How to Impact antibiotic prescribing?

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2015

Chapter 7

Tailored antibiotic stewardship programs to improve adherence to prescribing guidelines in residential care facilities

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Abstract

Objectives: To evaluate the implementation of tailored antibiotic stewardship programs in residential care facilities (RCFs), and to describe antibiotic use and guideline-adherent antibiotic selection before and after the implementation of these programs.
Design: Quasi-experimental, unblinded study.
Setting: Four RCFs in the Netherlands.
Participants: Physicians, nursing staff, and managerial staff.
Intervention: A participatory action research (PAR) approach was implemented in two RCFs, with local stakeholders in charge of the selection, development and implementation of tailored interventions to improve antibiotic prescribing informed by baseline data presented to them in multidisciplinary meetings.
Measurements: Pharmacy data were used to calculate differences in antibiotic use, and medical chart data to calculate differences in guideline-adherent antibiotic selection, pre- and post-intervention.
Results: We did not observe a change in trends related to antibiotic use in intervention versus control RCFs. However, guideline-adherent antibiotic selection for presumed respiratory tract infections increased by 55% in intervention RCFs versus 9% in control RCFs, and for urinary tract infections in residents without a catheter, by 14% in intervention RCFs compared to a 20% decrease in control RCFs. Recruitment issues resulted in the inclusion of only RCFs with limited numbers of affiliated general practitioners (GPs), and data collection issues resulted in the inability to determine appropriateness of antibiotic prescribing decisions.
Conclusion: PAR is a promising approach to implement tailored interventions that are successful in improving guideline-adherent antibiotic prescribing in RCFs. Research is needed to evaluate how to implement this approach in RCFs affiliated with multiple GPs.

Introduction

Antibiotic use is the main cause of development of antibiotic resistance.[1] Therefore, the global increase in antibiotic resistance has raised concern regarding the appropriate use of antibiotics.[2] In consequence, antibiotic stewardship programs have become more common. These programs aim to optimize antibiotic use and achieve the best clinical outcomes while minimizing the development of antibiotic resistance.[3] Examples of antibiotic stewardship activities include audit and feedback, formulary restrictions, education, and guideline development and implementation. Such activities are increasingly being implemented in hospital care, but are less common in long-term care facilities (LTCFs) despite the reporting of inappropriate antibiotic use in this setting.[4–6]

LTCFs represent a particularly challenging setting to implement antibiotic stewardship programs, in part due to difficulties diagnosing infections in LTCF residents. These challenges include the often atypical clinical presentation, residents' limited ability to express themselves due to cognitive impairments, difficulties obtaining appropriate specimens for culture, and a lack of diagnostic resources.[6] Antibiotic prescribing decision-making may be further influenced by pressure exerted by nursing staff, residents, and their family members, as well as environmental factors including a lack of guidelines.[7] In response, it has been argued that these influencing factors should be considered in the development of antibiotic stewardship programs.[4,8]

We hypothesized that participatory action research (PAR) is a suitable approach to develop effective antibiotic stewardship programs in LTCFs, as this approach addresses barriers and facilitators to appropriate prescribing. PAR is characterized by the involvement of local stakeholders in the identification of opportunities for improved practice, the development and implementation of tailored interventions directed at these opportunities, and the evaluation of the implemented interventions. We applied this approach in a study aimed at developing tailored antibiotic stewardship programs in nursing homes (NHs) and residential care facilities (RCFs) in the Netherlands.[9]

In the Netherlands, RCFs differ from NHs in the way medical care is provided. In RCFs, medical care is provided by general practitioners (GPs), who operate from their own practices. Individuals who move into RCFs typically continue to be cared for by their GP, so RCFs are often served by a large number of different GPs.[10] In NHs, on the other hand, medical care is provided by specialized (elderly care) physicians who are based in and employed by the NH.[11] Because physicians in RCFs are not on-site and a large number of GPs is involved in medical care provision, it is likely that it is more difficult to implement antibiotic stewardship programs in RCFs compared to NHs. This article evaluates the implementation of tailored antibiotic stewardship programs

developed with a PAR approach in RCFs, and describes antibiotic use and guideline-adherent antibiotic selection before and after the implementation of these programs.

