IMPROVING THE APPROPRIATENESS OF INTRAVENOUS CEFTRIAXONE USE IN TUANKU AMPUAN NAJIHAH HOSPITAL

Marzirah Ibrahim[1], Kong Lai San[1], Dr Fauzi Azizan Abd Aziz[2], Clara Christian Ramanathan[1], Wan Ruzana Wan Jusoh[1], Ong Yin Sin[1]

[1]Pharmacy Department, Tuanku Ampuan Najihah Hospital, Negeri Sembilan State Health Department,
Ministry of Health Malaysia

[2]Medical Department, Tuanku Ampuan Najihah Hospital, Negeri Sembilan State Health Department,
Ministry of Health Malaysia

Corresponding Author: Kong Lai San
Email: laisan_kong@hotmail.com

Abstract

Appropriateness of antimicrobial therapy is defined as correct decision, correct choice, and correct use of antimicrobials. Overuse and inappropriate use of intravenous ceftriaxone, a third-generation cephalosporin, will increase the resistance towards it, hence the emergence of multidrug-resistant organisms. A verification study observed that the appropriateness of intravenous ceftriaxone usage in Tuanku Ampuan Najihah Hospital (HTAN) was 21.4% in the pre-intervention phase. This study aimed to improve the appropriate use of intravenous ceftriaxone in HTAN. A quality improvement study was conducted in medical, orthopaedic, and surgical wards from 2015 to 2018. All patients who were on intravenous ceftriaxone for pneumonia treatment were recruited during the antibiotic round, except for paediatric patients. Appropriate use of intravenous ceftriaxone was measured using the indicator of the percentage of appropriate intravenous ceftriaxone cases, with a standard of more than 50% based on consensus within the AMS team members. Contributing factors of low appropriateness were no indication of antibiotic (45.46%), no de-escalation or intravenous-to-oral switch (27.27%), and inappropriate choice or duration of antibiotic (27.27%). Three intervention cycles were conducted via Antimicrobial Stewardship Programme (AMS), with each cycle lasted for at least six months. Strategies implemented were the addition of intravenous ceftriaxone into the existing Antibiotic Request Form and fortnightly antibiotic rounds to assess the prescribing of intravenous ceftriaxone, renewal of Antibiotic Request Form to be more user friendly to aid the monitoring and feedback part, continuous teaching sessions, and dialogue with pharmacy staff and nurses to ensure strict adherence to new standard operating procedures. Appropriateness of intravenous ceftriaxone use was increased from 21.4% (verification study) to 54.55% (re-evaluation). The ABNA was reduced to –4.55 and ceftriaxone consumption was reduced from 90.67 DDD/1000 patient-days (January–June 2015) to 23.78 DDD/1000 patient-days (January–December 2018). Overall, multidisciplinary collaboration via AMS has successfully improved the appropriateness of intravenous ceftriaxone use in HTAN.

KEYWORDS: Ceftriaxone, Appropriate use, Quality improvement study

Problem

Inappropriate use of antibiotic is one of the factors leading to the development and spread of antibiotic resistance (1). Antibiotic resistance is a global threat to the human health because it can increase morbidity, mortality, and subsequently the economic burden (2). In Malaysia, the first National Antibiotic Guideline (NAG) published in 2008 recommended intravenous ceftriaxone as an example of third-generation cephalosporin to be used in moderate and severe community-acquired pneumonia (CAP) not requiring mechanical ventilation, and placed before the choice of other preferred antibiotics, which was the beta-lactam/beta-lactamase inhibitors, such as amoxicillin/clavulanate or ampicillin/sulbactam (3). However, starting from the second edition of NAG released in 2014, intravenous ceftriaxone was changed from the preferred choice to the alternative choice (4).

Ceftriaxone, a third-generation parenteral cephalosporin, is a commonly prescribed broad-spectrum antibiotic in the hospitals (4–10). Ceftriaxone was found to be easily overused and misused by the physicians (11,12). The extensive use of ceftriaxone empirically might be due to its beneficial properties of highly protein-bound and longer half-life, which allows for once-daily administration, and no renal and liver dose adjustment as a result of its elimination through the biliary tract, as compared with the narrower spectrum penicillin group of antibiotics, such as amoxicillin/clavulanate and ampicillin/sulbactam (13).

HTAN, a district hospital, is the second-largest government hospital in Negeri Sembilan. It consists of 314 beds to serve the Kuala Pilah population of approximately 83,000. It provides several inpatient and outpatient specialist services, which include Medical, Paediatric, Surgical, Orthopaedic, Anaesthetic, Obstetrics and Gynaecology, Ophthalmology, Psychiatry, Dental, Dermatology, Emergency and Trauma, and Ear, Nose, and Throat (ENT).

The annual surveillance of adult inpatient parenteral antibiotic usage is currently monitored in a total of 91 hospitals, including 44 Ministry of Health hospitals (14 state hospitals, 26 hospitals with major specialist and four hospitals with minor specialist), three Ministry of Education hospitals, three Ministry of Defence hospitals, and 41 private hospitals in Malaysia. An upper limit (without lower limit) will be calculated from the yearly antibiotic usage data submitted by all involved hospitals. A hospital will be labelled as an outlier if its antibiotic usage exceeds the upper limit of yearly national ceftriaxone usage.

According to the National Surveillance on Antibiotic Utilisation, Ministry of Health (14), the ceftriaxone usage in HTAN (in Defined Daily Dose per 1000 patient-days, DDD/1000PD) was initially noted to be 33.28 (2009) and 33.9 (2010). Subsequently, the figure increased to 54.72 (2011), 87.02 (2012), 92.38 (2013) and 93.29 (2014). The ceftriaxone usage is the highest among all Ministry of Health hospitals under national surveillance of antibiotic usage in Malaysia from 2012 to 2014, thus making HTAN as an outlier hospital. This triggered the alarm to inspect on this serious problem. A verification study conducted between January–June 2015 further confirmed this issue as ceftriaxone usage in HTAN was 90.67 DDD/1000PD and its appropriateness was only 21.4%. Therefore, this study aimed to improve the appropriateness of intravenous ceftriaxone usage to more than 50%.

Antimicrobial Stewardship (AMS) program aims to optimise prudent use of antimicrobials, and it can be led by either infectious disease (ID) physicians, clinical microbiologist experts or physicians with interest (15). As ID physician and clinical microbiologist were not available in HTAN, AMS team HTAN was led by a senior medical consultant with interest in ID. The team was established in December 2014, with AMS activities implemented in HTAN starting January 2015. After the introduction of AMS in 2015, the awareness of using antibiotic appropriately and judiciously had gradually improved.

