RESEARCH

Original article

▶ Antimicrobial stewardship through telemedicine in a community hospital in southern Brazil

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Summary

We developed an antimicrobial stewardship programme, based on telemedicine, for a remote community hospital in southern Brazil. Expertise in infectious diseases was provided from a 250-bed tertiary hospital for cardiology patients located 575 km away. At the community hospital, antimicrobial prescriptions were completed via a secure web site. A written reply was sent back to the prescriber by email and SMS text message. During a 4-month study period there were 81 prescriptions for 76 patients. Most antimicrobial prescriptions (67%) were for respiratory infections. Ampicillin was prescribed in 44% of cases ($n = 56$), gentamicin in 18% of cases ($n = 23$) and azithromycin in 18% of cases ($n = 23$). Two infectious diseases specialists independently reviewed each antimicrobial prescription. A total of 41 prescriptions (55%) were considered inappropriate. The median time to obtain a second opinion via the web site was 22 min (interquartile range 12–55). Overall compliance with the recommendations of the infectious diseases specialist was 100% (81 out of 81 requests). Telemedicine appears to have a useful potential role in antimicrobial stewardship programmes.

Introduction

Antimicrobial stewardship programmes have been implemented to promote the rational use of antimicrobial drugs. There are two core strategies: prospective audit of antimicrobial use with direct interaction and feedback to the prescriber (the "back-end" approach), and formulary restriction and pre-authorization orders (the "front-end" approach).[1] In a survey conducted in 552 American hospitals, 61% reported having an antimicrobial stewardship programme. Community hospitals with fewer than 200 beds were less likely to have one.

Telemedicine has been little used in antimicrobial therapy, and most applications have concerned teleconsultation.[2–5] Teleconsultation is a method of remote assessment that is well suited to post prescription review and provision of feedback to physicians.

Antimicrobial stewardship programme in Southern Brazil

We developed an antimicrobial stewardship programme based on telemedicine, for a remote community hospital

in southern Brazil. Hospital São José is a 50-bed community hospital in Porto Lucena, a town of 5600 inhabitants in the northwestern region of Rio Grande do Sul (RS). The community hospital has general practitioners attending, including a pharmacist who provides clinical pharmacy service, but there are no antimicrobial stewardship activities. There is no infectious diseases specialist on staff.

A web application (http://www.portalqualis.com.br) was constructed in Javascript. The web pages have information regarding the remote hospital's antimicrobial policy, and suggested literature in the field. Other functions include on-line chat with an infectious diseases specialist, web-conferencing, antimicrobial prescription forms, and a form for the laboratory to report culture results. Expertise in infectious diseases is provided from the Instituto de Cardiologia de Porto Alegre (ICFUC-RS), a 250-bed tertiary hospital for cardiology patients in Porto Alegre, the capital city of Rio Grande do Sul. The ICFUC-RS is located 575 km from the Hospital São José.

When prescribing antimicrobial drugs, the remote physician inserts the patient information data into the web site. An infectious diseases specialist then assesses the patient's clinical information and laboratory results via the web application. A written reply is sent back to the prescriber by email and mobile-phone text message (SMS). This written reply can also be accessed on the web-site by the prescribing physician.

Staff at the community hospital (a nurse, 10 nurse assistants, a pharmacist and two physicians) were trained to use the web-platform. The training included three web-conferencing sessions coordinated by an ICFUC-RS infectious diseases specialist. The hospital's list of antimicrobial medications was also reviewed in conjunction with the pharmacy service, and a new standardized list of antibiotics was drawn up.

Methods

We conducted a trial to assess the feasibility of the antimicrobial stewardship programme during a 4-month period starting in May 2011. Ethics permission was not required.

Two infectious diseases specialists independently reviewed each antimicrobial prescription and gave a feedback to the prescriber. Afterwards, both specialists analysed each prescription. Any differences between the specialists were resolved by consensus. Prescriptions were categorized as: (1) adequate, (2) dose adjustments, (3) change to a comparable agent, (4) change of administration route, (5) narrow empirical coverage, (6) broad empirical coverage, (7) overlapping spectrum, (8) stop treatment. Prescriptions in categories 1–4 were considered to be appropriate; prescriptions in categories 5–8 were considered to be inappropriate.[6,7] For the evaluation of prescriptions for pneumonia, the Prognostic Severity Index (PSI) was measured[8] based on the information from the web site.

