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Decision-making regarding antibiotic therapy duration: An observational study of multidisciplinary meetings in the intensive care unit

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ABSTRACT

Purpose: Antibiotic therapy is commonly prescribed longer than recommended in intensive care patients (ICU). We aimed to provide insight into the decision-making process on antibiotic therapy duration in the ICU.
Methods: A qualitative study was conducted, involving direct observations of antibiotic decision-making during multidisciplinary meetings in four Dutch ICUs. The study used an observation guide, audio recordings, and detailed field notes to gather information about the discussions on antibiotic therapy duration. We described the participants' roles in the decision-making process and focused on arguments contributing to decision-making.
Results: We observed 121 discussions on antibiotic therapy duration in sixty multidisciplinary meetings. 24.8% of discussions led to a decision to stop antibiotics immediately. In 37.2%, a prospective stop date was determined. Arguments for decisions were most often brought forward by intensivists (35.5%) and clinical microbiologists (22.3%). In 28.9% of discussions, multiple healthcare professionals participated equally in the decision. We identified 13 main argument categories. While intensivists mostly used arguments based on clinical status, clinical microbiologists used diagnostic results in the discussion.
Conclusions: Multidisciplinary decision-making regarding the duration of antibiotic therapy is a complex but valuable process, involving different healthcare professionals, using a variety of argument-types to determine the duration of antibiotic therapy. To optimize the decision-making process, structured discussions, involvement of relevant specialties, and clear communication and documentation of the antibiotic plan are recommended.

1. Introduction

In the Intensive Care Unit (ICU), antibiotic therapy is used longer than recommended in guidelines [1-4]. The harms of prolonged therapy include the risk of adverse effects and the development of antimicrobial resistance (AMR) [5]. Reducing the duration of antibiotic therapy has shown to be safe for several types of infections [6-10] and short courses have been advocated in various (inter)national guidelines [11,12]. An understanding of the key drivers for prolonged antibiotic therapy duration is crucial to select appropriate antimicrobial stewardship (AMS) improvement interventions [13].

A recent scoping review [14] showed that there is limited literature describing factors influencing the duration of antibiotic therapy in general, and only one study specific to ICU practice [15]. This emphasizes the need for ICU studies that provide insight into drivers of professional behavior towards optimal duration of antibiotic therapy.

Abbreviations: AMR, antimicrobial resistance; AMS, antimicrobial stewardship; ICU, intensive care unit; MDMs, multidisciplinary team meetings.

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In Dutch ICUs, non-urgent decision-making mainly takes place during daily multidisciplinary team meetings (MDMs) [16]. The main goal of MDMs is to facilitate interprofessional shared decision-making about clinical problems aiming to improve patient care [17]. Earlier studies have investigated roles of various ICU healthcare professionals in AMS [15,18,19]. However, these report on described, self-reported behavior, and actual decision-making behavior is not described. Observations of multidisciplinary decision-making in everyday work settings, also in the field of AMS, are a promising approach to assess actual healthcare professionals' behavior, including group-behavior, as opposed to focusing solely on what they claim to do (work-as-done versus work-as-imagined) [20-23].

The aim of this study was to provide insight into the decision-making process on duration of antibiotic therapy during MDMs in Dutch ICUs in order to identify drivers that can serve as potential targets for stewardship interventions.

2. Methods

This study is reported in accordance with the Standards for Reporting Qualitative Research (SRQR) checklist (Additional file 1) [24].

2.1. Study design and setting

Between August 2020 and December 2021, a qualitative ethnographic study was conducted using non-participant direct observations of antibiotic decision-making during MDMs in four Dutch ICUs. All Dutch ICUs are closed format (i.e., intensivists are primarily responsible for all patients admitted to the ICU). The ICU directors of the participating ICUs received an email with information about the study to distribute among all potential participants attending the MDMs, including referring physicians usually present at these meetings. With this email participants were informed about an upcoming study about antibiotic decision-making in the ICU, however, the precise study topic (duration of antibiotic therapy) was not disclosed.

