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The importance of infectious disease specialists consulting on a weekly basis in a Japanese tertiary care hospital

A retrospective observational study

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Abstract

Limited data are available regarding part-time infectious disease consultations (IDCs) and their importance in tertiary care teaching hospitals in Japan. This is a retrospective review of IDCs from June 2016 to March 2021 and describes IDC services provided by part-time infectious disease specialists once a week for 4 hours, and their impact on the quality of medical care, including antimicrobial stewardship. Data, such as the requesting department, requesting reasons, and final diagnoses, were analyzed. In April 2018, part-time infectious disease specialists launched consultation services and attended an antimicrobial stewardship team conference. Meropenem, tazobactam/piperacillin, and cefepime monthly days of therapy (DOT) were calculated to assess the effect of each intervention; a pre-post analysis was conducted using the Kruskal–Wallis test. Additional quality improvement (QI) projects related to infectious diseases were implemented. There were 237 IDCs during the study period. Consultations were mostly requested by the General Internal Medicine, Emergency Medicine, and Cardiology departments. The most common diagnoses were bone/joint, respiratory, and genitourinary infections. Infectious disease services, even on a part-time basis, achieve good outcomes in patient management, antimicrobial stewardship, and QI projects.

DOT/1000 patient-days were reduced for meropenem and cefepime, while it increased for tazobactam/piperacillin. The DOT/1000 patient-days for the 3-antipseudomonal agents significantly decreased during this period. After implementing the QI tetanus vaccination project in the Emergency Room, the number of tetanus toxoid vaccinations per month increased.

Abbreviations: ASPs = antimicrobial stewardship programs, AST = antimicrobial stewardship team, DOT = days of therapy, ER = Emergency Room, ICMC = Itabashi Chuo Medical Centre, IDCs = infectious disease consultations, IDSs = infectious disease specialists, QI = quality improvement.

Keywords: antimicrobial stewardship, infectious disease specialist (IDS), infectious diseases consultations, Japan, quality of medical care

1. Introduction

Although the number of infectious disease specialists (IDSs) has increased, they still represent a rare subspecialty in Japan.[1] In 2019, there were only 1491 IDSs (1.2 per 100,000 population) in Japan, compared to 9102 IDSs in the US in 2018 (2.8 per 100,000 population).[2] Further, approximately only half of accredited physicians are actively working as IDSs in Japan.[3]

The Japanese Association for Infectious Diseases recommends that at least 1 if not a few board-certified clinical

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

This study was approved by the Institutional Review Board (IRB) of Itabashi Chuo Medical Centre (No. 20210201-1). The requirement to obtain written consent from all participants was waived by the IRB because of the observational nature of the study, without any deviation from current medical practice.

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IDSs should work full-time in hospitals with >300 beds.[4] Although approximately 800 institutions have infectious disease coverage in Japan,[5] there are sometimes only 1 or no clinical IDS in service. This is true in large tertiary care hospitals, and especially in regional or rural areas in Japan. Some hospitals must rely on part-time ID consultations (IDCs) and antimicrobial stewardship programs (ASPs). Very few clinical IDSs have been engaged in clinical consultation, promotion of the proper use of antibiotics to reduce drug-resistant bacterial numbers, and other quality improvement (QI) projects regarding infectious diseases. Therefore, it is necessary to share the resources of IDSs within local communities to promote the appropriate use of antimicrobial agents and to improve the quality of infectious disease treatment. Although published clinical research on IDCs in Japan has been increasing,[5–12] epidemiological data regarding part-time IDCs and their importance are limited.[13] In April 2018, 1 board-certified clinical IDS started working part-time at a tertiary-care teaching hospital in Tokyo, Japan. This study aimed to describe a comprehensive approach to experience, including consultation services, QI projects, and ASPs involving a part-time IDS, and its impact on an IDS in providing consultations.

