ monitoring	7/88 (8)
		○ audits	8/88 (9)
Written policy for indication	42/94 (45)	- Occasionally upon clinicians' request	48/88 (55)
Daily care bundle for antibiotic use		- No advice	29/88 (33)
- On all wards	7/88 (8)	Advice on antibiotic streamlining/de-escalation	
- On specific wards	1/88 (1)	- Systematically (monitoring and audits)	28/88 (32)
- No	80/88 (91)	○ monitoring	13/88 (15)
		○ audits	17/18 (99)
Daily checklist for antibiotic use		- Occasionally upon clinicians' request	50/88 (57)
- On all wards	5/88 (6)	- No advice	16/88 (18)
- On specific wards	3/88 (3)		
- No	80/88 (91)	Advice on discontinuation	
		- Systematically (monitoring and audits)	14/88 (16)
ID BEDSIDE CONSULTATIONS		○ monitoring	10/88 (11)
ID bedside consultations	49/89 (54)		

For type of infection		
-	<i>S. aureus</i>	16/48
bacteremia		(33)
-	Infective	31/48
endocarditis		(65)
-	Infection of	37/48
prosthetic joint		(77)
-	Infection of valvular	28/48
prosthesis		(58)
-	Invasive fungal	22/48
infection		(46)
-	Other	11/48
		(23)

Monitoring of bedside consultations		
		29/48
		(60)
-	Infective endocarditis	14/29
		(48)
-	Infection of prosthetic joint	20/29
		(69)
-	Infection of valvular prosthesis	12/29
		(41)
-	Invasive fungal infections	7/29 (24)
-	Other	2/29 (7)

MONITORING, REPORTING, AND FEEDBACK

Monitoring the quantity of antibiotic use	
	91/91
	(100)

Median times per year	2
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Measure used for the quantity of antibiotics

DDD	83/91
	(91)
DOT	7/91 (8)
Other	2/91 (2)

Antibiotic susceptibility reports	
	76/91
	(84)

Median times per year	1
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Point-prevalence survey	
	58/87
	(67)

Frequency of point-prevalence survey

-	Twice a year	3/58 (5)
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o	audits	5/88 (6)
-	Occasionally upon clinicians' request	40/88 (45)
-	No advice	36/88 (41)

Advice on therapeutic drug monitoring (TDM)

-	Systematically (monitoring and audits)	9/88 (10)
o	monitoring	6/88 (7)
o	audits	3/88 (3)
-	Occasionally upon clinicians' request	44/88 (50)
-	No advice	36/88 (41)

Advice on the prescription of surgical prophylaxis

-	Systematically (monitoring and audits)	43/88 (49)
o	monitoring	3/88 (3)
o	audits	41/88 (47)
-	Occasionally upon clinicians' request	22/88 (25)
-	No advice	26/88 (30)

Advice on the correct use of diagnostic tools

-	Systematically (monitoring and audits)	6/88 (7)
o	monitoring	1/88 (1)
o	audits	5/88 (6)
-	Occasionally upon clinicians' request	33/88 (43)
-	No advice	44/88 (50)

-	Once a year	28/58 (48)
-	Once every 2 years	4/58 (7)
-	Occasionally (no regular frequency)	23/58 (40)
<hr/>		
Reference used for point-prevalence survey		
-	ECDC	3/58 (5)
-	WHO	2/58 (3)
-	National point prevalence survey system	46/58 (79)
-	Locally developed point-prevalence survey	8/58 (14)
<hr/>		
Feedback from point-prevalence survey/audits		
		72/88 (82)
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N: number of respondents.

ABS=antibiotic stewardship, ID=Infectious diseases, DDD=Defined Daily Dose, DOT=Days of therapy, ECDC=European Centre for Disease Prevention and Control, WHO=World Health Organization, IV=intravenous, TDM=therapeutic drug monitoring.

Table 5. Education on antibiotic prescribing and stewardship to prescribers**Tableau 5.** Formation des prescripteurs sur l'antibiothérapie et le bon usage des antibiotiques

	Residents	Specialists
	n/N (%)	n/N (%)
Educational program on ABS	58/88 (66)	35/88 (40)
Mandatory education	31/58 (53)	1/35 (3)
Frequency of education		
- Daily	0	0
- Once a week	1/58 (2)	0
- Once a month	1/58 (2)	1/35 (3)
- Once every 2 months	1/58 (2)	0
- 4 times a year	5/58 (9)	3/35 (9)
- Twice a year	46/58 (79)	10/35 (29)
- Once a year	2/58 (3)	10/35 (29)
- On demand	2/58 (3)	7/35 (20)
- Other	0	4/35 (11)
Education topics		
- Antimicrobial resistance	49/58 (84)	31/35 (89)
- Specific syndromes (e.g., pneumonia)	42/58 (72)	28/35 (80)
- Restricted medication	32/58 (55)	22/35 (63)
- IV-to-oral switch	33/58 (57)	15/35 (43)
- Antibiotic streamlining or de-escalation	52/58 (90)	25/35 (71)
- Dose optimization (TDM)	18/58 (31)	10/35 (29)
- PPS or audit	2/58 (3)	10/35 (29)
- Other	2/58 (3)	2/35 (6)

N= number of respondents.

ABS=antibiotic stewardship, IV=intravenous, TDM=therapeutic drug monitoring, PPS=point prevalence survey.