Time for the consultation reply was reported in minutes. Information about prescription adherence and about patient outcomes (death or discharge) was recorded by the hospital staff. The data were analysed using a standard package (SPSS version 18.0).

Results

During the study period, there were 81 prescriptions for 76 patients. The median age of the patients was 64 years (interquartile range, IQR 52–77). Most patients were men (56%; $n = 45$). The most common comorbities were chronic respiratory diseases (32%; $n = 24$), cardiac diseases (15%; $n = 11$), neurological diseases (8%; $n = 6$) and neoplasia (4%; $n = 3$).

Fifty-seven prescriptions were for community-acquired infections (70%). Most antimicrobial prescriptions were for respiratory infections (67%; $n = 54$), bacteraemia (9%; $n = 7$) or soft tissue infections (7%; $n = 6$). Patients with a presumed diagnosis of pneumonia were classified as PSI class I (13%; $n = 7$), class II (53%; $n = 28$), class III (19%; $n = 15$) or class IV (6%; $n = 3$).

The most commonly prescribed antimicrobial drugs were ampicillin (44%; $n = 56$), followed by gentamicin (18%; $n = 23$), azithromycin (18%; $n = 23$), first-generation cephalosporin (5%; $n = 6$), ciprofloxacin (4%; $n = 5$) and ceftazidime (4%; $n = 5$). There were no vancomycin prescriptions. A combination of antimicrobial drugs was most commonly prescribed (56%; $n = 45$). The most common combinations were ampicillin plus gentamicin (27%; $n = 22$) and ampicillin plus azithromycin (25%; $n = 20$). Eight patients (10%) had previously been prescribed antimicrobial drugs.

All the prescriptions were based on empirical coverage for suspected pathogens. Forty-one out of 75 prescriptions (55%) were considered inappropriate. Most of the recommendations made by the infectious diseases specialist were related to: broadening empirical coverage (40%; $n = 32$); changing the administration route (27%; $n = 22$); narrowing empirical coverage (6%; $n = 5$); adjusting the dose (5%; $n = 4$); stopping treatment (4%; $n = 3$); and overlapping spectrum (1%; $n = 1$). Eight prescriptions (10%) were considered fully adequate. In six cases (7%), the general practitioner did not suggest an antimicrobial drug, and requested suggestions for the choice, dose, frequency and route of the antimicrobial drug.

The most common antimicrobial prescriptions during the study period are shown in Table 1. The number of macrolides prescriptions, all for respiratory infections, increased in the third and fourth month. A total of 36% ($n = 5$) of prescriptions were considered appropriate in the first month, 44% ($n = 8$) in the second, 29% ($n = 5$) in the third, and 60% ($n = 12$) in the fourth month. In comparing the last month to the three previous months, there was a significant increase in the rate of appropriateness (40% versus 60%; $P < 0.01$) see Table 2. The appropriateness rate for pneumonia prescription also increased in the fourth month (41% versus 63%; $P = 0.01$).

The median time for obtaining a second opinion via the web site was 22 min (IQR 12–55), starting from the time of

Table 1 Antimicrobial prescriptions during the study period

	Month 1	Month 2	Month 3	Month 4
No of antimicrobial prescriptions	26	25	31	37
Ampicillin, %	42	52	42	51
Azithromycin, %	8	8	19	35
Gentamicin, %	27	20	23	11
Cephazolin, %	11	0	3	3
Ceftazidime, %	8	4	6	0
Ciprofloxacin, %	4	16	0	0
Other, %	0	0	6	0

Table 2 Prescriptions judged to be appropriate during the study period. Values shown are percentages

	Month 1	Month 2	Month 3	Month 4
All prescriptions	36 (5/14)	44 (8/18)	29 (5/17)	60 (12/20)
Pneumonia prescriptions	38 (3/8)	36 (4/11)	36 (4/11)	63 (12/19)

antimicrobial prescription at the community hospital. The overall compliance rate with the specialist's recommendation was 100% (81 out of 81 requests). No positive culture results were recorded on the web site. Only, one patient had negative results for synovial fluid.

