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# Participatory action research in antimicrobial stewardship: a novel approach to improving antimicrobial prescribing in hospitals and long-term care facilities

**Laura W. van Buul[1,2]†, Jonne J. Sikkens[1,3,4]†, Michiel A. van Agtmael[3,4]*, Mark H. H. Kramer[5], Jenny T. van der Steen[1,2] and Cees M. P. M. Hertogh[1,2]**

*[1]EMGO Institute for Health and Care Research, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands; [2]Department of General Practice and Elderly Care Medicine, VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands; [3]Department of Internal Medicine: Infectious Diseases section, VU University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands; [4]Department of Internal Medicine: Pharmacotherapy section, VU University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands; [5]Department of Internal Medicine, VU University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands*

*Corresponding author. Tel: +31204448094; Fax: +31204444313; E-mail: agtmael@vumc.nl
†These authors made equal contributions.

It is challenging to change physicians' antimicrobial prescribing behaviour. Although antimicrobial prescribing is determined by contextual (e.g. a lack of guidelines), cultural (e.g. peer practice) and behavioural (e.g. perceived decision making autonomy) factors, most antimicrobial stewardship programmes fail to consider these factors in their approach. This may lead to suboptimal intervention effectiveness. We present a new approach in antimicrobial stewardship programme development that addresses relevant determinants of antimicrobial prescribing: participatory action research (PAR). PAR is a collaborative process that aims to bring about change in social situations by producing practical knowledge that is useful in local practice. It requires substantial involvement of relevant stakeholders to address determinants of the studied behaviour and to facilitate empowerment. PAR is well suited for complex problems in multidisciplinary settings as it adapts to local needs, delivering a tailored approach to improving local practice. We describe how PAR can be applied to antimicrobial stewardship, and describe the PAR design of two ongoing multicentre antimicrobial stewardship projects, in the acute care setting and the long-term care setting, respectively.

**Keywords:** prescribing practice, intervention implementation, antimicrobial prescribing behaviour

## Introduction

Antimicrobial stewardship programmes aim to improve antimicrobial prescribing to reduce antimicrobial resistance development, reduce costs and improve clinical outcomes. Antimicrobial prescribing is determined by contextual but also cultural and behavioural factors.[1–4] Examples of contextual factors include a lack of guidelines or access to guidelines, a lack of diagnostic resources, patient characteristics (e.g. clinical features, comorbidities, communication possibilities), patient expectations, nursing staff expectations, a lack of time or workforce and frequent staff turnover.[1,5–10] An example of a cultural factor is 'prescribing etiquette', a term describing the set of unwritten but widely accepted cultural rules around prescribing.[4] Examples of behavioural factors include a lack of awareness of guidelines, a lack of agreement with guidelines, physicians' perceived decision-making autonomy, fear of withholding or adjusting treatment and resistance to change current practice ('never change a winning team').[1,5,11–18]

Although many antimicrobial stewardship strategies are available,[11,12,19] changing physicians' prescribing behaviour is challenging,[13,14] due to the combination of the aforementioned influencing factors and the variety of possible interventions, disciplines, healthcare professionals and healthcare settings involved. Most antimicrobial stewardship strategies fail to consider contextual, cultural and behavioural factors in their approach, which may lead to suboptimal intervention effectiveness.[12,15,16] Antimicrobial prescribing improvement programmes should therefore include a proper analysis of relevant determinants.[1–4] We present an approach that addresses these determinants: participatory action research (PAR). To illustrate the use of PAR in antimicrobial stewardship programme development, we describe a study design that has been applied in two different healthcare settings (i.e. the acute care setting and the long-term care setting).