Background

Inappropriateness of antimicrobial therapy is defined as incorrect decision (no antimicrobial is prescribed for the treatment or prophylaxis of infection, or antimicrobial is prescribed in the absence of infection), incorrect choice (divergence from guideline), and incorrect use (inappropriate dosage, timing, route of administration, and duration of therapy) (16). Numerous studies have been conducted in the past to reduce ceftriaxone consumption and to review the appropriateness of ceftriaxone use. The appropriateness of ceftriaxone use has been reported to be as low as 19.8% to as high as 93% in various studies (6,9,11,12,17,18).

Findings from an internal audit conducted in HTAN (January–June 2015) found that majority of the ceftriaxone cases in HTAN was prescribed for the treatment of pneumonia (58%), followed by leptospirosis (11%), and meningoencephalitis (7%), all of which were in line with other reported studies (9,11,12). Studies have shown that there was no difference in outcome between patients being treated with ceftriaxone or amoxicillin/clavulanate in CAP (19,20). Instead of ceftriaxone, antibiotics with narrower spectrum and similar effectiveness, such as β-lactam/β-lactamase inhibitor combinations, can be used to minimise the development of resistance towards ceftriaxone (17,21).

The common reported causes of inappropriate ceftriaxone use were inappropriate duration of therapy and incorrect decision (absence of infection or ceftriaxone is not indicated) (8,9,12,22). A study observed that 50.4% of the antibiotic prescriptions were found to be non-compliant with the hospital antibiotic policy, as antibiotics were prescribed based on doctors' experiences (7). Other factors contributing to inappropriate antibiotic prescribing were fear of missing an infection that would cause deterioration in patient's condition, diagnostic uncertainty, inadequate training, knowledge or awareness on updated guidelines, lack of time to review antibiotic choice, lack of outcome feedback, and lack of awareness on antimicrobial resistance (23-27). Studies also showed that increased ceftriaxone usage will lead to increased resistance towards ceftriaxone, and thus, an increased emergence of extended-spectrum beta-lactamase (ESBL) producing organisms (5,17,28). Reduced third-generation cephalosporins would reduce the acquisition of ESBL strains (29).

AMS strategies have been recommended to improve the justified use of antibiotics in the hospitals (30,31). Among the AMS interventions that have been evaluated to be effective in improving the appropriateness of antibiotic prescribing were persuasion through effective communication, such as recommendations by experts such as AMS leader or ID physician, audit and feedback to prescribers, and increasing compliance to guidelines or policy through educational events (32,33). One study had shown improvement in antibiotics appropriateness through the preparation of evidence-based guidelines, creation of new workflow, promotion, and education of staff on the guidelines and workflow (34).

In addition, few studies had successfully reduced ceftriaxone consumption through restriction of ceftriaxone prescription, for example restricting its prescription to be initiated by specialists only and ceftriaxone continuation after 72 hours must be approved by an ID physician, containment of antimicrobial policy in the induction program for all new doctors, continuous educational program for doctors on the use of narrower spectrum alternative antibiotic for empirical treatment of infection, and disallowing wards except the emergency department and intensive care unit to keep ceftriaxone (35,36). In general, periodic audit and monitoring on the prescribing pattern and rational use of antibiotics should be conducted to improve the appropriateness of prescribing practice (6,7).

Measurement

The general objective of this study was to improve the appropriateness of intravenous ceftriaxone use in HTAN. The appropriateness was measured using an indicator of the percentage of appropriate intravenous ceftriaxone injection cases using the following formula:

$$\text{Percentage of appropriate ceftriaxone injection cases} = \frac{\text{Number of appropriate uses of intravenous ceftriaxone cases}}{\text{Total intravenous ceftriaxone cases during antibiotic round}}$$

The appropriateness (choice, dose, frequency, duration, and indication) was determined by the AMS leader during the antibiotic round. Based on the literature search, there was no minimum percentage on the appropriate use of antibiotics set in any country. The appropriateness of ceftriaxone use has been reported to be as low as 19.8% to as high as 93% in various studies (6,9,11,12,17,18). Hence, the standard was set to be more than 50% based on consensus among the AMS team members.

This quality improvement study was conducted in medical, surgical and orthopaedic wards in HTAN, as these were the main users of intravenous ceftriaxone in the past few years. Study samples were recruited weekly or fortnightly during antibiotic rounds by the AMS team. Inclusion criterion was that all patients receiving intravenous ceftriaxone for the treatment of pneumonia, as it was mainly prescribed for pneumonia based on the result of internal audit (58%). Paediatric patients were excluded because the DDD methodology does not apply to them owing to the different doses based on age and body weight used in them (35). As all intravenous ceftriaxone cases encountered during the antibiotic rounds were recruited, a universal sampling method was applied.

Concurrently, intravenous ceftriaxone consumption was monitored to observe any reduction when the appropriateness increases. Ceftriaxone consumption was measured in DDD/1000PD based on the formula from National Surveillance on Antibiotic Utilisation (14), as shown below:

$$\text{No. of DDD per year} = \frac{\text{Total ceftriaxone injection usage (Grams) for adult inpatient in a year}}{\text{DDD (from World Health Organisation)}}$$

$$\text{DDD/1000PD} = \frac{\text{No. of DDD per year}}{\text{Total number of days adult patient warded for that particular year}} \times 1000$$

In order to calculate intravenous ceftriaxone consumption, intravenous ceftriaxone usage in vials was collected from the inpatient pharmacy and data of the number of patient-days for adult inpatients was obtained from the medical record unit. Intravenous ceftriaxone consumption was expressed in a 6-monthly DDD/1000PD data to allow for sufficient time to observe the effect of interventions. As HTAN is not a fully computerised hospital, it was not feasible to collect data for intravenous ceftriaxone usage for pneumonia only. Therefore, total intravenous ceftriaxone consumption instead of intravenous ceftriaxone consumption for pneumonia was used in this study.