A total of 75 patients (93%) were discharged, one patient (1%) was transferred to another hospital and three patients (4%) died. Two patients were still in hospital when the 4-month trial ended.

Discussion

During the first meetings and training process, the hospital staff reported that they felt comfortable about using the web site, and there was a willingness to implement telemedicine as a tool for antimicrobial stewardship. There was an increase in the rate of appropriate prescriptions after the start of the programme.

The rate of inappropriate prescriptions at the remote hospital was similar to that found in other studies.[9–11] Based on the current guidelines for the management of community-acquired pneumonia in adults,[12] most of the prescriptions considered inappropriate were related to a narrow antimicrobial spectrum. The Infectious Diseases Society of America (IDSA) recommendation includes a beta-lactam and macrolide or a quinolone, for patients categorized with PSI of 2–3 (non-severe pneumonia). In our evaluation, the lack of macrolides in prescriptions for moderate to severe community acquired pneumonia was the most common inadequacy. The drop in adequacy in month 3 might be due to the absence of one remote physician for a holiday.

The benefits of antimicrobial stewardship programmes have been documented in several publications.[13–15] Reduction of inappropriate use of antibiotics results in decreased nosocomial infections, reduction in antimicrobial resistance and lower costs. The range of these benefits is not restricted to individual patients; it affects other patients, the institution, administrators and the community.

The development of tools to help decision making that is sustainable, easily available to physicians, user friendly, which can be used by anyone with an Internet connection, at a low cost, can overcome barriers related to antimicrobial stewardship.[16] The fact that, on six occasions, the community physician at Porto Lucena requested a direct antimicrobial suggestion through the platform without choosing a drug and just providing the patient's clinical data, demonstrates how efficient this type of communication can be. The IDSA recommends that antibiotic therapy for pneumonia should be initiated within 4 h of admission.[12,17] In our study, 75% of the interventions through the web-platform were made within 55 min, which we assume leads to better patient care. Others have demonstrated that compliance with the recommendations of an infectious diseases specialist for

antimicrobial therapy is associated with better inpatient clinical outcomes.[12,13]

Gennay *et al.* described a prospective study of an infectious diseases consultation hotline, over a 1-year period in a French hospital. The results showed an increased number of consultations through the hotline, suggesting that this informal type of consultation, without patient examination, meets the needs of an attending physician.[2] Another study addressed the acceptance, both formal and informal (telephone calls to a hotline) for infectious diseases consultation. Hotline consultation had similar levels of acceptance to formal consultation. Most important, patient outcomes, including mortality, were similar for the two consultation types.[3]

Yam *et al.*, have shown the benefits of an antimicrobial stewardship programme in a rural hospital, with the remote participation of an infectious diseases specialist. In their study, there was an increase in antimicrobial streamlining, based on culture laboratory results; a decrease in *Clostridium difficile* infection and a reduction of antibiotic costs.[18]

Consultations with infectious diseases specialists are common. Informal (without seeing the patient), telephone or "corridor" consultations, have been shown to occur frequently both in private and academic practice. They can save time, be educational, and reduce hospital admissions, transfers and emergency departments visits. They are especially important in rural areas with limited specialists.[19,20]

Our study had some limitations as it was not a controlled study. Also, we could not assess the effect of the intervention in terms of antimicrobial resistance, since there were no positive culture results during study period. Finally, the sample size was small and from a single centre. Controlled studies of cost-effectiveness are needed to prove the clinical benefits of antimicrobial stewardship programmes via telemedicine.

The present study reports the results of a back-end antimicrobial stewardship programme, implemented through telemedicine, in a small community hospital in Brazil. Telemedicine appears to have a useful potential role in antimicrobial stewardship programmes.

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