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# Journal Pre-proofs

Short communication

A pilot project of expert nurses for the follow-up of complex intravenous antimicrobial treatment

L. Rolland, A. Mainguy, S. Boissier, M. Ki Zerbo, A. Tardivel, M. Sébillotte, M. Cailleaux, S. Patrat-Delon, M. Revest, P. Tattevin

L Rolland <sup>1</sup> , A Mainguy <sup>1</sup> , S Boissier <sup>1</sup> , M Ki Zerbo <sup>1</sup> , A Tardivel <sup>1</sup> , M Sébillotte <sup>1</sup> , M Cailleaux <sup>1</sup> , S Patrat-Delon <sup>1</sup> , M Revest <sup>2</sup> , P Tattevin <sup>3</sup>

Affiliations

Affiliations

1 Infectious Diseases and Intensive Care Unit, Pontchaillou University Hospital, Rennes, France.

2 Infectious Diseases and Intensive Care Unit, Pontchaillou University Hospital, Rennes, France; INSERM U1230, IFR140, Rennes 1 University, Rennes, France.

3 Infectious Diseases and Intensive Care Unit, Pontchaillou University Hospital, Rennes, France; INSERM U1230, IFR140, Rennes 1 University, Rennes, France. Electronic address: pierre.tattevin@chu-rennes.fr.

## Abstract

**Objective:** To report a pilot project of expert nurses for outpatient parenteral antimicrobial treatment (OPAT) follow-up.

**Methods:** Three nurses with specific training on antibiotics started a state-funded programme including: i) consultations for OPAT follow-up; ii) hotline for satellite hospitals; iii) peer training. Patients' data were prospectively collected. A representative sample of patients and physicians was interviewed to learn about their opinion on the project.

**Results:** From December 2020 to December 2021, 118 patients (median age 66.5 years [52-75], male-to-female ratio 2.5) were enrolled, for a total of 621 consultations. Patients were mostly on OPAT for bone and joint infections (n = 76, 64 %) and cardiovascular infections (n = 16, 14 %), for a median duration of 29 days [22-57]. Eleven patients (9 %) required unplanned hospital admissions, and three experienced treatment failure. Most patients (21/22) and physicians in charge (10/10) reported a high level of satisfaction.

**Conclusions:** Nurses may be important actors for OPAT follow-up.

**Keywords:** Antimicrobial resistance; Competency building; Nurses; Outpatient parenteral antimicrobial treatment; Task delegation.

## 1. Introduction

The emergence of antimicrobial resistance (AMR) is one of the major challenges for human health, according to the World Health Organization [1]. Antimicrobial stewardship (AMS) has proven effective to optimize antibiotic use [2] and to fight against AMR, but it requires funding and commitment from governments, the hospital administration, health care workers, patients, and the general population. Among health care workers, nurses may play a pivotal role, as they are at the frontline of patient care [3, 4, 5]. However, their role has been neglected in most AMS programs thus far [6, 5].

During the years 2018 and 2019, we performed a 60-hour training on AMS dedicated to nurses who committed to specializing in this area, which led to the certification of 'expert nurses in antibiotics'. Within a pilot project funded by the French ministry of health, three of these expert nurses were appointed in 2020 to develop an hospital-based program under the supervision of two infectious diseases physicians, including: *i*) on-site nurse consultations for the follow-up of outpatient parenteral antimicrobial treatment (OPAT); *ii*) hotline on OPAT issues for nurses working in other hospitals in the area; *iii*) peer training on OPAT. We aimed to report the activities undertaken, the achievements, and the challenges met during the first year of this pilot project.

## 2. Methods

The Rennes University Hospital is an 1,800-bed tertiary care center in western France (population catchment area, 1 million inhabitants). This hospital coordinates a network of nine public hospitals. The grant awarded by the expert nurses was 100,000 euros, which covers the salary of one full-time nurse for two years, with a monthly supplement of 100 euros as

compared to regular nurses' salary in France, to reward their personal commitment to the development of this expertise. The project's terms of references stated that their activities should contribute to better use of antibiotics within the whole hospital network. The continuation of their financial support will depend on a follow-up report including an overview of the main achievements after one year.