2.2. Participants

The study population consisted of healthcare professionals attending the MDMs, who were involved in antibiotic decision-making for ICU patients (i.e., intensivists, ICU residents, ICU nurses, clinical pharmacists, and clinical microbiologists, as well as referring physicians from different specialties (e.g., surgeons, pulmonologists and infectious disease physicians)). The duties and responsibilities of clinical microbiologists can vary greatly between healthcare systems and countries. In the Netherlands, clinical microbiologists play a role in various areas, including laboratory diagnostic investigations, medical consultations, laboratory management, policy-making and development of protocols and guidelines, infection prevention and epidemiology of infectious diseases, and they are regularly part of AMS teams [25]. Patients themselves were not included as study participants and no identifiable or personal data were collected.

2.3. Data collection

One trained researcher (RJ) observed and audio-recorded the MDMs. Per ICU, 15 observations were conducted over a period of 6–8 weeks. A prespecified observation guide was developed and used during the observations to document the characteristics of the MDMs (e.g., location, duration, attending physicians) (Additional file 2). To minimize the risk of bias, including the Hawthorne effect (i.e., the phenomenon in which individuals modify an aspect of their behavior in response to their awareness of being observed), we implemented several measures during our study. Firstly, we adopted a participant-observation approach by attending the MDMs while dressed in doctor's clothing to blend in with the group. Secondly, the participants were informed that someone would be attending the MDMs to observe antibiotic policies in the ICU, but not when and without being explicitly informed of the study's specific focus on the duration of antibiotic therapy. Audio-recordings were used to collect information related to the content of the discussions. Detailed field notes were taken during the observations to collect details about the decision-making process that cannot be obtained from the audio recordings. These notes were immediately transcribed after the MDMs to limit the risk of recall bias [26,27].

2.4. Data analysis

The audio recordings were transcribed verbatim (in Dutch). The transcripts, together with information from the fieldnotes were scanned for relevant discussions on antibiotic therapy duration. Text fragments/discussions were considered "relevant" when, according to two researchers (RJ and JS), they focused on decision-making with regards to the duration of antibiotic therapy. Subsequently, all this information was used to describe the decision-making process of each discussion.

We first identified the person who initiated the communication on antibiotic therapy duration (for example asking: "*can we stop the antibiotics*?" or "*for how long should we continue the antibiotics*"). Second, the final decision on antibiotic therapy duration (either stopping, continuing, or postponing decision to another moment) was assessed. Third, it was evaluated whether this decision was a multidisciplinary shared-decision and, if not, who determined the decision that was reached, being the person who was most instructive/persuasive in reaching the decision). For this study, "multidisciplinary shared decision-making" was defined as the decision being made based on the interaction and collaboration between healthcare professionals from at least two different specialties (e.g. intensive care, microbiology, surgery, etc.). When individual clinicians made the decision, the final decision was not considered a "multidisciplinary shared decision" [16]. To determine this, two researchers discussed all relevant text fragments. In situations where doubt remained, a third researcher was involved to reach consensus. Fourth, for all involved participants we described their role in the decision-making process (*pro-active*: participants actively participated in de discussion process on stopping of antibiotics, *supportive*: participants participated in the conversation but only to provide some background information, *non-participatory*: participants were present but did not get involved in the discussion, or *absent*: participants were not present during the MDM). Fifth, we zoomed in on the arguments provided by each healthcare professional to contribute to the antibiotic decision-making process. For a schematic overview of this process see Fig. 1.

Descriptive statistical analyses (frequency distributions) were conducted for the data collected in steps 1–4, using SPSS version 27.0 software (IBM Corporation, Armonk, NY, USA). The thematic analysis approach [28] was used to identify argument categories, by assessing all arguments provided by the healthcare professionals to determine antibiotic therapy duration (step 5), using the qualitative analysis software ATLAS.ti version 22.