2. Materials and Methods

This single-center retrospective study was conducted at the Itabashi Chuo Medical Centre (ICMC), a 569-bed tertiary-care teaching hospital with a 12-bed intensive care unit in Tokyo, Japan. This hospital has an active General Internal Medicine department but does not have trained full-time IDSs. In April 2018, 1 board-certified clinical IDS began working only 4 hours per week and attended an antimicrobial stewardship team (AST) conference. The work of this IDS included providing an IDC service (in person or by email) for outpatients and hospitalized patients, attending a 1.5-hour AST case conference, and addressing QI projects regarding ID through an AST. This study was approved by the ICMC Research Ethics Committee (No. 20210201-1). IDCs and ASPs are a part of standard patient care. The need for informed consent was waived owing to the retrospective design of the study.

2.1. Infectious diseases consultations

All IDCs were eligible for analysis and only the first IDC for each patient during the study period was included because it was often the same diagnosis on subsequent visits. However, if a patient developed a subsequent infection after their initial infection, it was recognized as a separate episode. In addition, the same patient may have had multiple consultations because of weekly IDCs, but this was only considered as 1 consultation. The following patient demographic data were collected: age, sex, requesting department, reasons for referral at the time of the first IDC, where the consultation took place (intensive care unit, general ward, and outpatient/emergency room [ER]), presence or absence of bacteremia, and final diagnosis. The initial reasons for IDC were categorized as diagnosis and management (fever or elevated inflammatory markers, such as white blood cell count and C-reactive protein, of unknown etiology, suspicion of infections, positive blood culture), treatment of established infections (management of already diagnosed infections including intra-abdominal, respiratory, urinary tract, etc.), and other (e.g., allergy, surgical antimicrobial prophylaxis). Treatment of established infections was further classified into 3 categories: empirical therapy, definitive therapy (choice of antimicrobials or switching from intravenous to oral form), and difficult-to-manage. We analyzed the IDC database from April 2018 to March 2021.

2.2. ASP intervention

The ASP was implemented in 3 phases. Phase 1: monitoring and feedback by infectious disease pharmacists in the infection control team and IDC service by general internal medicine physicians (June 2016–March 2018). Phase 2: attending an ASP case conference and IDC service once a week by an IDS (April 2018–March 2020). Phase 3: coronavirus disease 2019 era; same intervention as phase 2 (April 2020–March 2021).

A multidisciplinary AST team was implemented in April 2018. The program was staffed by 3 physicians (respiratory medicine, pediatrics, and nephrology) (0.1 full-time equivalent), a clinical pharmacist (0.6 full-time equivalent), a microbiology laboratory technician (0.1 full-time equivalent), an infection control nurse (0.1 full-time equivalent), and 1 part-time ID physician (0.1 full-time equivalent). Before the launch of the AST, IDCs were performed by the General Internal Medicine department, and infectious disease pharmacists in the infection control team monitored the use of designated injectable antimicrobial agents (anti-methicillin-resistant *staphylococcus aureus* agents, carbapenems, and broad-spectrum penicillins, such as piperacillin/tazobactam, in all inpatients), performed therapeutic drug monitoring with the appropriate feedback, and identified and supported the proper use of designated injectable antimicrobial agents. After the AST was organized, pharmacists extracted cases, provided support for appropriate use, and reviewed cases in 1.5-hour case conferences once a week. Target patients were those who had used broad-spectrum 3-antipseudomonal agents (meropenem, tazobactam/piperacillin, and cefepime) and intravenous quinolones for >7 days, had positive blood cultures, and were difficult-to-treat. We measured changes in meropenem, tazobactam/piperacillin, cefepime, and quinolone days of therapy (DOT) per 1000 patient-days per month in the hospital. These data were collected retrospectively from electronic charts.

2.3. QI projects

During this intervention period, new QI projects related to infectious disease involved collaboration of various health workers. Some cases were tackled by ASTs, while others were initiated through consultations between each department and IDSs. We addressed the need for the production of antibiograms in ICMC in collaboration with an external laboratory, interim gram-stain results from sputum samples were reported by the microbial technician while waiting for the microbial culture results, and we encouraged a tetanus vaccination program for trauma patients in the ER, performed by emergency medicine physicians assisted by the part-time IDS.