In April 2015, a simple audit on 14 cases was conducted to identify the contributing factors of inappropriate use of intravenous ceftriaxone. It was conducted during the antibiotic rounds led by a medical consultant as the leader of the AMS team to determine the appropriateness of intravenous ceftriaxone prescribed in the ward and the reasons for inappropriate intravenous ceftriaxone cases. Simultaneously, a survey was also conducted, where a self-administered questionnaire (Appendix 1) was distributed to a total of 18 doctors from the medical department, 11 pharmacists from the inpatient pharmacy, and ten pharmacists from the ward pharmacy to further identify factors that contribute to prescribing of intravenous ceftriaxone in pneumonia. Such factors are their decision to select antibiotic for CAP, perceptions on superiority of intravenous

ceftriaxone in CAP, willingness to de-escalate intravenous ceftriaxone, and challenges faced by pharmacists in intervening intravenous ceftriaxone prescriptions.

Initial Assessment of the Problem

The initial process of a care of intravenous antibiotic prescribing and supply was reviewed, and critical steps were identified (Figure 1). It was observed that the inappropriate use of intravenous ceftriaxone could be controlled at the steps of prescribing by doctors in the ward and supply of antibiotics by the pharmacy. Inappropriate use of intravenous ceftriaxone could be reduced by advising doctors to use alternative antibiotics according to the NAG for treatment of CAP during the prescribing step and withholding the supply of intravenous ceftriaxone by the pharmacy in the event of inappropriateness.

From the simple audit conducted in April 2015, it was observed that among the inappropriate intravenous ceftriaxone cases (11 out of 14 cases, 78.6%) identified, there were five cases (45.46%) of no indication of antibiotic (e.g., fluid overload instead of

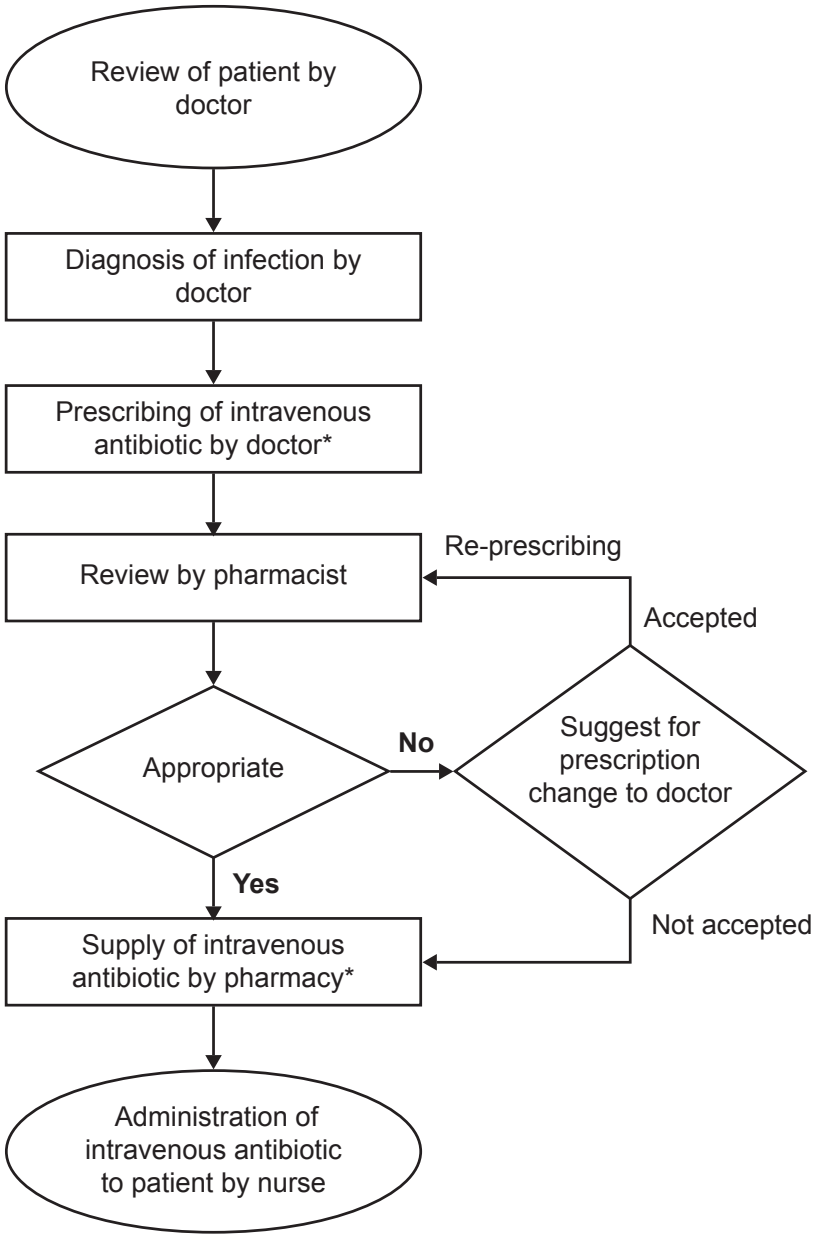

Figure 1: Initial process of care on prescribing, supplying, and administering intravenous antibiotic. (* indicates critical step)

pneumonia), three cases (27.27%) of no de-escalation (e.g., change of impression from covering for both leptospirosis and CAP to CAP only later on) or intravenous (IV)-to-oral switch as per guidelines and culture results (e.g., patients fulfilled the IV-to-oral switch criteria and could be discharged), and three cases (27.27%) of inappropriate choice (ceftriaxone is not the preferred choice for CAP) or duration of antibiotic (more than seven days in CAP treatment). Figure 2 illustrates the cause-effect analysis of the inappropriate use of intravenous ceftriaxone in HTAN.