## PAR

A research approach that is well suited to addressing complex problems in healthcare settings is PAR. This approach always uses qualitative research methods, often combined with quantitative methods.[20,21] A primary aim of PAR is to produce practical knowledge that is useful in local practice.[22] Several definitions of action research have been developed over the years.[20,22–24] We incorporated these definitions into the following description of PAR:

> Participatory action research aims to bring about change in social situations by both *improving practice* (i.e. taking action) and *creating knowledge or theory* (i.e. reflecting on action). In other words, it bridges the gap between theory and practice. It works through a *cyclical process* of planning, action and reflection. This process is *collaborative*: it requires substantial involvement of relevant stakeholders, which facilitates empowerment. The persons under study are considered 'co-researchers' who test practices and gather evidence in action phases, and evaluate this action and plan further action in reflection phases. In other words, participatory action research is working *with* people, not *on* people.

Whereas PAR has been described and applied in social sciences since the 1940s, hardly any PAR was published in the context of healthcare until the late 1990s.[22] Since then, the use of PAR in healthcare has increased.[21,25,26] PAR differs in several aspects from randomized controlled trials (RCTs), which are considered the gold standard in healthcare research.[27] This is based on the consensus that the highest level of evidence can only be derived from settings where influences on the outcome other than the intervention are controlled.[25] As PAR is an approach that involves multiple factors, interventions and stakeholders, it is not feasible to control every single aspect of the research situation. Consequently, outcomes cannot be attributed to a single intervention: it is the process as a whole that brings about change. An advantage of this multifactorial and multidisciplinary involvement is that PAR produces evidence that is of practical use to the local setting for which it is intended. The latter is not always true for evidence produced by RCTs, as real-life situations may not be comparable to the controlled situation. This is especially a concern in geriatric medicine: as people with older age, comorbidities, polypharmacy, decreased cognitive function and physical impairment are often excluded from participation in RCTs, the potential to generalize trial findings to this population is limited.[28] It can therefore be argued that the context and research question determines which research approach delivers the best-quality evidence. In clinical situations where multidisciplinary teams work with complex problems, new situations or whole systems, PAR may be an appropriate approach.[25,26]

Due to the complex and multidisciplinary character of antimicrobial stewardship programmes, PAR seems a suitable approach for developing, implementing and evaluating these programmes. However, we are not aware of any studies describing the use of PAR in the development of antimicrobial stewardship programmes. We did, however, identify two studies that used PAR in studies on prescribing drugs other than antimicrobials. Dollman *et al.*[29] described a PAR approach that was effective in reducing benzodiazepine use in the management of insomnia in a rural community. PAR has also been shown to be effective in improving medication use in general practice by first enabling the understanding of patient barriers to optimal medication use and subsequently offering tailored interventions.[30] In addition, PAR has been reported as an effective approach in complex healthcare situations other than drug prescribing. Examples include the development and implementation of a critical pathway for patients with symptoms suggestive of an acute coronary syndrome,[31] the development and implementation of a model of care for older acutely ill hospitalized patients,[32] and the identification of potentially feasible interventions for the improvement of dietary habits and physical activity.[33]

## A PAR design for antimicrobial stewardship

Although to date PAR has not been used to improve antimicrobial prescribing, we hypothesize that this approach is suitable for the development, implementation and evaluation of antimicrobial stewardship programmes, as it is for other complex healthcare situations. Below we describe a research design that uses PAR to develop, implement and evaluate antimicrobial stewardship programmes. The design consists of nine phases, each representing an element of the cyclical process of planning, action and reflection that is typical of PAR (Figure 1). Furthermore, in Table 1 we present two applications of the design in two different healthcare settings: the DUMAS project (acute care) and the IMPACT project (long-term care).

### *Phase 1: preparation (planning)*

Identifying and contacting participating centres and their relevant stakeholders (e.g. physicians, nursing staff, pharmacists, microbiologists, infectious disease consultants and managerial staff), initiating partnership development, determining objectives and key outcomes, and planning data collection.

### *Phase 2: data collection (action)*

Researchers collect local quantitative and qualitative data on (appropriateness of) antimicrobial use, factors that influence antimicrobial prescribing and potential areas for improvement.

