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F. Sana*
W. Hussain
G. Zaman
L. Satti
U. Khurshid
M.T. Khadim

Department of Microbiology, Armed Forces Institute of Pathology, National University of Medical Sciences, Rawalpindi, Pakistan

* Corresponding author. Address: Department of Microbiology, Armed Forces Institute of Pathology, National University of Medical Sciences, Rawalpindi, Pakistan.
E-mail address: fatimasanaullah@hotmail.com (F. Sana)

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The impact of dispatching infectious diseases physicians for infection control. Interrupted time-series analysis on carbapenem use and blood cultures

The overuse of broad-spectrum antimicrobials is associated with multidrug-resistant organisms. Whereas infectious disease (ID) specialists and their consultation services are associated with successful antimicrobial stewardship, there is a shortage of ID specialists in Japan and many hospitals do not have them [1–6]. Some hospitals rely on ID physicians dispatched on a part-time basis for consultations and antimicrobial stewardship programmes. To evaluate the effectiveness of such part-time ID physicians, we conducted an interrupted time-series analysis (ITSA) on broad-spectrum antibiotic, carbapenem, and blood culture use to evaluate the effectiveness of ID physicians dispatched on a weekly basis.

ITSA was conducted at Kakogawa Medical Center, a 300-bed tertiary care hospital in Hyogo prefecture, Japan. The study period was from April 2012 to April 2017. The hospital did not have trained full-time ID specialists. As the first intervention (intervention 1), an ID fellow from the division of infectious diseases at Kobe University Hospital, Hyogo, Japan was dispatched weekly to provide ID services and antimicrobial stewardship in April 2015. He was replaced by an ID attending physician from the same division in April 2016 (intervention 2). Their work included providing a consultation service for hospitalized patients, aiming specifically at appropriate use of antibiotics, as well as multiple lectures for staff regarding management of infectious diseases.

By defining the time of commencement of these two physicians (interventions 1 and 2), and assuming that there was no time lag for their interventions to be effective, the intervention efficacy was assessed using segmented regression analysis of an interrupted time-series using the Newey model [7]. Both the changes following commencement, and the post-intervention trend, were evaluated monthly, using moving-average methods to adjust autocorrelation. Monthly carbapenem use was measured using defined daily dose, or DDD per 1000 patient-days. The number of blood cultures taken, the number of multiple sets of blood cultures, and the multiple sets of blood culture rate were also measured monthly per 1000 days. We also compared in-hospital mortality rates during the pre- and post-intervention periods to see whether there was no increase in in-hospital mortality after decreasing broad-spectrum antibiotic use. All comparisons were performed using Stata version 15.1 (StataCorp, College Station, TX, USA). The ethics committee at Kakogawa Medical Center approved this study.

Carbapenems other than meropenem were not approved or rarely used at the hospital, and only data on meropenem were used for analysis. Meropenem use significantly decreased after commencement of intervention 1 ($P < 0001$), as well as for post-intervention trend ($P = 0.006$). Intervention 2 also led to a significant further decrease in meropenem use ($P < 0.001$ for intercept and $P < 0.001$ for trend) (Figure 1).

For blood cultures, there was already an increase in numbers before any intervention ($P < 0.001$). Both interventions 1 and 2 were associated with a significantly increased trend ($P < 0.001$); similar patterns were observed for both the number of multiple sets of blood cultures and multiple sets rate.

In-hospital mortality during the study period increased significantly after intervention 1 (for trend, $P = 0.001$). However, intervention 2 led to a significant decrease in mortality ($P = 0.002$ for intercept, and $P < 0.001$ for trend).

Our investigation revealed that intervention by weekly assigned ID physicians significantly affected the use of the broad-spectrum antibiotic, meropenem. Likewise, both interventions somewhat contributed to boosting blood cultures.

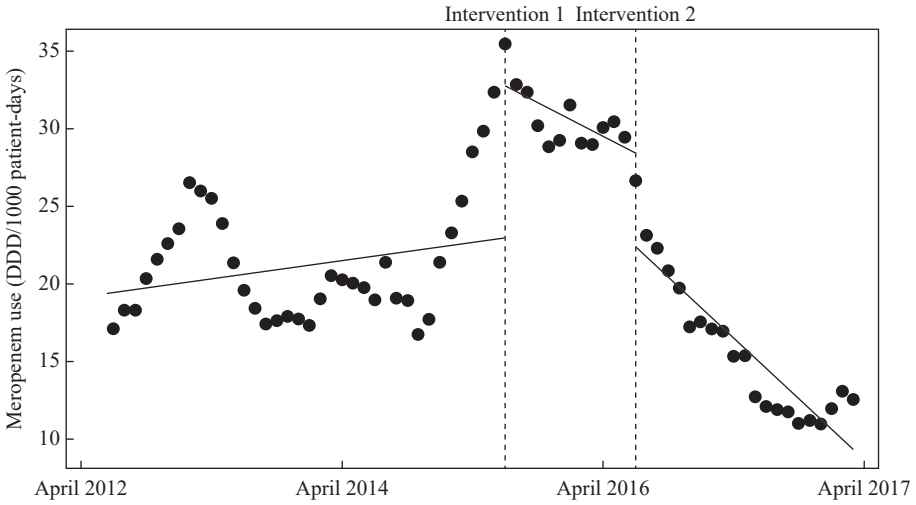

Figure 1. Interrupted time-series analysis (ITSA) on meropenem use (per 1000 patient-days). Intervention 1 denotes the participation of an infectious diseases (ID) fellow. Intervention 2 denotes the participation of an ID attending. DDD, defined daily dose.

For in-hospital mortality, intervention 2 led to an overall decrease in in-hospital mortality, whereas intervention 1 was associated with increased mortality. The reasons for this final observation are unknown. However, it does provide a reminder of the importance of ensuring that any antibiotic stewardship programme does not risk adversely affecting patients' clinical outcomes.

Even though this was a single-centre study, the results suggest that even weekly attendance by ID physicians could have an impact on parameters associated with an antimicrobial stewardship programme, such as use of broad-spectrum antibiotics and use of laboratory tests. Further studies will be necessary to further investigate the impact of the programme on overall antibiotic use, and to obtain more data on the safety of the intervention.

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K. Iwata[a,*]
N. Morishita[b]
Y. Sakai[c]
K. Doimoto[c]
M. Nishiwaki[d]
[a]*Division of Infectious Diseases, Kobe University Hospital, Hyogo, Japan*

[b]*Department of Nursing, Hyogo Prefectural Kakogawa Medical Center, Hyogo, Japan*

[c]*Department of Pharmacy, Hyogo Prefectural Kakogawa Medical Center, Hyogo, Japan*

[d]*Department of Cardiovascular Surgery, Hyogo Prefectural Kakogawa Medical Center, Hyogo, Japan*

* Corresponding author. Address: Division of Infectious Diseases Therapeutics, Kobe University Graduate School of Medicine, Kusunokicho 7-5-2, Chuoku, Kobe, Hyogo 650-0017, Japan. Tel.: +81 78 3826296.
E-mail address: kentaroiwata1969@gmail.com (K. Iwata)

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