2.5. Ethics

This study was approved by the research ethics committee Arnhem-Nijmegen (registration number: 2020–6098). Local approval was obtained from the research ethics committees of the participating ICUs. Permission to audio-record and analyze the meetings was obtained from all involved departments. The transcripts of the data were anonymized: names of participants and patients were deleted, and we refer to the participants by their roles. This research was conducted in accordance with the Declaration of Helsinki and national and institutional standards.

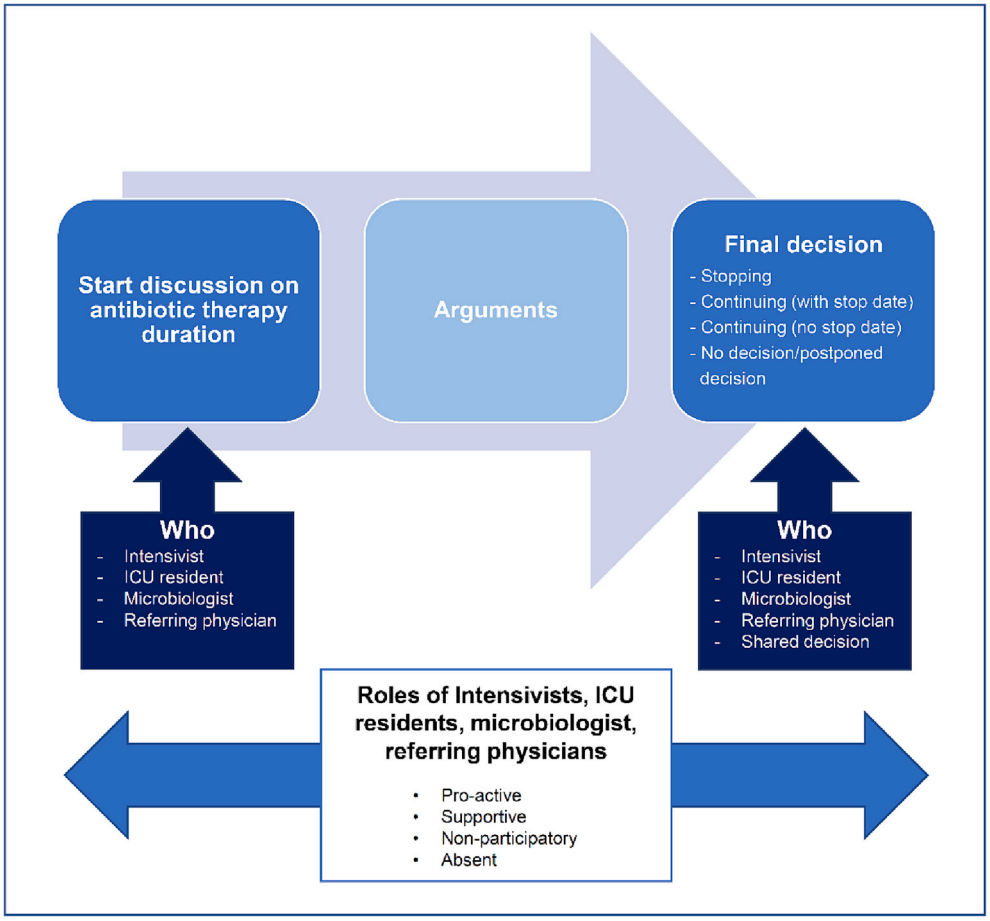

Fig. 1. Antibiotic therapy duration decision-making process.

3. Results

In total, 60 MDMs were observed (spanning 53 h and 11 min). Eight of the 60 MDMs were excluded from the analysis because duration of antibiotic therapy was not discussed. Eventually, 121 relevant text fragments (decision-making moments) on duration of antibiotic therapy were extracted from the transcripts and analyzed.