### *Phase 3: data evaluation (reflection)*

The data collected in Phase 2 are analysed by the researchers and presented to relevant stakeholders of the involved healthcare setting. The data are subsequently discussed.

### *Phase 4: data uptake (action)*

Relevant stakeholders and researchers collaboratively identify facilitators and barriers with regard to antimicrobial use, and determine opportunities to improve appropriate antimicrobial use.

### *Phase 5: intervention selection (action)*

Based on the analysis of facilitators and barriers in Phase 4, the stakeholders discuss intervention types that suit their preferences and their identified opportunities. Subsequently, they select existing interventions, or interventions that need to be adjusted or developed, for implementation in collaboration with the researchers.

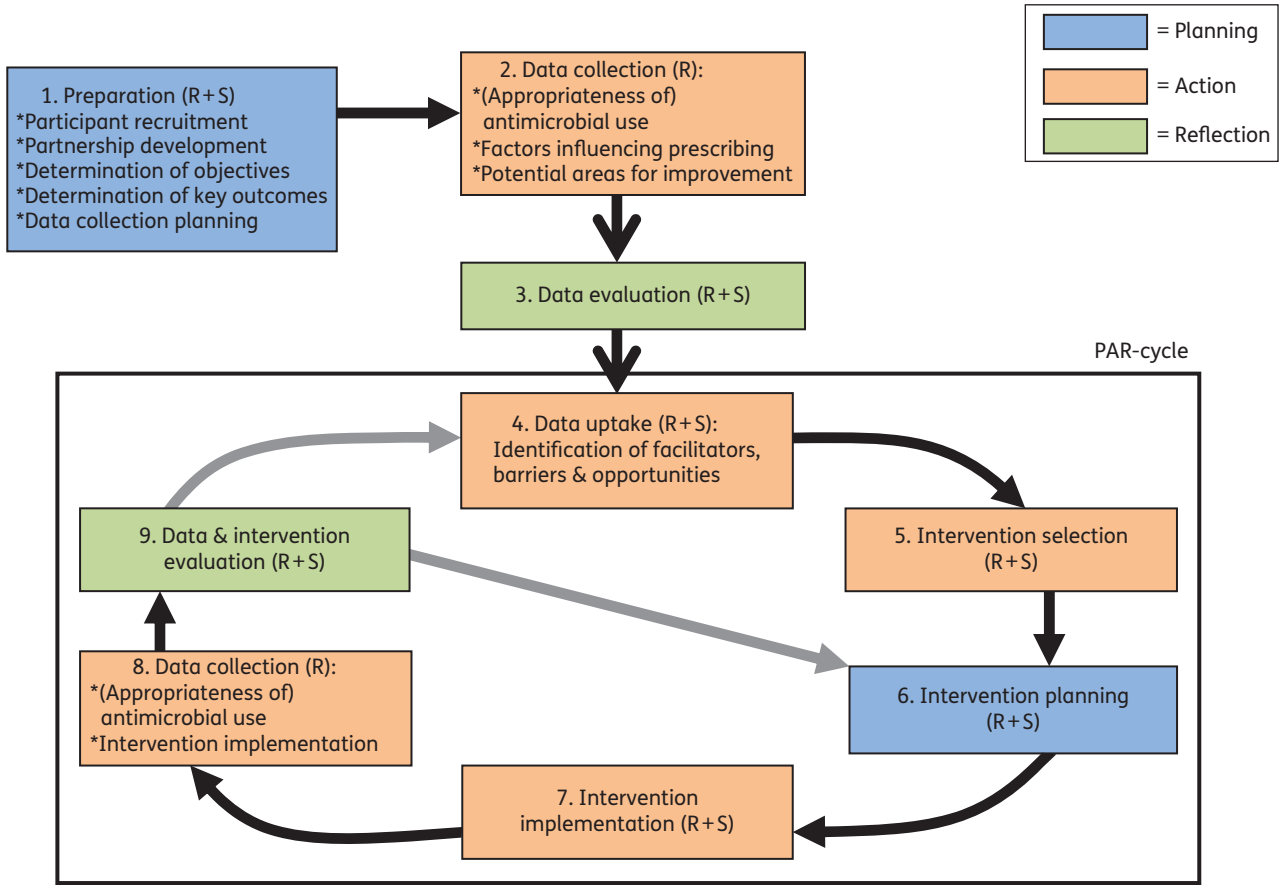


**Figure 1.** Visualization of the PAR design for the development, implementation and evaluation of antimicrobial stewardship programmes. R, researchers; S, (relevant) stakeholders.