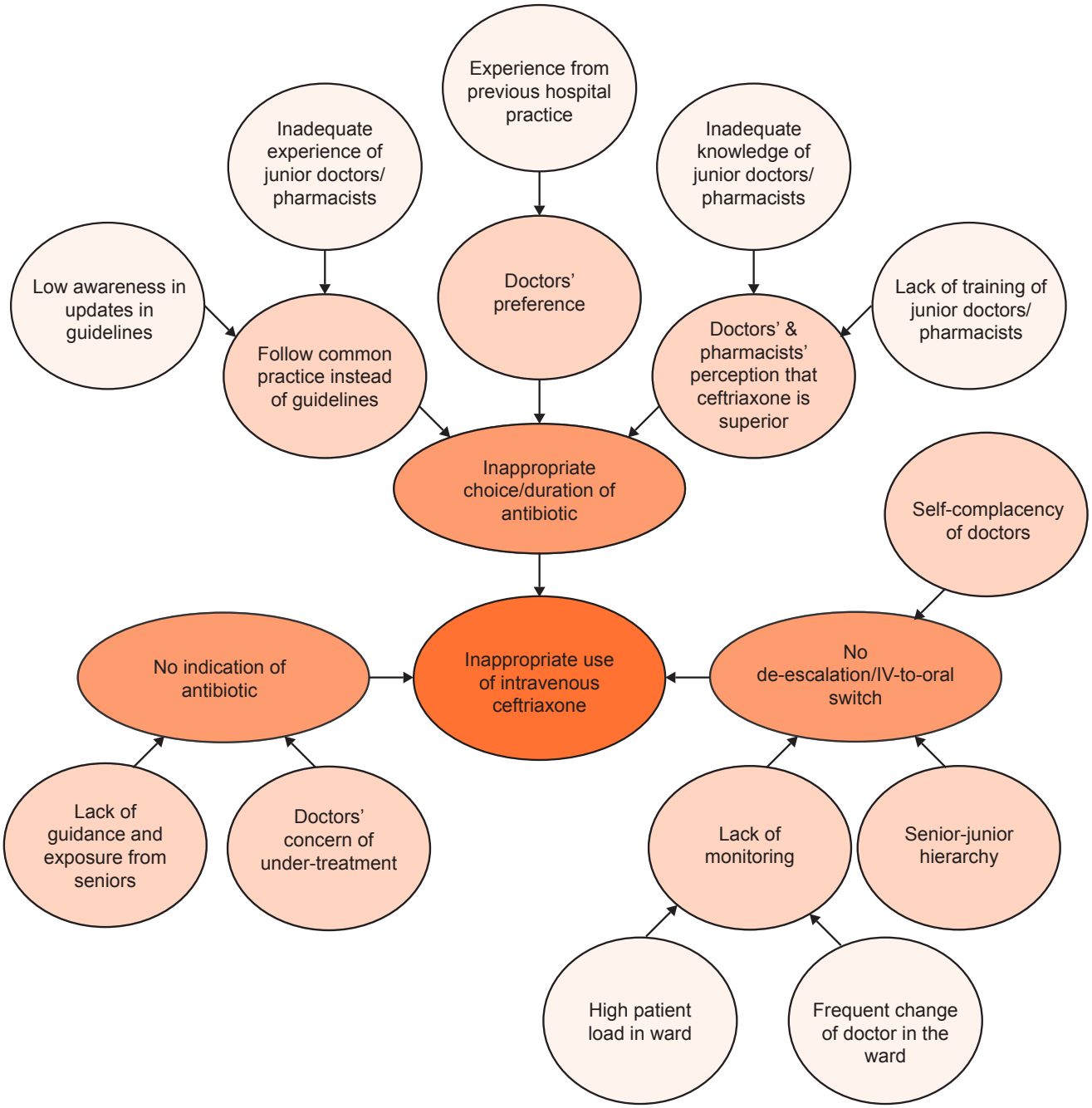

Figure 2: Cause-effect analysis chart of inappropriate use of intravenous ceftriaxone in HTAN.

The response rate for the survey conducted in April 2015 was 92.68%. The survey observed that 66.7% of the doctors would prescribe and 50% of the pharmacists would recommend antibiotic choice for CAP based on the common practice in the hospital rather than current guidelines even though they know that intravenous ceftriaxone is not superior than amoxicillin/clavulanate in treating CAP. The majority of the doctors would de-escalate intravenous ceftriaxone in clinically stable CAP patients (94.4%) and dare to de-escalate intravenous ceftriaxone started by their colleagues (61.1%). The majority of the pharmacists also answered that their suggestion to change intravenous ceftriaxone to alternative antibiotics was often accepted by doctors (70%). These highlighted that it was possible to change doctors' practice in prescribing intravenous ceftriaxone for CAP by implementing suitable strategies. Among the challenges mentioned by the pharmacists in intervening intravenous ceftriaxone prescriptions were lack of confidence in convincing doctors to de-escalate ceftriaxone and the preference of certain doctors to continue intravenous ceftriaxone despite the omission of cultural sensitivity (e.g., negative leptospirosis serology, penicillin-sensitive *Streptococcus spp*.), as doctors perceived no issue in continuing intravenous ceftriaxone or they were afraid that de-escalation would worsen patient's condition.

Strategy

Remedial measures were implemented in three 6-month cycles (Cycle 1: July–December 2015; Cycle 2: January–June 2016; Cycle 3: July–December 2016). Strategies in the previous cycles were continuously carried out in the following cycles throughout the study period. The success of remedial measures was evaluated between January–December 2017 and re-evaluated between January–December 2018 to ensure sustainability of interventions.

The Cycle 1 of intervention was conducted to tackle all the three contributing factors of antibiotic not indicated, inappropriate choice/duration of antibiotic and no de-escalation/IV-to-oral switch. Continuous teaching sessions for all specialists and medical officers, which focused on the medical discipline were conducted by the medical consultant, who was also the AMS team leader to inform and remind about the preferred antibiotic choice to treat CAP in the latest NAG, non-superiority of intravenous ceftriaxone in treating pneumonia and risk of increased resistance rate towards ceftriaxone. They were also advised to review patients from time-to-time to revise diagnosis and to de-escalate intravenous ceftriaxone to alternative or oral antibiotics. Similar continuous teaching sessions were also conducted by senior ward pharmacists to all wards and inpatient pharmacists.

A small increment in the appropriateness of intravenous ceftriaxone use was observed after Cycle 1 (from 21.4% between January–June 2015 to 33.33% between July–December 2015) and a small reduction in intravenous ceftriaxone consumption was also observed (from 93.29 between January–December 2014 to 79.44 between January–December 2015). Feedbacks received from the ward pharmacists and inpatient pharmacists where some doctors still prefer to prescribe intravenous ceftriaxone and were not keen to change their practice or not dare to de-escalate intravenous ceftriaxone started by colleagues or specialists. In addition, pharmacists were still facing challenges in intervening doctors for the intravenous ceftriaxone prescriptions, especially in the non-medical wards.