Methods

Study setting

This mixed-methods, quasi-experimental, unblinded study was part of a research project aimed at optimizing antibiotic prescribing in LTCFs in the Netherlands: the Improving Rational Prescribing of Antibiotics in Long-term Care Facilities (IMPACT) study.[9] Both NHs and RCFs were included in this study. This article focuses on RCFs only; the conduct and results of the NH study is described elsewhere.[12] We included four RCFs in the study, two of which were assigned to the intervention group and two to the control group, thereby ensuring a comparable number of residents in each group. To recruit RCFs, we approached 34 GPs who previously participated in a training program for elderly care medicine, assuming that those GPs may provide care to a substantial number of residents of RCFs. Half of these GPs indeed did so, and were invited to participate in the IMPACT study. Four agreed that their general practices would participate in the study. Refusal was based on participation in other research projects, organizational issues, no interest, and other reasons. Of the four general practices that agreed to participate, two were affiliated with another general practice, and one with two other general practices. Together, these eight general practices provided medical care to all residents of four RCFs. These RCFs and the four affiliated general practices were invited to participate in the study, and all agreed.

Data collection

For the collection of data on antibiotic use, pharmacies affiliated with the RCFs provided an overview of all drugs of Anatomical Therapeutical Chemical (ATC) class J01 (i.e., antibacterials for systemic use) prescribed for all residents of the RCFs between January and September 2012 (pre-test phase) and the same months in 2013 (post-test phase). These data included drug names, prescription dates, and information on duration and dosing. To link the pharmacy data to the number of resident-care days in the facilities, RCF staff provided information on size (number of places) and occupancy.

For the collection of data on antibiotic selection, chart review was conducted. To this end, we asked all residents who lived in the RCFs between spring 2012 and spring 2013 for written consent to review their medical charts from January to September in 2012 (pre-test phase) and over the same period in 2013 (post-test phase). If residents were not mentally competent, a family member was asked for written consent. A researcher (LB) screened medical charts of consenting residents/families and recorded details of treatment decisions for urinary tract infection (UTI), respiratory tract infection (RTI), and skin infection (SI).

Intervention

Tailored interventions were selected, developed and implemented in the intervention RCFs during the 3 months between the end of the pre-test phase and the start of the post-test phase (i.e., October – December 2012; in the control RCFs, this occurred after the post-test phase). A PAR approach was used for this purpose, as described in short below and in more detail elsewhere.[9] After completion of the pre-test phase, 1.5- to 2-hour multidisciplinary meetings were held in each intervention RCF. This meeting included four members of the project team (i.e., the researchers and advisors of the Dutch Institute for Rational Use of Medicine) and eight local stakeholders including physicians, nursing staff[1], and managerial staff. Researchers presented the RCF's pre-test data in comparison with pre-test data from all RCFs, and qualitative data on factors influencing antibiotic prescribing behavior.[7] Next, project team members moderated focus group discussions aimed at discussing the baseline data and identifying facilitators, barriers, and opportunities to improve antibiotic prescribing in that particular RCF. These opportunities were prioritized in a plenary discussion, followed by the selection of interventions that addressed the most promising opportunities. In the next months, tailored interventions were developed and implemented by the local stakeholders in collaboration with the project team. Table 1 provides an overview of the implemented interventions.

Table 1. Interventions implemented in the two intervention RCFs.

Intervention	RCF A	RCF B
Improving physician knowledge by studying relevant guidelines on diagnosis, evaluation and treatment of UTI and RTI	X	X
Optimizing medication formularies for UTI and RTI, based on relevant prescribing guidelines	X	X
Educating nursing staff on infections in general, antibiotics, antibiotic resistance, UTI, and RTI (one hour meetings)	X	X
Developing protocols for nursing staff on recognizing, recording, and communicating infection signs and symptoms	X	X
Agreeing to take urine cultures more regularly	X	

RCF, residential care facility; UTI, urinary tract infection; RTI, respiratory tract infection

Data analysis

We used pharmacy data to calculate the number of therapeutic (as opposed to prophylactic) antibiotic prescriptions and defined daily doses (DDDs; therapeutic and prophylactic) per 1,000 resident-care days (using the number of places in the RCF multiplied by the occupation rates). DDDs were calculated using the WHO ATC/DDD Index 2014. We used data from the residents' medical charts to calculate the percentage of total antibiotic prescriptions that was guideline-adherent, separately for presumed RTI and UTI in residents without a catheter. The decision to not include data from catheterized residents with UTI and residents with SI in these analyses was based on the small numbers of these residents. A guideline-adherent prescription was defined as prescribing the first-choice antibiotic for the presumed infection (i.e., RTI: amoxicillin, UTI: nitrofurantoin) based on national prescribing guidelines (for RTI the guideline 'acute cough' (2011) and for UTI the guideline 'urinary tract infections' (2006), both of the Dutch College of General Practitioners). Quantitative analyses

[1] Nursing staff includes nurses and nurse assistants. United States equivalents: nurse = registered nurse, nurse assistant (levels 2, 3 and 4) = licensed practical nurse (level 4) or nurse aid (levels 2 and 3).

compared pre-post-intervention changes in antibiotic use and guideline-adherent antibiotic selection in intervention and control RCFs. As there were only 2 cases (i.e., RCFs) per group, we did not test between-group differences. Results also address issues related to implementing tailored antibiotic stewardship programs developed with a PAR approach in RCFs (i.e., issues related to recruitment, data collection procedures, and the intervention itself).