### *Phase 6: intervention planning (planning)*

In collaboration with the researchers, the stakeholders create a plan for development, adjustment and implementation of the interventions selected in Phase 5, including elements to ensure sustainability of the interventions.

### *Phase 7: intervention implementation (action)*

The interventions described in Phase 6 are developed, adjusted and implemented by the researchers and stakeholders collaboratively.

### *Phase 8: data collection (action)*

Researchers collect local quantitative and qualitative data on (appropriateness of) antimicrobial use and the implementation of the interventions.

### *Phase 9: data and intervention evaluation (reflection)*

The data collected in Phase 8 are analysed by the researchers, compared with the data collected in Phase 2 and presented to all relevant stakeholders of the involved healthcare setting. The stakeholders reflect on the data and the implemented interventions. Where necessary, adjustments are made to the intervention plan or new opportunities are determined, in which case another cycle of planning, action and reflection follows.

## First experiences with PAR in antimicrobial stewardship

Examples of interventions selected in the PAR process in acute care settings (DUMAS project) include interactive education of physicians, guideline optimization, optimization of guideline accessibility, E-learning, work process restructuring and publicity campaigns on guideline importance. The selected intervention types differed by medical specialty and ward, due to the identification of different barriers and variable preferences. For example, ear–nose–throat surgeons preferred the development of a concise pocket guideline card with the most common infections in their practice, whereas internists preferred education and a comprehensive guideline app for smartphones. In long-term care settings (IMPACT project), examples of selected interventions include optimization of local therapeutic guidelines, optimization of diagnostic protocols, physician education, nursing staff education, the development of standardized checklists on which the nursing staff register signs and symptoms of infections, and taking routine urine cultures to determine local resistance patterns. The selected intervention types

**Table 1.** Design of DUMAS (acute care) and IMPACT (long-term care), two multicentre projects that apply PAR to the development, implementation and evaluation of an antimicrobial stewardship programme