Hence, in Cycle 2 the intravenous ceftriaxone issue was listed as one of the focus of activities under the HTAN AMS team. First, the Antibiotic Request Form (Appendix 2) was required for all intravenous ceftriaxone prescriptions. Previously, this form was only applied to colistin, carbapenem, piperacillin/tazobactam and ceftazidime. This strategy was implemented to ensure that specialists play an important role in assessing and reviewing the need to prescribe or continue intravenous ceftriaxone, as the Antibiotic Request Form must be countersigned by the specialist said. The previous process of care was strengthened by adding a few important steps on Day 1 of antibiotic and 72 hours

after the initiation of antibiotic, as illustrated in Figure 3. Completion of Part A (for justification upon antibiotic initiation and countersign by a specialist) and Part B (to review patient after 72 hours of intravenous ceftriaxone initiation, trace pending cultures, writing reasons or justifications to continue, de-escalate or IV-to-oral-switch of ceftriaxone) in Antibiotic Request Form was emphasised. Intravenous ceftriaxone will not be supplied if the form is not countersigned by the specialist or incomplete after the time frame allowed (after 72 hours for Part B). These interventions also allowed the medical consultant to check the doctors' ceftriaxone prescribing practice from time-to-time through the Antibiotic Request Forms received in pharmacy and to remind the specialists during routine rounds to de-escalate or discontinue inappropriate use of intravenous ceftriaxone.

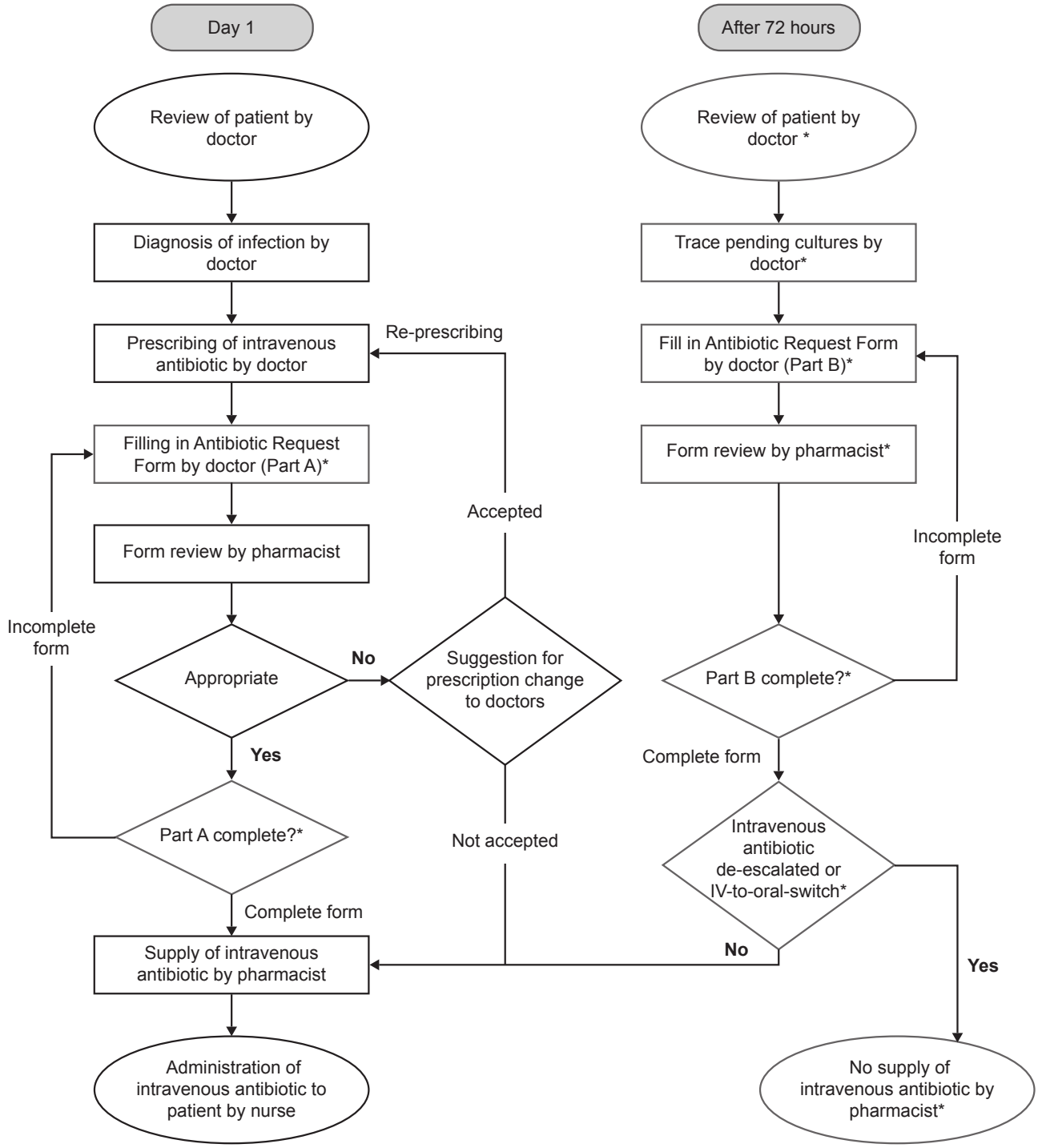

Figure 3: New process of care of prescribing, supplying and administering intravenous antibiotic. (* indicates critical step)

Secondly, all intravenous ceftriaxone cases in medical, orthopaedic and surgical wards were included into the fortnightly antibiotic round. Prior to this, only colistin, carbapenem, piperacillin/tazobactam and ceftazidime were included in the antibiotic round. The antibiotic rounds were led by a medical consultant who is the leader of the HTAN AMS team to assess the appropriateness of intravenous ceftriaxone, and to provide recommendations such as discontinue or de-escalate or IV-to-oral-switch of intravenous ceftriaxone.

Following the implementation of Cycle 2, intravenous ceftriaxone consumption was further reduced to 35.13 and the appropriateness was increased to 37.04% in January–June 2016. As it was understood that behavioural changes require time, the same strategies in both Cycle 1 and Cycle 2 were continued in Cycle 3. Further feedbacks regarding the Antibiotic Request Form were collected from multiple disciplines. One main issue was detected where some doctors, pharmacy staff and nurses were unaware of the requirement to complete Part B of the Antibiotic Request Form, or unsure of which part in the Part B to be filled in after 72 hours. This indicated that not all intravenous ceftriaxone prescribed was reviewed by doctors and pharmacy staff after 72 hours of initiation and it was still ongoing. Hence, Cycle 3 was implemented between July–December 2016, where strict adherence to the new process of care (filling in Antibiotic Request Forms) by doctors, nurses and pharmacy staff was enforced through continuous dialogues between the pharmacy and the nurses or doctors. In addition, the Antibiotic Request Form was revised and amended to be more user-friendly to all disciplines involved in order to ensure the form will be completed as required. In the revised form (Appendix 2), one column for empirical use and one column for definitive use of antibiotic were created to avoid confusion. After Cycle 3, the appropriateness of intravenous ceftriaxone was increased to 46.15%. As gradual behavioural changes were seen as time progress, implementation of existing strategies was improvised after Cycle 3 and carried out throughout the whole study period. Evaluation of intervention was done annually instead of 6-monthly in 2017 and 2018, as lesser intravenous ceftriaxone cases were encountered during antibiotic rounds due to reduced intravenous ceftriaxone consumption in the subsequent years.