The programme started with the opening of dedicated nurse consultations (five half-days per week) in the outpatient department of the infectious diseases ward, under the supervision of an infectious disease physician, who would see the patient at the request of the nurse whenever she thought it necessary, according to a protocol validated by infectious diseases physicians, expert nurses, and the institution. The selection of patients eligible for a follow-up by OPAT-expert nurses was based on predefined criteria (Figure 1). The first consultation with the expert nurse took place after hospital discharge (to home or to another hospital). However, nurses were informed in advance and could collect information from medical charts before meeting the patient. The medical physician who referred the patient to expert nurses' follow-up could be contacted if need be. The list of investigations that could be prescribed by nurses was predefined in the protocol, including additional investigations potentially required in case of common adverse events (e.g., stool testing for *Clostridioides difficile* in case of severe or persistent diarrhea during antibacterial treatment). All patients had consultations with an infectious disease physician at least at the beginning, and at the end of the OPAT programme.

The one-year report included two main parts. First, an analytical report of consultations performed by expert nurses, with patients' characteristics, infection(s) targeted (sites, pathogens), antibacterial treatment (dose, duration, infusion mode), and outcomes, including

adverse events (tolerability, treatment failure, unplanned hospital admission, death). Data were prospectively collected on a standardized questionnaire by the expert nurses (supplementary Table). Second, we performed an audit of patients and infectious disease physicians. This audit was performed after one year using an online questionnaire with a representative sample of patients and their physicians. Qualitative data are reported as numbers (%), quantitative data as medians [interquartile range]. Due to the exploratory design and limited sample size, no statistical test was performed. This study was approved by the Rennes University Hospital institutional review board.

### 3. Results

Between December 1, 2020 and December 31, 2021, 121 patients were managed by one of the three OPAT-expert nurses, for a total number of 621 consultations (mean, 5.3 nurse consultations per patient). Three patients were excluded (lost to follow-up). Table 1 details the characteristics of the 118 patients enrolled: median age was 66.5 years [52-75], and male-to-female ratio was 2.5. By the time of the first nurse consultation, most patients (n=98, 83%) had returned home, while others were either in a rehabilitation center (n=13), in another hospital (n=6), or a long-term care facility (n=1).

Most patients (n=106, 90%) received their intravenous antibacterial treatment through a peripherally-inserted central catheter (PICC). The main infections targeted were bone and joint (n=76, 64%) and cardiovascular (n=16, 14%) infections, due to Gram-positive (n=74, 63%), or Gram-negative (n=13, 11%) bacteria. The median duration of management by expert nurses was 29 days [22-57]. Early removal of PICC line was necessary in 21 cases (16 patients), after a median duration of 26 days post-catheter insertion [13-39], mostly due to suspected

infection (n=11) or obstruction (n=7), with an estimated incidence of 2.2 local infections and 0.8 catheter obstructions per 1,000 catheter-days. No bacteremia or vascular thrombosis was reported. Eleven patients (9%) required unplanned hospital admissions during follow-up, due to adverse events of OPAT in four cases. Three patients experienced treatment failure that required another course of antibacterial treatment, and no patient died.

Twenty-two selected patients fulfilled the questionnaire: 21 (95%) stated that they greatly appreciated the opportunity to be followed by expert nurses during their OPAT. Direct patients-nurses interaction, nurses' professionalism, and the opportunity to receive regular follow-up by an expert health care worker while being at home were the three most appreciated items. Ten selected physicians in charge of patients enrolled in this program fulfilled the questionnaire, with 100% rate of satisfaction: they particularly appreciated that the nurses requested their intervention appropriately (at the right time, when necessary), and that the implementation of nurses' consultations could save time for them, so that they could spend more time on their other duties.