| | Dutch Unique Method for Antimicrobial Stewardship (DUMAS) | Improving Rational Prescribing of Antibiotics in Long Term Care Facilities (IMPACT) (The Netherlands National Trial Register ID: NTR3106) |
|---|---|---|
| Population | Hospital inpatients (1 tertiary care centre and 2 community hospitals) in the Netherlands. | Residents of 10 nursing homes (NHs) and 4 residential care facilities (RCFs) in the Netherlands. |
| Design | Initiation of PAR approach varies per participating clinical ward according to a stepped wedge design. | Facilities are allocated to an intervention or a control group (5 NHs and 2 RCFs each). The control group proceeds through the phases in a different order: 1, 2, 8, 3, 4, 5, 6, 7 (Phase 9 skipped). |
| Analysis | Intervention effect evaluated using segmented regression analysis of antimicrobial consumption and appropriateness, combined with qualitative data analysis. Levels and slopes of appropriateness in the period prior to PAR Phase 3 are used as control data within and between departments. | Intervention effect evaluated using multilevel regression analysis (intervention group versus control group), combined with qualitative data analysis. |
| Time schedule | October 2011–Spring 2015 | March 2011–Spring 2014 |
| PAR phases | | |
| 1. Preparation | Determine objectives and target hospitals. Invite hospitals and all wards to participate. Identify and contact coordinating ward specialists. Determine key outcomes and collaboratively prepare data collection. | Determine objectives and randomly invite facilities to participate. Allocate facilities to the intervention or control group. Identify and contact relevant stakeholders. Determine key outcomes and collaboratively prepare data collection. |
| 2. Data collection | Researchers conduct 2-monthly point-prevalence surveys of antimicrobial prescribing and retrieve pharmacy data. Appropriateness of prescribing is judged by local hospital guidelines using a standardized algorithm.[34] (Duration: Phase 3 starts after 12 months but the surveys of Phase 2 are continued until the end of the project.) | Quantitative data collection: registration of infection diagnosis and treatment by physicians, chart review by researchers and retrieval of pharmacy data. Physicians' registered data are used to judge appropriateness of antibiotic prescribing with a guideline-based algorithm developed by an expert panel. Qualitative data collection: semi-structured interviews with physicians and nursing staff on antibiotic prescribing and resistance. |
| 3. Data evaluation | In individual semi-structured interviews, ward members evaluate Phase 2 data and discuss potential interventions. These ward members are selected in collaboration with the local 'ward team' (coordinating medical specialist, specialist in training and nurse), which is established in each ward as the first point of contact. Researchers present survey and interview results to all ward members, followed by a discussion. | Researchers present the local study results to the facilities in the intervention group and discuss them in a multidisciplinary team meeting with relevant stakeholders, including physicians, nursing staff, pharmacists, microbiologists and managerial staff. |
| 4. Data uptake | Collaboratively identify local facilitators and barriers to appropriate antimicrobial prescribing and opted interventions. *Example: the surveys may reveal that a ward frequently uses amoxicillin/clavulanate to treat surgical site infections (SSIs), whereas flucloxacillin or even no antibiotic treatment is recommended by the guidelines. The interviews may show that this can be explained by a combination of concerns for consequences of SSIs, custom, convenience (e.g. amoxicillin/clavulanate generally covers most pathogens for most infections) and a lack of knowledge of alternatives and the guidelines recommending them.* | Relevant stakeholders identify local facilitators and barriers to appropriate antibiotic prescribing in focus group discussions facilitated by the researchers, and prioritize opportunities to improve antibiotic prescribing. *Example: the study results may reveal a substantial level of inappropriate antibiotic prescribing for urinary tract infections. Potential barriers to appropriate prescribing that may be identified are suboptimal communication between nursing staff and physicians, perceived patient pressure to prescribe antibiotics and a lack of local therapeutic guidelines.*[1,5,7,8] |