Ethics approval

All study procedures were reviewed and approved by the Medical Ethics Review Committee of the VU University Medical Center (Amsterdam, the Netherlands) prior to study commencement. The IMPACT study is registered in The Netherlands National Trial Register (ID number NTR3206).

Results

Antibiotic use and guideline-adherent antibiotic selection

The four participating RCFs had a mean of 68 residents per facility (range: 60 – 82) and a mean occupancy of 99% (range: 98% - 100%). The mean percentage of residents who provided informed consent for chart review was 72% (range: 56% - 90%). We reviewed 236 medical charts, and found data on 494 presumed infections (pre-test, 250; post-test, 244) for 217 residents (pre-test, 105; post-test, 112). Of the recorded infections, most were in female residents (84%, range: 77% - 89%), with a mean age of 87.7 (range: 86.3 – 88.4), and a median length of stay of 35.4 months (range: 18.0 – 49.5). Most of the presumed infections were UTI (pre-test, 52%; post-test, 51%), followed by RTI (pre-test, 27%; post-test, 40%) and SI (pre-test, 21%; post-test, 9%). Antibiotics were prescribed in 82% of the cases in the pre-test phase (range: 62% - 88%), and in 85% of the cases in the post-test phase (range: 81% - 89%).

Table 2. Antibiotic use pre-test and post-test.

	Therapeutic antibiotic prescriptions / 1,000 resident-care days			DDD / per 1,000 resident-care days		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
Intervention RCFs						
A	5.0	4.7	-0.3	45.7	44.5	-1.2
B	3.5	4.0	+0.5	43.7	53.8	+10.1
Control RCFs						
C	7.2	5.5	-1.7	46.4	35.6	-10.8
D	2.6	5.2	+2.6	30.9	44.6	+13.7

DDD, defined daily doses; RCF, residential care facility

Table 2 shows the number of antibiotic prescriptions and the number of DDDs per 1,000 resident-care days, per RCF and study phase. The numbers suggest no trend toward increased or decreased antibiotic use in intervention versus control RCFs (i.e., one RCF in both arms evidenced increased use, and one in both arms evidenced decrease use). Figure 1 shows the percent of guideline-adherent selection of antibiotics for RTI (1A) and UTI in residents without a catheter (1B), per group and study phase. There was a notable increase in first-choice antibiotic selection for RTI in intervention RCFs (from 13% to 69%) compared to control RCFs (from 20% to 29%).

For UTI, a smaller increase in guideline-adherent antibiotic selection was observed in interventions RCFs (from 42% to 56%), whereas a decrease was observed in control RCFs (from 62% to 42%).

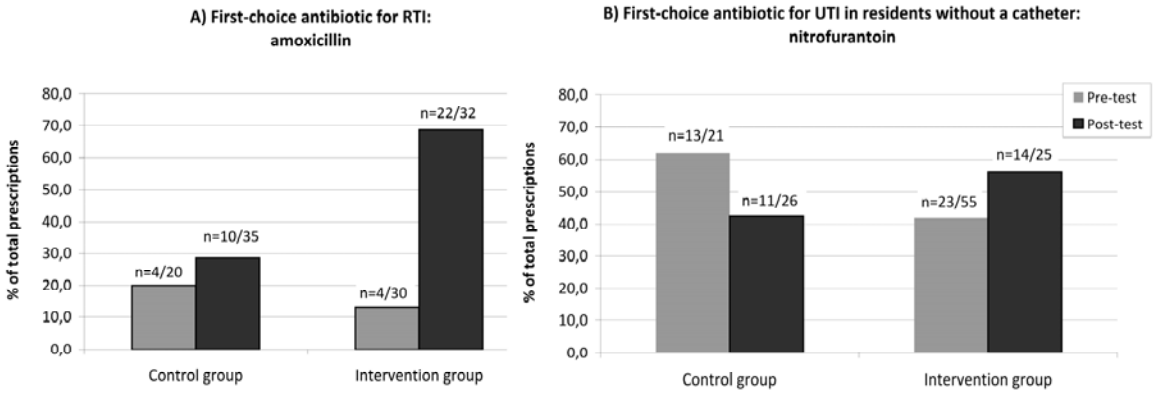

Figure 1. Percentages guideline-adherent antibiotic selection for respiratory tract infection (RTI; A) and urinary tract infection (UTI) in residents without a catheter (B), per group and study phase.