2.4. Statistical analysis

The difference in median values between the use of intravenous antibiotics and tetanus vaccinations were analyzed by the Kruskal–Wallis test, followed by the Steel–Dwass test. The Jonckheere–Terpstra trend test was used to compare the trends of intravenous antibiotics use and tetanus vaccinations during various periods. Differences were considered statistically significant at $P < .05$. All statistical analyses were performed using SAS software (version 9.4, SAS Institute, Cary, NC) and JMP Pro software (version 16.0, SAS Institute, Cary, NC).

3. Results

Based on the criteria, there were 237 IDCs during the 3-year study period. Baseline patient characteristics are shown in Table 1. The median patient age was 76 years (interquartile range, 61–85) (range, 19–99 years). Among a total of 237 IDCs, 164 (69.2%) were requested from the Internal Medicine Department, and 73 (30.8%) were requested from staff not

Table 1

Characteristics of the infectious disease consultations (n = 237).

Variables	No. of patients
Age (yr) (IQR)	76 (61–85)
Sex	
Male	142 (59.9%)
Female	95 (40.1%)
Consultation places	
General ward	199 (84.0%)
Intensive care unit	18 (7.6%)
Outpatient/Emergency Room	20 (8.4%)
Consultation setting	
Community-acquired infection	163 (68.8%)
Hospital-acquired infection	74 (31.2%)
Specialty	
Internal medicine	164 (69.2%)
Non-internal medicine	73 (30.8%)
Consult reason	
Diagnosis and management	25 (10.6%)
Treatment of established infection	203 (85.6%)
Empirical therapy	20 (8.4%)
Definitive therapy	118 (49.8%)
Difficult to manage	65 (27.4%)
Others	9 (3.8%)
Bacteraemia	125 (52.7%)

IQR = interquartile range.

associated with internal medicine. The reasons for IDC included the treatment of established infections and diagnosis and management, with established infections subcategorized into empirical therapy, definitive therapy, and difficult-to-manage cases. The rate of bacteremia was 52.7% (125/237 cases). The departments that most frequently requested consultations were General Internal Medicine and Emergency Medicine (Table 2). As for the final diagnosis, the most common diagnoses were bone/joint infections, respiratory infections, and genitourinary infections (Table 3).

3.1. Trends in broad-spectrum antibiotics use

Table 4 shows changes in the broad-spectrum-DOTs during the study period. The DOTs/1000 patient-days for meropenem, cefepime, and the 3-antipseudomonal agents decreased during the periods before and after intervention, while piperacillin-tazobactam DOTs/1000 patient-days increased. No increase or decrease in the use of any antimicrobial agent was evident in phase 3, after the start of the coronavirus disease 2019 epidemic, compared with that in phase 2.

3.2. QI projects

3.2.1. Production of antibiogram in ICMC. In this hospital, there is no in-house microbial laboratory and all clinical samples for culture are outsourced to an external laboratory. An antimicrobial biogram was not available until October 2018 because it was not customary for an IDS or microbial technician to make one until then. In October 2018, an antimicrobial biogram was developed in collaboration with an external laboratory and it has since been updated every year by an infectious disease pharmacist and microbial technician and its use was supported by the IDS antimicrobial biogram.

3.2.2. Gram-staining results from sputum samples reported before culture results. At that time, final culture results were reported for each sputum sample but without interim reports of gram-staining results. From April 2019, the gram-stain results of sputum smears were displayed using the Geckler classification to allow for early de-escalation or escalation.[14]

Table 2

Breakdown of infectious disease consultations request by department (n = 237).