3.1. Characteristics of the MDMs

The MDMs varied in terms of setting, duration, participants and attending disciplines (Table 1). The MDMs had a mean duration of 53 min (range 22–100 min). In general, more participants and types of specialties attended the MDMs in the university hospitals compared to the non-university teaching hospitals, mostly because of the presence of more intensivists, junior residents and referring physicians. A clinical microbiologist was present during all MDMs in all hospitals. ICU nurses were present during the MDMs in the non-academic hospitals but not in the academic hospitals. A clinical pharmacist was only present during the MDMs in hospital 3, on average twice weekly. Most of the observed meetings, except the ones from hospital 4, had a somewhat similar structure, starting with the general introduction of the patient by an ICU resident, using the ABCDE method (A: airway, B: breathing, C: circulation, D: disability, E: Exposure). Infection and antimicrobial use were usually discussed within the E section. In hospital 4, a clinical problem-oriented approach was used in patient discussions.

3.2. Decision-making process

We analyzed 121 discussions about antibiotic therapy duration. The discussion was most often initiated by intensivists (45.5%), followed by clinical microbiologists (28.1%) and ICU residents (24.8%). Once (0.8%), a referring infectious disease physician started the discussion and once a clinical pharmacist (0.8%) (Fig. 2a).

In 24.8% of the discussions, it was decided to stop antibiotics, in 37.2% the stop date was determined, while in 20.7% antibiotics were continued without a specific end date. No decision was made at all in 9.1% and in the remaining 7.4% the final decision was unclear (Fig. 2b).

The final decision was mostly determined by the intensivists (35.5%), followed by the clinical microbiologist (22.3%), but only rarely by ICU residents (4.1%) or referring physicians (1.7%). In 28.9% of the discussions on antibiotic therapy duration, there was multidisciplinary shared decision-making. We found clear differences between hospitals. In hospital 1, duration of antibiotic therapy was often determined by the clinical microbiologist, while in the other 3 hospitals intensivists were most dominant in the decision-making process. Multidisciplinary shared decision-making was almost twice as common in hospital 3 compared to the other hospitals and was lowest in hospital 4. Hospital 4 had the highest percentage where no clear decision regarding therapy duration was made (29%) (Fig. 2c).

Fig. 2d shows the role of the different healthcare professionals during the antibiotic decision-making process. Intensivists pro-actively participated in 84.3% of discussions, while clinical microbiologists were pro-actively involved in 76% and ICU residents in 44.6%. Referring physicians were mostly absent (57%) or did not participate in the decision-making process (25.6%). ICU nurses were not involved in discussions about antibiotic therapy duration.

Table 1
Characteristics of the participating hospitals, intensive care units and MDMs.

Characteristics	Hospital 1	Hospital 2	Hospital 3	Hospital 4
Hospital characteristics				
Hospital type	Academic	Non-academic teaching	Non-academic teaching	Academic
Prescribing system	Electronic	Electronic	Electronic	Electronic
ICU characteristics				
ICU type	Combined medical and non-medical	Combined medical and non-medical	Combined medical and non-medical	Combined medical and non-medical
Number of ICU beds operational	34	15	20	24
Yearly number of ICU admissions	2481	659	1339	2000
Admission type				
Medical	42%	82.40%	85%	42.80%
Surgical (emergency)	14.60%	7.10%	6.30%	15.60%
Surgical (planned)	43.10%	10.40%	8.70%	41.60%
Other	0.30%	0.20%	0%	0%
MDM characteristics				
Days of MDMs	Monday-Friday afternoon	Monday-Friday afternoon	Monday-Friday afternoon	Monday-Friday afternoon
Mean duration of MDMs in minutes (range)	71 (45–100)	38 (31–52)	43 (22–68)	61 (40–83)
Number of intensivists per MDM	5	2	3	6
Clinical microbiologists present	Yes	Yes	Yes	Yes
ICU nurses present	No	Yes	Yes	No
Clinical pharmacists present	No	No	Yes (3 times per week)	No