Results

Following the implementation of remedial measures, the appropriateness of intravenous ceftriaxone use was observed to increase from 21.4% (three out of 14 cases in verification study) to 33.33% (two out of six cases), 37.04% (20 out of 54 cases), 46.15% (six out of thirteen cases), 50.00% (six out of twelves cases) and 54.55% (six out of eleven cases), with ABNA gap reduced to -4.55% (Figure 4). Intravenous ceftriaxone consumption was successfully reduced from 90.67 (verification study) to 23.78 (January–December 2018), as shown in Figure 5. HTAN is also no longer the high user of ceftriaxone since the year 2016 till 2019. To date, ceftriaxone consumption was maintained low throughout the years (10.91 in 2019 and 17.64 in 2020).

Lessons and Limitations

Strong teamwork between doctors, pharmacists, and nurses plays an essential role in ensuring the quality of antimicrobial management for patients of this study to reduce inappropriate antibiotic use. Multidisciplinary collaboration through AMS had successfully reduced ceftriaxone injection usage in HTAN. This is the strength of this study, where feedback from multiple disciplines was considered, especially during the implementation of the Antibiotic Request Form in Cycle 2 and Cycle 3. In addition, the Antibiotic Request Form together with the new process of care have been successfully introduced to cluster hospitals, Jempol Hospital and Tampin Hospital, since 2018 and 2019, respectively. The ceftriaxone consumption was reduced from 41.95 (2018) to 14.03 (2019) in Jempol Hospital and from 22.46 (2018) to 2.86 (2019) in Tampin

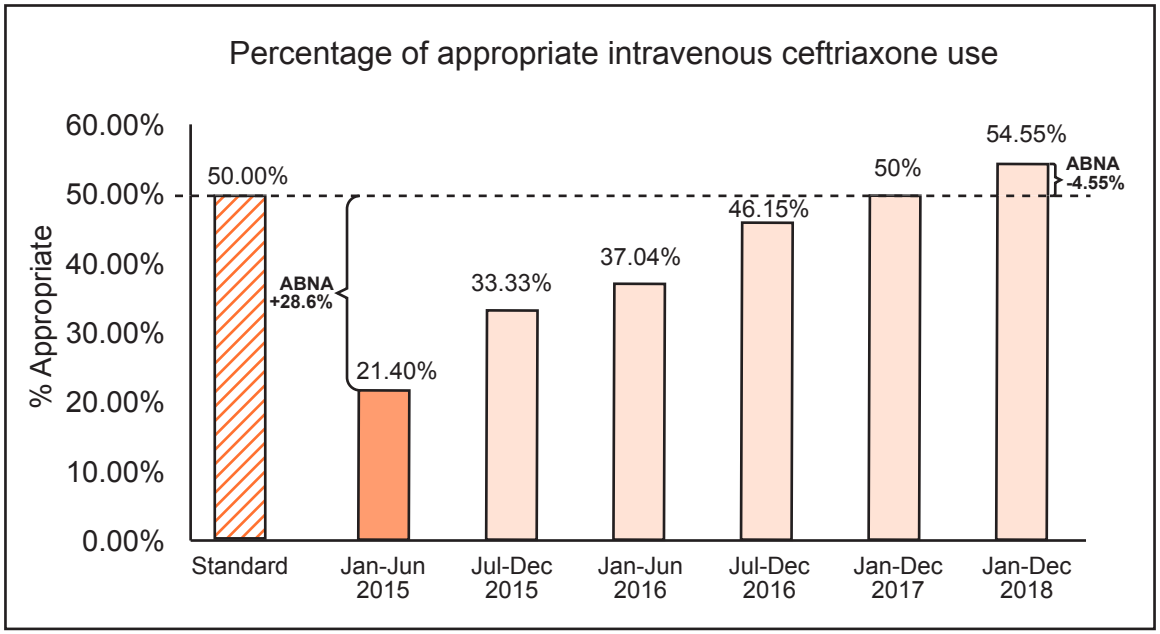

Figure 4: Trend of appropriate use of intravenous ceftriaxone in HTAN (ABNA analysis)