Hospital department	No. of patients
General internal medicine	126 (53.2%)
Emergency medicine	44 (18.2%)
Cardiology	13 (5.5%)
Neurosurgery	8 (3.4%)
Respiratory	8 (3.4%)
Plastic surgery	6 (2.5%)
Haematology	6 (2.5%)
Nephrology	6 (2.5%)
Surgery	5 (2.1%)
Gastroenterology	5 (2.1%)
Orthopaedic surgery	5 (2.1%)
Transplant surgery	3 (1.3%)
Thoracic surgery	2 (0.8%)
Total	237 (100%)

Table 3

Final diagnosis of infectious diseases by infectious disease specialists (n = 237).

Variable	No. of patients
Bone/Joint infection	47 (19.8%)
Respiratory infection	41 (17.3%)
Genitourinary infection	40 (16.9%)
Bacteraemia	20 (8.4%)
Cardiovascular infection	18 (7.6%)
Catheter-related bloodstream infection	12 (5.0%)
Skin and soft tissue infection	11 (4.6%)
Central nervous system infection	8 (3.4%)
Hepatobiliary tract infection	7 (3.0%)
Syphilis related consultation	7 (3.0%)
Intra-abdominal infection	6 (2.5%)
noninfectious disease	6 (2.5%)
Fever of unknown origin	3 (1.3%)
Febrile neutropenia	2 (0.8%)
Head, eyes, ears, nose, and throat infection	2 (0.8%)
Other	7 (3.0%)
Total	237 (100%)

3.2.3. Tetanus vaccination program in the ER. Although ICMC, which has a highly active emergency medicine care center, cares for many trauma patients, there were no tetanus vaccination systems or protocols established in the ER. After IDCs with an emergency medicine physician, we recognized this situation and attempted to improve it. The tetanus vaccination protocol was started in August 2018 and performed by emergency medicine physicians, assisted by the part-time IDS. The average number of tetanus toxoid vaccinations per month in the ER increased during the study period (phase 1: 1.0, phase 2: 4.0, and phase 3: 3.5, respectively; both $P < .01$ for trend), indicating a significant change.

4. Discussion

In this study, we evaluated IDCs on a weekly basis, addressing QI projects and changes in antimicrobial charges at a Japanese tertiary care hospital. In some instances, an IDS may be employed to provide regular site visits to patients requiring consultation (e.g., once per week).

Bone/joint, respiratory tract, and genitourinary infections were the most frequent final diagnoses in our study. Interestingly, the frequency of bone infections was higher than previously reported. This may be because the General Internal Medicine department in this hospital follows non-internal medicine

Table 4

Days of therapy with each antibiotic targeted in the antimicrobial stewardship program.

per 1000 patient-days	Phase 1, median (IQR)	Phase 2, median (IQR)	Phase 3, median (IQR)	*P* value*	*P* value for trend†
Meropenem	30.8 (27.4, 36.2)	10.9 (7.8, 24.1)	8.4 (7.0, 11.8)	<.01	<.01
Tazobactam/piperacillin	27.3 (25.4, 29.9)	32.9 (31.2, 37.9)	34.2 (26.3, 36.6)	<.01	<.01
Cefepime	14.0 (11.2, 15.7)	10.5 (8.5, 14.3)	10.6 (9.3, 12.0)	.04	.02
Quinolones	4.6 (3.3, 5.6)	4.6 (3.3, 5.6)	4.4 (3.3, 5.7)	.94	.94
Meropenem+ tazobactam/piperacillin+cefepime	74.0 (64.3, 81.9)	57.2 (51.7, 67.3)	53.1 (43.7, 58.7)	<.01	<.01

IQR: interquartile range.

* Kruskal–Wallis test.

† Jonckheere–Terpstra trend test.

patients, especially orthopedic patients with a variety of medical problems, including infectious diseases. The management of bone and joint infections may be necessary for internists in Japan. The departments most commonly requesting this service were General Internal Medicine and Emergency Medicine. This may be because generalists in Japan are often responsible for treating infectious diseases (which requires special clinical skills to manage) because there is a paucity of IDSs compared to other countries. In this study, approximately 1/4 of the consultation cases were difficult to manage and IDSs tend to assume a more direct role, especially in the care of these difficult cases.[6] Weekly consultations from part-time IDSs may be useful to solve this problem, even if it is not the preferred approach, especially in small- to medium-sized community hospitals.