3.3. Argument types

Thirteen categories of arguments involved in decision-making regarding stopping or continuing antibiotic therapy could be identified. Most frequently arguments from the intensivist related to (1) the clinical status of the patient, followed by (2) the uncertainty regarding whether a patient actually has an infection or whether he/she was only colonized with micro-organisms and (3) source control. Clinical microbiologists, on the other hand, based their arguments on (1) the culture results, followed by (2) guidelines and (3) source control. See Additional file 3 for all categories with quotation examples. Intensivists of all four hospitals used the same type of arguments to determine the duration of antibiotic therapy, whereas arguments used by the clinical microbiologist varied more. In hospital 2, for example, microbiologists frequently based their arguments on guidelines, but not at all on source control, whereas this was inverse for hospital 1. A microbiologist from hospital 3 also used arguments based on the clinical status of the patient, while this was less often the case for the other hospitals.

4. Discussion

This study provides valuable insight into the decision-making process of antibiotic therapy duration in intensive care patients. In about a third of cases, the ultimate decision on antibiotic therapy duration was the result of multidisciplinary shared decision-making in the MDM. Determining the duration of antibiotic therapy was a senior-level decision in which the intensivist and the clinical microbiologists were most involved, while ICU residents and referring physicians played a limited role in the decision-making process. When determining the duration of antibiotic therapy in ICU patients, intensivists mostly focus on the clinical status of the patients while microbiologists mostly use arguments based on culture results.

Decision-making in critical care is complex, and collaboration between the ICU team and other specialties is key to providing the best care for patients [16]. In our study, in 30% of the discussions, the decision about antibiotic therapy duration was a multidisciplinary shared-decision. If it was not a multidisciplinary shared-decision, the decision was predominantly made by the intensivist (35.5% of the discussions). Even though ICU residents had a supportive role (e.g., by introducing the patient history, describing the clinical status and current antibiotic therapy) they were often not involved in taking decisions. Moreover, in almost a third of the discussions observed, they did not play any role. Previous studies show that residents find it challenging to determine therapy duration and they are often not expected to make such decisions [29,30]. Encouraging residents to take an active role in the practical side of decision-making can have several benefits, such as improving the quality of the decisions, accelerating their learning curve, and better preparing them for future responsibilities [31]. One way to achieve this is to involve them in providing structure to MDM by giving them specific tasks, such as bringing up the possibility of stopping antibiotic therapy if it has not been mentioned, verifying prior decisions, and summarizing newly made decisions. This approach can help increase their confidence in making informed decisions regarding the duration of antibiotic therapy and improve their overall understanding of appropriate antibiotic use.

We observed that antibiotic therapy duration was not discussed during every MDM (8 out of 60 MDMs were excluded from this study for this reason). Moreover, in 20.7% of the discussions, antibiotics were continued without agreeing on a specific end-date. Though the required duration of therapy is not always clear at the start of therapy (e.g., because diagnosis is unclear), making a clear plan for future decision-making, while evaluating this daily might help prevent forgetting to talk about it initially [31,32]. Furthermore, in 9.1% of the discussions the decision was postponed because consultation with other healthcare professionals, not present at the MDM, was deemed necessary. Referring physicians were absent during almost 60% of discussions, and if they were present, they were mostly represented by junior residents and were rarely involved in the decision-making regarding antibiotic therapy duration. This is unfortunate as referring physicians often have valuable information necessary to determine therapy duration (e.g., information on appropriateness of source control). Lastly, in 7.4% of all discussions on antibiotic therapy durations, the final decision was “unclear”. Also, it was not always apparent during discussions how long patients had been receiving antibiotics, and what had been previously discussed and decided. Clear communication and documentation are essential for the quality and functioning of the MDMs [31], improves antibiotic prescribing [33] and might prevent antibiotics to be unnecessarily continued.