*Continued*

**Table 1.** *Continued*

| | Dutch Unique Method for Antimicrobial Stewardship (DUMAS) | Improving Rational Prescribing of Antibiotics in Long Term Care Facilities (IMPACT) (The Netherlands National Trial Register ID: NTR3106) |
|---|---|---|
| 5. Intervention selection | The local ward team and the researchers collaboratively select the definite bundle of interventions. The choice of interventions is unrestricted but inclusion of at least an educational, a structural, an organizational and a cultural intervention is promoted.[16] | Relevant stakeholders select interventions that suit the opportunities prioritized in Phase 4, in collaboration with the researchers. |
| 6. Intervention planning | Collaboratively plan development, adjustment and implementation of the selected intervention(s). | Collaboratively plan development, adjustment and implementation of the selected intervention(s). |
| 7. Intervention implementation | Collaboratively develop, adjust and implement interventions. *Example: for the ward in the above-described example, the bundle may comprise E-learning for physicians and nurses on the therapy of SSIs and the effects of overuse of amoxicillin/clavulanate on resistance (educational intervention), automatic stop orders for antibiotics (structural intervention), rewriting local SSI therapy guidelines and handing out pocket summaries (organizational intervention) and appointing a staff member as antibiotic 'champion' who encourages colleagues to prescribe appropriately during regular clinical meetings (cultural intervention).* | Collaboratively develop, adjust and implement interventions. *Example: in the case of the above-described example, stakeholders may decide to implement a protocol for nursing staff to improve communication with physicians about symptoms of urinary tract infections, physician training in coping with external pressure and physician–pharmacist meetings aimed at developing therapeutic guidelines applicable to the local setting.* |
| 8. Data collection | Ongoing point-prevalence surveys of antimicrobial appropriateness (see Phase 2) combined with frequent contacts with each local ward team. | Data collection (see Phase 2) is repeated, combined with a questionnaire survey on perceptions of the activities that occurred in Phases 3–7. |
| 9. Evaluation | Evaluate the effectiveness of the implemented interventions by using Phase 8 data. Adjust the intervention bundle where necessary (repeat the procedure from Phase 6 to Phase 9). If the desired effect is not achieved according to both the researchers and the ward (*e.g. there are continued signs of inappropriate amoxicillin/clavulanate use*), repeat the PAR procedure starting at Phase 4 (the researchers will be involved in at least one repeated cycle if needed). | Evaluate the effectiveness of the implemented interventions by comparing pre- and post-intervention data. *In the case of the above-described example, the selected interventions are judged successful if the level of inappropriate prescribing for urinary tract infections has decreased to an acceptable level (as determined collaboratively by researchers and relevant stakeholders, based on the literature and overall findings in the facilities participating in the project).* Report the results to each facility; this allows them to reflect on their and other facilities' performance. Where necessary, adjust interventions or develop new interventions, in which case the PAR procedure is repeated starting at Phase 4 (by the relevant stakeholders themselves; researchers are involved in the PAR cycle up to this point). |

differed by long-term care facility, and if similar intervention types were selected the focus often differed (e.g. optimizing diagnostic protocols for urinary tract infections in one facility and for respiratory tract infections in another).

In both projects, several participants expressed their appreciation of being involved in the development and implementation of the antimicrobial stewardship programme. A surgeon participating in the DUMAS project stated: 'the approach appeals to me because people are more involved instead of getting an assignment. I think that giving people the initiative will lead to more effect. New projects are generally critically received because we are already overloaded with things we must do, and people can be rigid, making change difficult. So they will love being in charge themselves.' Regarding the multidisciplinary nature of the approach, DUMAS participants indicated that this intensifies and improves mutual understanding and collaboration between different medical specialties. For example, the approach enables infectious disease consultants to better promote appropriate prescribing across hospital wards ('management by walking around'). The appeal of the PAR approach is also reflected in the high participation rate of the IMPACT project: 11 of 12 invited nursing homes wanted to participate in the project. A general practitioner stated: 'The thing I like about IMPACT is that you do not only get insight into how you are doing [with regard to antibiotic prescribing], you can also actually do something about it, and you can decide with all those involved what should be good to do.'

A challenge experienced throughout the PAR process in both projects is time pressure on relevant stakeholders. As the

involvement of relevant stakeholders is crucial for the process, it is important to prioritize intervention development and implementation by first focusing on the most important barriers to be addressed. It can also be challenging to keep relevant stakeholders motivated and involved. Two important conditions are needed to achieve this. First, regular contact between the researcher and relevant stakeholders ensures that relevant stakeholders remain well informed about the antimicrobial stewardship programme development process, and in turn that researchers remain well informed about local practice. The second condition is the appointment of a 'champion', a stakeholder who promotes exemplary prescribing behaviour and is responsible for ensuring involvement of colleagues in the PAR process.

## Discussion

We propose PAR as a new approach to the development of antimicrobial stewardship programmes in local healthcare settings. This approach systematically analyses and accounts for the many contextual, cultural and behavioural factors involved in local antimicrobial prescribing, to optimize intervention effectiveness. We show how a PAR design has been applied to antimicrobial stewardship using the example of two Dutch multicentre antimicrobial stewardship projects, in the hospital setting (DUMAS) and long-term care setting (IMPACT), respectively. Key to these projects is the participation of physicians, nursing staff and other relevant stakeholders, who are motivated for and actively involved in changing their own practice.