#### **4. Discussion**

We report on the first year of an innovative project aimed to increase the participation of nurses for better use of antibiotics. The main findings of this one-year follow-up are that, at a moderate cost, expert nurses could be increasingly involved in the follow-up of OPAT, with multiple secondary benefits, including: *i*) patients' safety and satisfaction; *ii*) decreased workload for physicians in charge, while preserving quality of care. Recent years have demonstrated that shortage of medical physicians is a major issue worldwide, affecting high-income as well as low- and middle-income countries. This has promoted effort to transfer part of medical activities to other health care workers, which has been repeatedly successful [7, 8,

9]. This transfer of competency should only be implemented with a rigorous plan, including selection and training of health care workers who will take over the activity, with a clear definition of their tasks, a well-defined roadmap, and regular evaluation of outcomes [10]. In parallel, effort to increase the number and competencies of nurses is of utmost importance, as shortage of staff affects nurses as well as many other health care worker categories. The transfer of activities from medical physicians to nurses should come with an ambitious programme to increase the number of nurses, and to develop their skills to endorse additional activities, such as OPAT follow-up.

In France as in many other countries, nurses cannot prescribe antibiotics. This may be one of the reasons why their participation in AMS programs have been limited so far, despite them being primary actors of patient care, especially in hospital settings [6]. Their potential role in the fight against AMR should be reinforced, and may include patient education, as well as empowerment to be more involved in the follow-up of patients during complex antibacterial treatments [11]. We hope that this report of our pilot project will encourage colleagues from other sites to engage in more innovative projects.

This one-year report of a pilot project has limitations. First, as it was developed in a university hospital, our findings and the lessons learnt cannot potentially be generalized to other sites. Second, as a pilot project, it only included a limited number of patients, and could only audit a limited number of physicians. Third, the programme was started in 2020 while the COVID-19 pandemic had a dramatic impact on hospitals worldwide. We collectively decided to start the programme despite this dreadful situation, but it may have been easier (and results may have been more convincing) to postpone the launch after the COVID-19. However, the fight against AMR is a public health issue, which should not be postponed. Our project of expert nurses for the follow-up of complex intravenous antimicrobial treatment is

essential, as it increases participation of a major category of health care workers. We advocate that their skills (in terms of patient education, quality of care, and commitment) will be an asset in the fight against AMR.