Implementation issues

When conducting the study, we experienced two issues that resulted in deviation from the original study plan. First, our original recruitment strategy was to approach RCFs first and next their affiliated general practices. However, in many RCFs a large number of general practices each served only a small number of residents, making it unlikely and infeasible to engage all GPs in the study. We therefore chose to include only RCFs that were affiliated with limited numbers of practices, by approaching GPs who provided medical care to substantial numbers of RCF residents. Second, we intended to evaluate the appropriateness of antibiotic prescribing decisions in RCFs using guideline-based algorithms, similar as we did in our NH study.[13] In the NHs, physicians completed recording forms for this purpose, but in RCFs, such forms were not completed by physicians due to time constraints. We anticipated that we could instead use the information derived from the medical charts for this evaluation, but the quality of this information was insufficient to do so.

With regard to the collection of pharmacy data, no issues were encountered. In addition, we did not encounter any issues related to the selection, development, and implementation of interventions. The multidisciplinary meetings were well-attended by a variety of local stakeholders who were motivated to develop and implement a variety of interventions directed at improving antibiotic use (table 1).

Discussion

We conducted a study in RCFs in the Netherlands aimed at implementing tailored antibiotic stewardship programs with a PAR approach. The PAR approach worked well in that the local stakeholders were motivated to be actively involved in the selection, development and implementation of tailored interventions aimed at improved

antibiotic use. The findings of this small study suggest a positive effect of these interventions on adherence to antibiotic prescribing guidelines, as we observed an increase in guideline-adherent selection of antibiotics in intervention RCFs for RTI and, to a lesser extent, for UTI in residents without a catheter. The observation of increased guideline-adherent antibiotic selection is likely attributable to a combination of feedback on antibiotic prescribing patterns and the guideline-based evaluation of medication formularies, as these intervention activities were the ones focusing on choice of antibiotic types.

We did not observe decreased antibiotic use in intervention versus control RCFs. This lack of effect may be explained by the baseline number of 4.6 antibiotic prescriptions per 1,000 resident-care days, which is close to the lower bound of the range of 3.4 – 11.5 antibiotic courses per 1,000 resident-care days reported in LTCF in other countries,[14-23] which suggests little room for improvement a priori.

We hypothesized that it may be more difficult to conduct a study aimed at implementing tailored antibiotic stewardship programs in RCFs compared to NHs in the Netherlands, as the on-site presence of physicians in the latter setting may facilitate the study conduction. Indeed, in our NH study, we did not encounter the two issues experienced with RCFs (i.e., the challenge of recruiting facilities affiliated with a large number of general practices, and the inability of physicians to complete recording forms).[13] The inclusion of only RCFs affiliated with limited numbers of GPs in the current study raises the question of how to implement a PAR approach in settings with a high number of involved stakeholders, such as RCFs with residents cared for by many GPs and NHs in countries where medical care is provided by many different practices. A similar study conducted in the United States found that it was more challenging to involve the numerous medical care providers of RCFs in an antibiotic prescribing training program, compared to the limited number of medical care providers of NHs.[24] Therefore, if medical care is provided by many different GPs or practices, efforts should be made to ensure the involvement of all stakeholders.

Both the inability of GPs to complete recording forms and the limited quality of data derived from the medical charts of residents resulted in the failure to determine the appropriateness of antibiotic prescribing decisions. The limitation of using medical charts has been previously reported in studies that aimed to evaluate antibiotic prescribing.[25,26] This finding advocates for the use of more standardized recording forms (such as in our NH study and in the US study reported above),[13,24] or the need to improve routine recording practices in research that evaluates the appropriateness of antibiotic use.

Conclusion

In the RCFs included in the current study, with medical care provided by a limited number of general practices, PAR seems a promising approach for the implementation of tailored interventions that are successful in improving guideline-adherent antibiotic prescribing. Future research is needed to evaluate if and how this approach can be applied in RCFs affiliated with multiple general practices.

Acknowledgements

We thank the RCFs for their participation in the study, in particular the residents and their family members for giving permission for chart review. We also thank the general practices for their participation in the study, and for facilitating the collection of data from medical charts. In addition, we thank the affiliated pharmacies for providing data on antibiotic use. From the Dutch Institute for Rational Use of Medicine (IVM), we acknowledge Marjorie Nelissen, Anke Lambooij, and Gemma Yocarini, for contributing to the development of material for the intervention phase of the study, and their involvement in intervention activities in the participating RCFs.

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