This study highlights the crucial role of clinical microbiologists in the decision-making process for determining the duration of antibiotic therapy in the Netherlands. The presence of microbiologists during MDMs was consistently observed, with a high pro-active participation rate (76% of the discussions). In almost a third of the discussions, microbiologists initiated the conversation about antibiotic therapy duration, demonstrating their proactive approach. Multidisciplinary shared

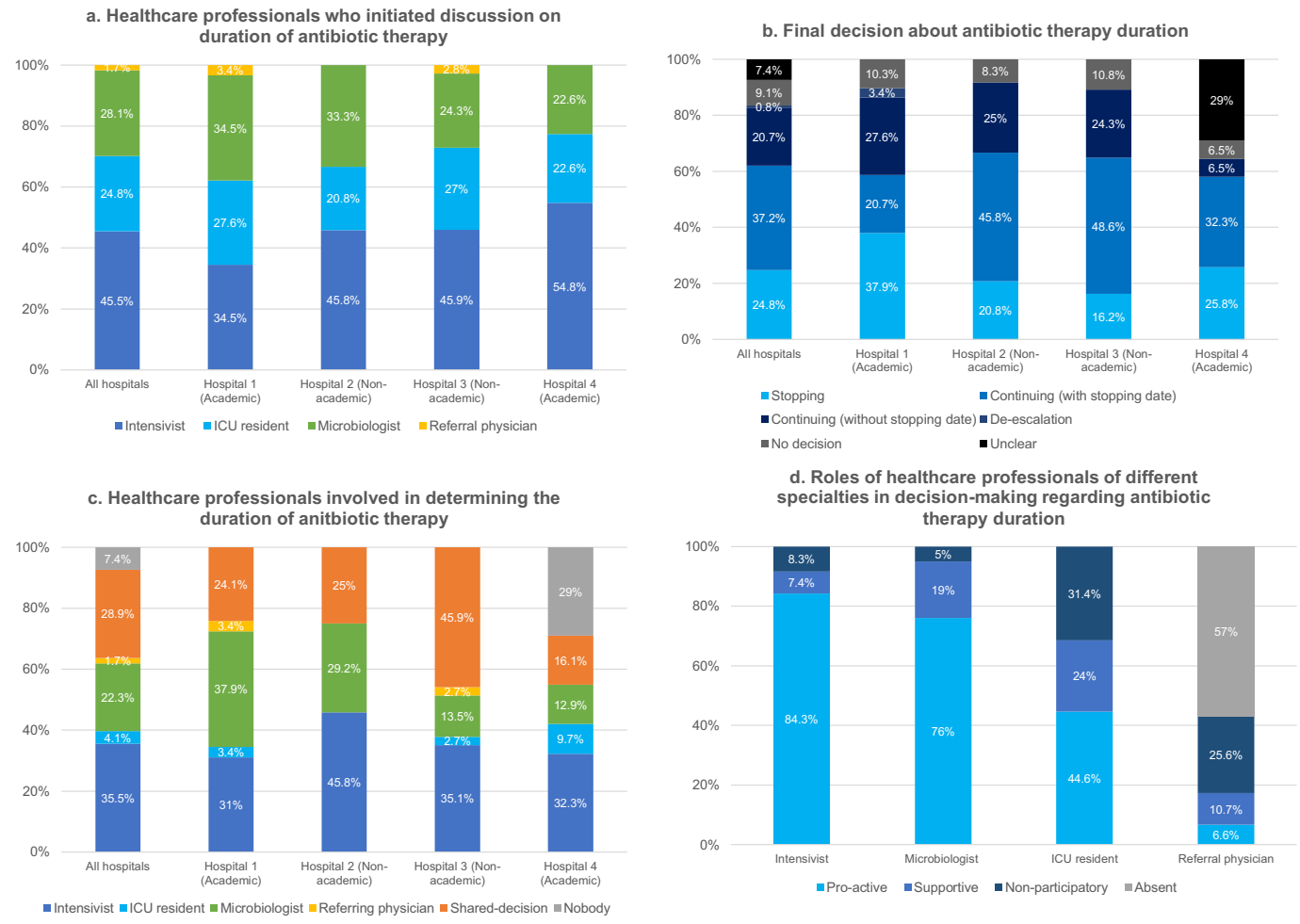

Fig. 2. Results of the antibiotic decision-making process.