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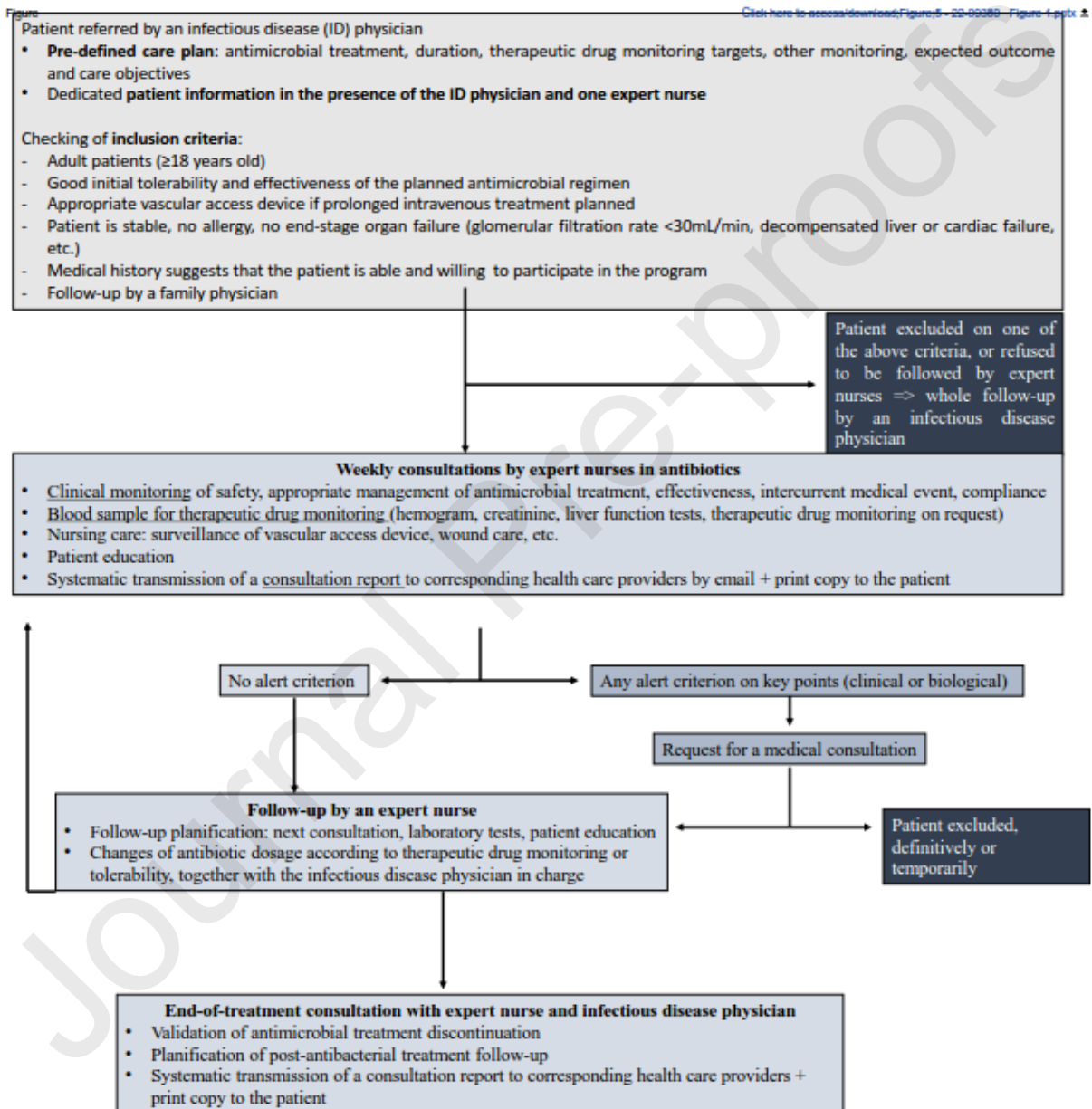
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**Figure 1.** Enrolment of patients and follow-up



**Table 1.** Characteristics of patients followed up during expert nurse consultations

Characteristics of patients	Total population n=118 (100 %)	Ambulatory care n=98 (83%)
<b>Age, years</b>	66.5 [52-75]	64 [51-73]
<b>Male-to-female sex ratio</b>	2.5	2.7
<b>Infection characteristics</b>		
- Bone and joint infections	76 (64%)	62 (63%)
- Infective endocarditis	16 (14%)	11 (11%)
- Abdominal or urinary tract infections	6 (5%)	6 (6%)
- Skin and soft tissue infections	3 (3%)	3 (3%)
- Neurological infections	4 (3%)	4 (4%)
- Vascular infections	4 (3%)	3 (3%)
- Other	9 (8%)	9 (9%)
<b>Microbiological characteristics</b>		
<b>- Gram-positive bacteria</b>	<b>74 (63%)</b>	<b>55 (55%)</b>
<i>Staphylococcus aureus</i>	16 (14%)	9 (9%)
Coagulase-negative <i>staphylococci</i> (CoNS)	13 (11%)	10 (10%)
<i>Streptococcus</i> sp.	19 (16%)	14 (15%)
<i>Enterococcus</i> sp.	9 (8%)	8 (8%)
Other	17 (%)	14 (15%)
<b>- Gram-negative bacteria</b>	<b>13 (11%)</b>	<b>13 (13%)</b>
<i>Enterobacteriaceae</i>	5 (4%)	5 (5%)
<i>Pseudomonas aeruginosa</i>	6 (5%)	6 (6%)
Other	2 (2%)	2 (2%)
<b>- polymicrobial</b>	<b>24 (20%)</b>	<b>23 (24%)</b>
<b>- other</b>	<b>4 (3%)</b>	<b>4 (3%)</b>
<b>Type of vascular access</b>		
- peripherally-inserted central catheter	106 (90%)	89 (90%)
- midline catheter	7 (6%)	5 (5%)
- tunneled catheter	1	1
- subcutaneous venous access device	1	1
- peripheral venous catheter	1	0
<b>Vascular access complications, n</b>	Not available	<b>16 (16%)</b>
- bacteremia		0
- vascular thrombosis		0
- hospitalization		1
- catheter obstruction		4
- local infection		11
- mechanical complication		5
<b>Outcome at the end of nurse follow-up</b>		-
- death	0	
- relapse	3 (3%)	
- cure or remission	115 (97%)	
<b>Expert nurse follow-up</b>		
<b>- duration, days</b>	<b>29 [22-57]</b>	<b>38.5 [28-69]</b>
<b>- consultations, n</b>	<b>621</b>	<b>520</b>
on-site	488 (79%)	Not available