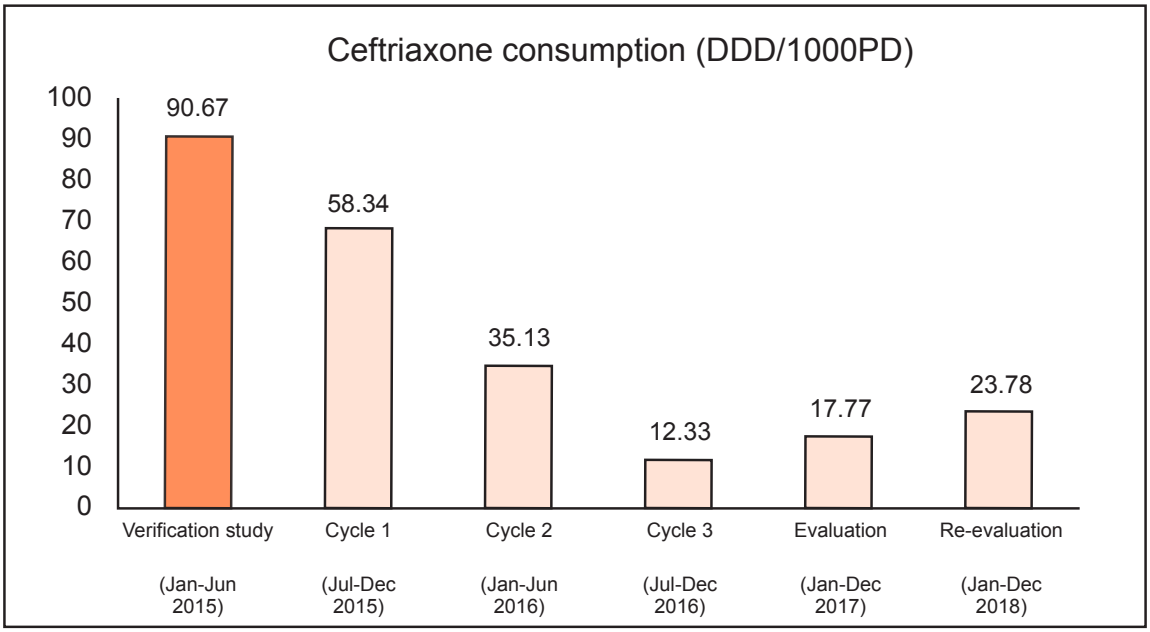

Figure 5: Trend of ceftriaxone consumption in HTAN

Hospital. These outcomes have further proven that the interventions to reduce intravenous ceftriaxone consumption are also effective in being adopted in hospitals without specialist. Appropriateness of ceftriaxone injection use could not be assessed in the cluster hospitals due to the unavailability of AMS rounds during the years mentioned.

There were few limitations in this study. First, the total intravenous ceftriaxone consumption instead of intravenous ceftriaxone consumption in pneumonia was used because of the difficulty to identify intravenous ceftriaxone consumption in pneumonia only in a non-computerised hospital such as HTAN. Secondly, the small up and down of the intravenous ceftriaxone usage during the evaluation phase and re-evaluation phases were likely due to the turnover of hospital staff, where doctors from other hospitals tend to prescribe ceftriaxone to patients with pneumonia. Although the influence on the results was minimal (as shown by ceftriaxone consumption observed to be sustainably low), but awareness should be created among the new staff regarding the use of ceftriaxone in CAP during the orientation before they start to work.

Conclusion and the Next Steps

Many studies had successfully improved the appropriateness of antibiotic use and reduce antibiotic consumption in order to slow down the development of antibiotic resistance. However, limited studies were available to describe in detail the efforts and processes to succeed. This study describes a feasible way to improve the appropriate ceftriaxone injection use and successfully and continuously reduce ceftriaxone injection consumption in hospitals without ID subspecialty through a multidisciplinary approach among essential role players (e.g., doctors, pharmacists, and nurses) in the process. In ensuring the sustainability of the outcome, the efforts of continuous teaching sessions, regular antibiotic rounds by the AMS team, continuous monitoring and enforcement of submission of Antibiotic Request Form are kept up-to-date. The strategies in this project have successfully been replicated to the other cluster hospitals to reduce ceftriaxone consumption. It is suggested that it is conducted in hospitals without ID subspecialty, preferably with a supportive AMS team.

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Conflict of Interest

None.

Funding

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Appendix 1

Questionnaire on Factors Contributing to Intravenous Ceftriaxone Prescribing in Pneumonia

Survey questions for doctors

1. Is your decision of choosing antibiotics for CAP based on:
   (a) common practice at your hospital, or
   (b) based on current guideline?

2. Do you think that ceftriaxone (Rocephine) is superior than amoxicillin/clavulanate (Augmentin) in treating CAP? (Yes/No)

3. Will you de-escalate IV ceftriaxone for CAP if it is started by your colleagues? (Yes/No)

4. Will you de-escalate IV ceftriaxone in clinically stable CAP patients even though blood culture is not back yet? (Yes/No)

5. If yes (for Question 4), what antibiotics will you de-escalate to? (open-ended question)

Survey questions for pharmacists

1. Is your suggestion of antibiotics for CAP based on:
   (a) common practice at your hospital, or
   (b) based on current guideline?

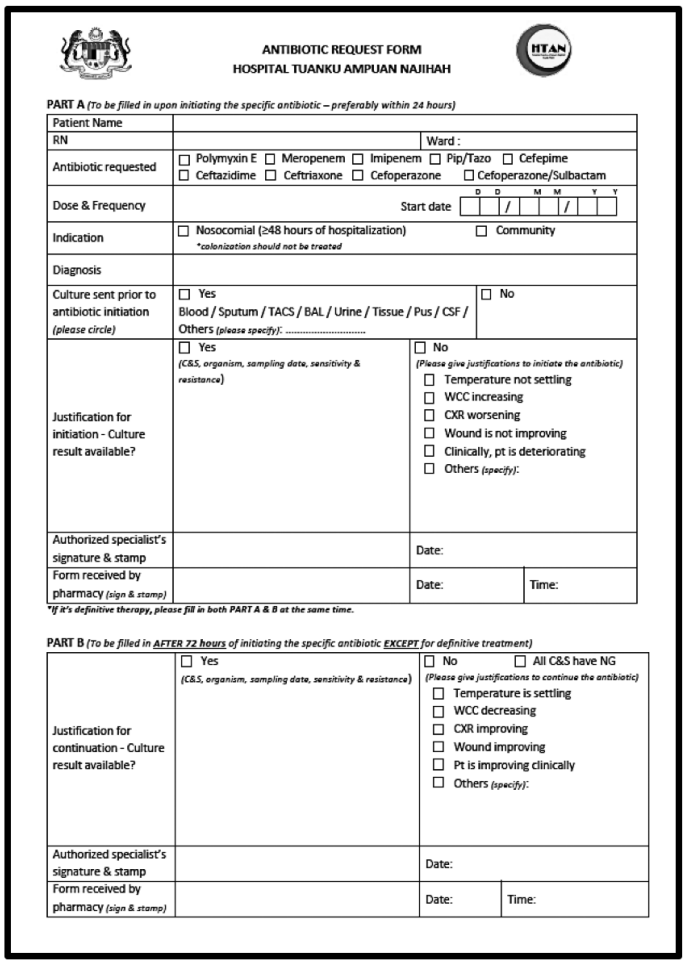
2. Do you think that ceftriaxone (Rocephine) is superior than amoxicillin/clavulanate (Augmentin) in treating CAP? (Yes/No)

3. If you suggest doctors to change ceftriaxone to other alternative antibiotics in patients with CAP, do they always accept your suggestion? (Yes/No)

4. If no (for Question 3), what are the challenges you always faced during intervening the doctors? (open-ended question)

Appendix 2

Revised Antibiotic Request Form



ANTIBIOTIC REQUEST FORM
HOSPITAL TUANKU AMPUAN NAJIHAH

PART A *(To be filled in upon initiating the specific antibiotic – preferably within 24 hours)*