In this study, the use of meropenem and cefepime significantly decreased during the study period, with a simultaneous significant increase in the use of tazobactam/piperacillin. Ideally, we would like to see a decrease in both meropenem and tazobactam/piperacillin, but this may be a limitation of part-time intervention. It remains to be seen how antimicrobial use changes with long-term interventions. A previous study showed that in a 70-bed community hospital in the US, a physician-led ASP was associated with a significant improvement in *Pseudomonas aeruginosa* resistance and decreased antimicrobial expenditure in a community hospital setting.[15] In Japan, Iwata et al reported that weekly attendance by ID physicians could impact parameters associated with ASPs, such as the use of broad-spectrum antibiotics.[13] Thus, part-time ID involvement in the hospital may be helpful for AST without IDSs for successful antimicrobial stewardship. Asynchronous telemedicine (eConsultation) is a feasible and viable option for hospitals without IDSs. According to a case-control study performed in 2 rural hospitals in the US, ID eConsultation was associated with a decrease in 30-day mortality, no increase in hospital-to-hospital transfer, and a high level of satisfaction from referring providers.[16,17]

Three QI projects described in this study addressed the creation of hospital antibiograms, tetanus vaccination in the ER, and the display of sputum gram-staining results on electronic medical records before culture results were identified. The usefulness of these has been proven[18–25] and are standard practices for IDSs, but they may be difficult for non-specialized medical staff who may not recognize their importance. The quality of medical care in daily practice can be improved by involving IDSs once per week on a part-time basis. IDSs have many ideas to encourage antimicrobial stewardship and to improve the quality of medical care, possibly improving previously unrecognized problems. IDSs should share their knowledge and ideas with hospitals without IDSs to improve not only their hospitals, but also their communities.

As mentioned above, most tertiary care hospitals have no or limited clinical IDS resources, especially in regional or rural areas in Japan. We need to consider how to efficiently use a limited number of IDS resources to improve the quality of medical care, such as antimicrobial stewardship and outcomes for patients with infection in Japan.

This study had several limitations related to its retrospective and uncontrolled nature. First, the monthly broad-spectrum antibiotic DOT/1000 patients were evaluated using pre-post analysis. It is difficult to adjust a pre-post analysis precisely, considering the many confounding factors, such as time, patient characteristics, the implementation of the antimicrobial resistance action plan in Japan, the change in physicians' practice, and the increased recognition of standard antibiotic use among physicians. Interrupted time series analysis may be a better way to accurately evaluate the impact of ID consultation, but we could not perform interrupted time series analysis because of the technical limitation of our research team. Second, only broad-spectrum antibiotics were evaluated in this study, limiting the antibiotic type analyzed. Third, it was a retrospective observational study conducted at a single center; thus, the study findings may not be generalizable to other settings. Fourth, we cannot exclude classification biases or diagnostic errors associated with the evaluation performed by IDSs. Fifth, we were unable to determine the proportion of IDCs for all infectious diseases in each department. Finally, our results did not include informal consultations that played a role in the workload. Nevertheless, our study is valuable because it describes the impact of IDC, antimicrobial stewardship, and QI projects in collaboration with a part-time IDS and AST in a Japanese tertiary care hospital. Further research is needed to determine the effect of part-time interventions by IDSs on clinical aspects, including antimicrobial stewardship in Japan.

5. Conclusion

In conclusion, we described the role of part-time IDSs in an acute tertiary care hospital. Although the number of IDSs in Japan is limited, ID services may play an important role in patient management, antimicrobial stewardship, and QI projects to achieve good outcomes with AST, even on a part-time basis. IDSs should support hospitals without in-person IDCs or ID consultation services to improve the quality of medical care, including antimicrobial stewardship.

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