telemedicine	133 (21%)	Not available
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Quantitative data are presented as medians [interquartile range], qualitative data as numbers (%)

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S Patrat-Delon<sup>1</sup>, M Revest<sup>1,2</sup>, P Tattevin<sup>1,2</sup>

<sup>1</sup> Infectious diseases and intensive care unit, Pontchaillou University Hospital, Rennes, France

<sup>2</sup> INSERM U1230, IFR140, Rennes 1 University, Rennes, France.

#### **Corresponding author:**

Pr Pierre Tattevin, M.D., Ph.D.

Infectious diseases and intensive care unit, CHU de Rennes, Univ Rennes, INSERM U1230,  
IFR140, F-35033, Rennes, France.

e-mail : [pierre.tattevin@chu-rennes.fr](mailto:pierre.tattevin@chu-rennes.fr)

#### **Contribution of authors**

Laetitia Rolland, Anne Mainguy and Sophie Boissier contributed to the project design, followed-up the patients, collected data, and critically reviewed the manuscript.

Muriel Ki Zerbo and Anne Tardivel contributed to the project design, research for fundings, and critically reviewed the manuscript.

Marine Sébillotte and Marine Cailleaux contributed to patients' follow-up, study analysis, and critically reviewed the manuscript.

Solène Patrat-Delon and Matthieu Revest coordinated the project, wrote the first draft of the study design, obtained the funding, contributed to patients' follow-up, performed the analysis, and critically reviewed the manuscript.

Pierre Tattevin participated in the project design, patients' follow-up, the analysis, and wrote the first draft of the manuscript.

**Conflicts of Interest.** All authors, none.

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**Keywords.** Nurses; outpatient parenteral antimicrobial treatment; antimicrobial resistance; competency building; task delegation

## Highlights

- Nurses can be precious allies in the fight against antimicrobial resistance.
- In a pilot project, three expert nurses were trained for complex antimicrobial treatment follow-up.
- At one year, they performed 621 consultations, mostly (64%) for bone and joint infections.
- No severe adverse event related to the programme was reported.
- Patients, infectious diseases physicians, and expert nurses reported high-level of satisfaction.

## ABSTRACT

**Objective.** To report a pilot project of expert nurses for outpatient parenteral antimicrobial treatment (OPAT) follow-up.

**Methods.** Three nurses with specific training on antibiotics started a state-funded programme including: *i)* consultations for OPAT follow-up; *ii)* hotline for satellite hospitals; *iii)* peer training. Patients' data were prospectively collected. A representative sample of patients and physicians was interviewed to learn about their opinion on the project.

**Results.** From December 2020 to December 2021, 118 patients (median age 66.5 years [52-75], male-to-female ratio 2.5) were enrolled, for a total of 621 consultations. Patients were mostly on OPAT for bone and joint infections (n=76, 64%) and cardiovascular infections (n=16, 14%), for a median duration of 29 days [22-57]. Eleven patients (9%) required unplanned hospital admissions, and three experienced treatment failure. Most patients (21/22) and physicians in charge (10/10) reported a high level of satisfaction.

**Conclusions.** Nurses may be important actors for OPAT follow-up.