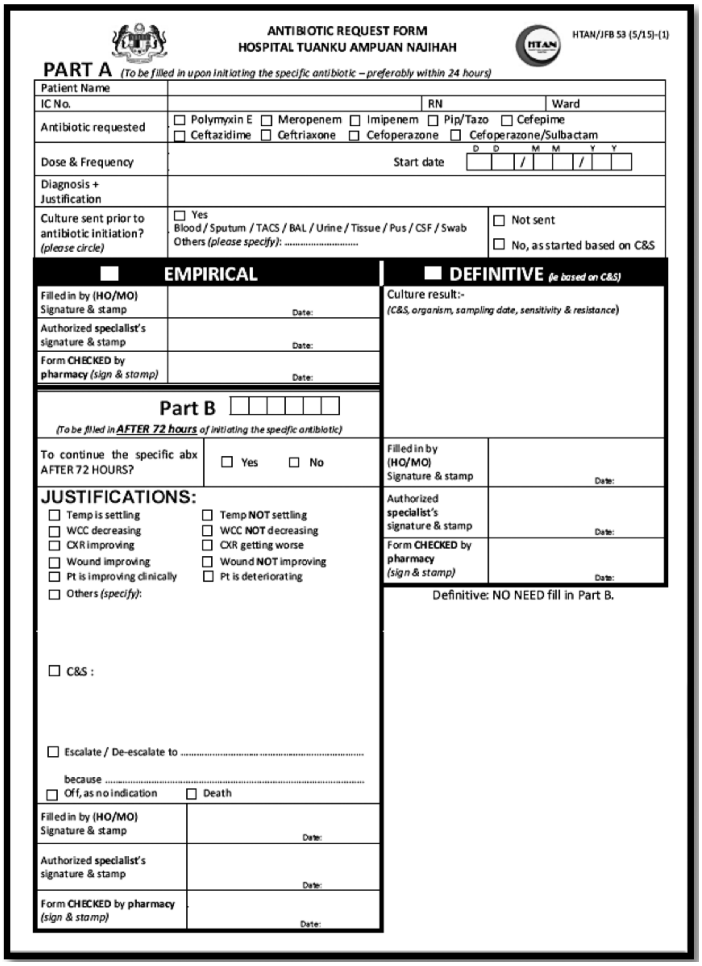
Patient Name			
RN		Ward :	
Antibiotic requested	☐ Polymyxin E ☐ Meropenem ☐ Imipenem ☐ Pip/Tazo ☐ Cefepime ☐ Ceftazidime ☐ Ceftriaxone ☐ Cefoperazone ☐ Cefoperazone/Sulbactam		
Dose & Frequency	Start date D D / M M / Y Y		
Indication	☐ Nosocomial (≥48 hours of hospitalization) **colonization should not be treated*	☐ Community	
Diagnosis			
Culture sent prior to antibiotic initiation *(please circle)*	☐ Yes Blood / Sputum / TACS / BAL / Urine / Tissue / Pus / CSF / Others *(please specify)*:	☐ No	
Justification for initiation - Culture result available?	☐ Yes *(C&S, organism, sampling date, sensitivity & resistance)*	☐ No *(Please give justifications to initiate the antibiotic)* ☐ Temperature not settling ☐ WCC increasing ☐ CXR worsening ☐ Wound is not improving ☐ Clinically, pt is deteriorating ☐ Others *(specify)*:	
Authorized specialist's signature & stamp		Date:	
Form received by pharmacy *(sign & stamp)*		Date:	Time:

**If it's definitive therapy, please fill in both PART A & B at the same time.*

PART B *(To be filled in AFTER 72 hours of initiating the specific antibiotic EXCEPT for definitive treatment)*

Justification for continuation - Culture result available?	☐ Yes *(C&S, organism, sampling date, sensitivity & resistance)*	☐ No ☐ All C&S have NG *(Please give justifications to continue the antibiotic)* ☐ Temperature is settling ☐ WCC decreasing ☐ CXR improving ☐ Wound improving ☐ Pt is improving clinically ☐ Others *(specify)*:	
Authorized specialist's signature & stamp		Date:	
Form received by pharmacy *(sign & stamp)*		Date:	Time:

Old version



ANTIBIOTIC REQUEST FORM
HOSPITAL TUANKU AMPUAN NAJIHAH
HTAN/JFB 53 (5/15)-(1)

PART A *(To be filled in upon initiating the specific antibiotic – preferably within 24 hours)*

Patient Name			
IC No.		RN	Ward
Antibiotic requested	☐ Polymyxin E ☐ Meropenem ☐ Imipenem ☐ Pip/Tazo ☐ Cefepime ☐ Ceftazidime ☐ Ceftriaxone ☐ Cefoperazone ☐ Cefoperazone/Sulbactam		
Dose & Frequency	Start date D D / M M / Y Y		
Diagnosis + Justification			
Culture sent prior to antibiotic initiation? *(please circle)*	☐ Yes Blood / Sputum / TACS / BAL / Urine / Tissue / Pus / CSF / Swab Others *(please specify)*:	☐ Not sent ☐ No, as started based on C&S	

■ EMPIRICAL		■ DEFINITIVE *(le based on C&S)*	
Filled in by (HO/MO) Signature & stamp	Date:	Culture result:- *(C&S, organism, sampling date, sensitivity & resistance)*	
Authorized specialist's signature & stamp	Date:		
Form CHECKED by pharmacy *(sign & stamp)*	Date:		

Part B ☐☐☐☐☐☐

(To be filled in AFTER 72 hours of initiating the specific antibiotic)

To continue the specific abx AFTER 72 HOURS?	☐ Yes ☐ No	Filled in by (HO/MO) Signature & stamp	Date:
		Authorized specialist's signature & stamp	Date:
		Form CHECKED by pharmacy *(sign & stamp)*	Date:

JUSTIFICATIONS:

☐ Temp is settling
☐ WCC decreasing
☐ CXR improving
☐ Wound improving
☐ Pt is improving clinically
☐ Others *(specify)*:

☐ Temp NOT settling
☐ WCC NOT decreasing
☐ CXR getting worse
☐ Wound NOT improving
☐ Pt is deteriorating

☐ C&S :

☐ Escalate / De-escalate to .....
because .....
☐ Off, as no indication ☐ Death

Filled in by (HO/MO) Signature & stamp	Date:
Authorized specialist's signature & stamp	Date:
Form CHECKED by pharmacy *(sign & stamp)*	Date:

Definitive: NO NEED fill in Part B.

Latest version