decision-making mainly involved the intensivist and clinical microbiologist. In cases where the decision was not classified as a shared-decision, arguments presented by the microbiologist prompted the decision in 22% of the discussions, second only to the intensivist (36%). Earlier studies showed that daily presence of microbiologists was found to be valuable to intensivists and contributed to better antimicrobial practices through a close collaboration between the two specialties [15,18,34,35]. Overall, these findings underscore the importance of involving microbiologists in the antibiotic in the decision-making process.

Despite the important role of the clinical microbiologist in the decision-making process, their advice is not always followed. Intensivists may find it challenging to follow the recommendations of clinical microbiologists, as they may have concerns that the microbiologists' advice is based on incomplete patient information, since microbiologists typically do not directly examine their patients [15]. There also seems to be a difference in prioritization between the specialties: where intensivists are primarily committed to patient outcomes, microbiologists may exercise a broader perspective e.g., on guidelines, culture results or on the ecological effects of antibiotic overuse on the development of AMR. Healthcare professionals who need to make quick decisions or rely on intuition seem to prefer the immediate possible benefits of antibiotics for their patients (i.e., perceiving the necessity for prescribing 'as a means of protecting the patient') over outcomes such as AMR affecting future patients, and prefer taking action over inaction (i.e., giving antibiotics rather than not giving antibiotics) [15,36]. This difference in prioritization between intensivists and microbiologist, however, is not necessarily detrimental, as long as solid arguments are shared openly and shared decision-making takes place weighing all options.

Improving care standards while balancing adequate antibiotic use with stewardship principles in ICUs is a challenge [37]. Stewardship initiatives targeted at raising AMR awareness are likely to be less successful to improve antibiotic prescribing, compared to interventions evaluating intensivists' concerns when making decisions for their patients [15]. Rather than providing intensivists with generic AMR-related information, antimicrobial stewards like the clinical microbiologist should provide arguments that increase physicians' concerns about potential immediate risks to the patient and reduce the intensivists' perception for the need to continue antibiotics. Regular engagement of dedicated microbiologists with intensivists, while taking part in occasional bedside rounds, will make it easier for microbiologists to gain consistent exposure to the clinical difficulties intensivists face in the ICU. This will help the microbiologists to develop their "integrative consultation abilities" [18], which in the end, might lead to an improvement in the antibiotic therapy duration decision-making process.

To our knowledge, there is currently no evidence in the literature regarding the direct impact of MDMs on clinical patient outcomes (related to antibiotic use). However, various studies have explored the impact of MDMs on the quality of decision-making. A systematic review of interprofessional shared decision-making in the ICU suggested that clinicians should consider adopting an interprofessional model to facilitate collaborative decision-making and information exchange [16]. Similarly, studies in the field of infectious diseases have emphasized the importance of MDMs in facilitating clinical decision-making [38,39]. As such, improving the decision-making process for antibiotic therapy duration during MDMs represents a promising stewardship intervention.

Based on the findings of this study, several recommendations have been developed to improve this decision-making process during MDMs in the ICU. These recommendations are shown in Box 1.

4.1. Future directions

Despite evidence supporting shorter duration of antibiotic therapy in the ICU, prolonged use remains a common prescribing practice. To bridge this gap and improve stewardship interventions, it is first of all important to focus on improving the decision-making process in MDMs regarding antibiotic therapy duration in the ICU, for which we provide recommendations in Box 1. In addition, gaining a better understanding of the key drivers behind prescribing behavior is essential. Building on the knowledge of the decision-making process and the involved "key players" gained with this study, future studies should focus on identifying the determinants (barriers and facilitators) of appropriate/recommended antibiotic therapy duration in the ICU. By exploring why antibiotics are continued for longer than recommended in guidelines, targeted quality improvement AMS interventions can be designed to reduce the duration of antibiotic therapy in the ICU setting.