The first experiences of the DUMAS and IMPACT projects show that the selected intervention types differ between care settings (acute care versus long-term care) but also within care settings (e.g. between different locations or departments), which strengthens the assumption that complex clinical settings need a tailored approach to antimicrobial stewardship programme development rather than a 'one size fits all' approach. Some differences between and within care settings may be attributed to variation in patient population. For example, in the acute care setting, appropriate antimicrobial prescribing may be more challenging in the intensive care unit or the emergency department as there may be insufficient time to check local guidelines in urgent situations.[35–37] In long-term care facilities, decision making on antimicrobial prescribing is different for residents with limited life expectancy, where medical considerations are often accompanied by ethical and legal considerations.[38] Other differences between and within care settings may be attributed to practical considerations. For example, availability of diagnostic resources in long-term care facilities is limited compared with acute care settings.[6,7] Practical considerations may play an even more important role in low-income countries, where resources may be scarce (e.g. limited access to web-based interventions or diagnostic resources). PAR does not depend upon the availability of specific interventions, and accounts for diversity in local facilitators and barriers. Therefore, we expect this approach to be broadly applicable to antimicrobial stewardship in a wide variety of local settings.

The applicability of PAR to antimicrobial stewardship programmes depends on the motivation and involvement of relevant stakeholders. Our first experiences indicate that this can be supported by ensuring close collaboration between researchers and local stakeholders, and the appointment of an exemplary relevant stakeholder as 'champion'. In addition, participants in the DUMAS and IMPACT projects indicated that the collaborative nature of PAR results in greater engagement compared with top-down approaches. Indeed, top-down approaches can result in prescribers' resistance to antimicrobial stewardship programmes, explained by some as due to perceived threat to physicians' autonomy.[39]

A concern of the applicability of PAR in antimicrobial stewardship is that the involvement of physicians, nursing staff and other relevant stakeholders in intervention selection and development may lead to the selection of the easiest, least invasive and therefore possibly least effective interventions. This is in line with several studies showing that interventions directed at behaviour or attitudes are difficult to implement, whereas these are generally more effective in changing clinical practice.[40,41] However, first addressing facilitators, barriers and opportunities with regard to appropriate antimicrobial prescribing, and selecting interventions thereafter, encourages the selection of interventions that take these facilitators and barriers into account. In addition, we believe that confronting participants with their prescribing behaviour motivates increased effort to improve, especially in these times of increasing transparency of healthcare quality.

A limitation of the PAR approach is that it does not enable the determination of which interventions in a bundle are (the most) effective and which are not, because it is the approach as a whole that is evaluated rather than its individual components. Nevertheless, the aim of PAR in the context of antimicrobial stewardship is not to produce successful interventions that are generalizable to other settings, but to produce an antimicrobial stewardship programme that is applicable to an individual setting. Consequently, results of a PAR approach cannot be directly extrapolated to other (local) settings. Nevertheless, the experience of previous PAR in antimicrobial stewardship will yield practical knowledge about specific situations, which may accelerate the application of the methodology in new settings.

In conclusion, we presented two multicentre antimicrobial stewardship projects to show how PAR can be applied to antimicrobial stewardship in different healthcare settings. This approach includes an analysis of determinants of complex problems in local, multidisciplinary situations to generate tailor-made solutions. Based on the literature and first experiences of the projects, PAR is a new and promising approach in the challenging field of changing physician behaviour in antimicrobial prescribing.

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## Transparency declarations

Conflicts of interest: none to declare.

### *Author contributions*

M. H. H. K. contributed to the conception of the DUMAS study. J. J. S. and M. A. v. A. contributed to the conception and design of the DUMAS study. J. T. v. d. S. and C. M. P. M. H. contributed to the conception and design of the IMPACT study. L. W. v. B. contributed to the design of the IMPACT study. L. W. v. B. and J. J. S. screened and selected relevant literature, analysed and interpreted the literature, and drafted the article. All authors revised the article critically for important intellectual content and approved the final draft.

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