4.2. Strengths and limitations

This is the first study using direct observations to study the decision-making process regarding antibiotic therapy duration during MDMs in ICUs. The advantages of this type of study are that we were able to observe real-life patient-related and healthcare professional-related situations in the ICU and that we could directly observe the arguments used by the healthcare professionals in a real-life setting. We were able to identify who ultimately makes the decisions about duration of antibiotic therapy, which helped us identify a target group for AMS. This study provides an ideal starting point for future interviews in a mixed-method approach where real-life examples can be used, rather than fictitious cases.

This study does have limitations. First, we only looked at the decision-making during the MDMs, therefore we were not able to capture decisions outside the MDMs. However, stopping antibiotics in the Netherlands is a decision that is almost universally taken during MDMs. Second, we observed the MDMs at set moments and did not follow up on specific patient cases, changes in decision-making over time could therefore not be captured. Third, we only studied prescribing in Dutch ICUs from four relatively large hospitals. Variations among hospitals were observed and it is anticipated that these variations will be even greater in diverse hospital settings and across different countries. Fourth, we did not evaluate the adherence to guidelines or clinical viability of the decision to stop antibiotics or determine therapy duration. However, it was our intention to study the process of decision-making and not the appropriateness of these decisions.

5. Conclusion

Decision-making regarding antibiotic therapy duration in the ICU is a complex process, mainly involving intensivists and clinical microbiologists, with intensivists using clinical status arguments and clinical microbiologists relying on diagnostic results. Daily ICU MDMs do provide an excellent opportunity to discuss and determine the duration of antibiotic therapy. To optimize the decision-making process, structured discussions, involvement of relevant specialties, and clear communication and documentation of the antibiotic plan are recommended.

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Box 1
Recommendations to optimize decision-making about duration of antibiotic therapy in the ICU

Advice for the intensivists:

- Make 'antibiotic therapy duration' an essential part of the daily structured patient discussion
- Develop an initial antibiotic plan for patients receiving antibiotics, even when it is not yet possible to directly determine the exact duration of antibiotic therapy, and evaluate this regularly
- Ensure that each specialty involved (especially referring physicians) attends the MDMs
- Establish an open/safe environment where everyone feels free to participate in the discussion
- Involve ICU residents in discussions on antibiotic therapy duration by giving them a role in the decision-making process (preparing information, bringing up stopping, verifying and documenting decisions). This benefits their learning, teaches them about the importance of responsible antibiotic use, and prepares them for future decisions.
- Ensure clear communication and documentation of the decisions made. The role of the ICU residents could, for example be extended to ensure clear communication ("so what have we decided on the duration of therapy?") and documentation in the patient files.

Advice for the clinical microbiologists (or other antibiotic stewards):

- Engage in clinical bedside activities with intensivists, to create a better understanding of the clinical challenges that intensivists are faced with in the ICU to develop "integrative consultation abilities"
- While giving arguments based on your expertise, also provide arguments that are in line with the concerns of the intensivists

Advice for the referring physicians:

- Attend the daily MDMs (and do not only send the residents, but also senior physicians)
- Participate actively in the discussion as you have valuable information necessary to determine the duration of antibiotic therapy (e.g., information on the level of source control)

The funders had no role in study design, data collection, data analysis, decision to publish or preparation of the manuscript.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Robin Janssen and Jeroen Schouten. The first draft of the manuscript was written by Robin Janssen and Jeroen Schouten and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of data

The data collected and analyzed during the current study can be made available from the corresponding author on reasonable request.

Declaration of Competing Interest

The authors have no financial interest or any other conflict of interest to declare.

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Appendix A. Supplementary data

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