

BMJ Open What factors in the workplace enable success in antimicrobial stewardship in paediatric intensive care? An exploration of antimicrobial stewardship excellence through thematic analysis of appreciative inquiry interviews with healthcare staff

Emma Roche, Alison Jones, Adrian Plunkett 

To cite: Roche E, Jones A, Plunkett A. What factors in the workplace enable success in antimicrobial stewardship in paediatric intensive care? An exploration of antimicrobial stewardship excellence through thematic analysis of appreciative inquiry interviews with healthcare staff. *BMJ Open* 2024;**14**:e074375. doi:10.1136/bmjopen-2023-074375

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2023-074375>).

Received 04 April 2023
Accepted 02 January 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

Paediatric Intensive Care Unit, Birmingham Women's and Children's NHS Foundation Trust, Birmingham, UK

Correspondence to

Dr Adrian Plunkett;
adrianplunkett@nhs.net

ABSTRACT

Objectives Antimicrobial resistance (AMR) is a major global health problem. Efforts to mitigate AMR prioritise antimicrobial stewardship (AMS) interventions. These interventions typically focus on deficiencies in practice and providing negative or normative feedback. This approach may miss opportunities to learn from success. We aimed to identify factors that enable success in AMS practices in the paediatric intensive care unit (PICU) by analysing the data obtained from interviews with staff members who had achieved success in AMS.

Design Qualitative study design using thematic analysis of appreciative inquiry interviews with healthcare staff.

Setting 31-bedded PICU in the UK between January 2017 and January 2018.

Participants 71 staff who had achieved success in AMS in the PICU.

Results Six themes were identified: (1) cultural factors including psychological safety, leadership and positive attitude are important enablers for delivering good clinical care; (2) ergonomic design of the physical environment and ready availability of tools and resources are key elements to support good practice and decision-making; (3) expertise and support from members of the multidisciplinary team contribute to good care delivery; (4) clarity of verbal and written communication is important for sharing mental models and aims of care within the clinical team; (5) a range of intrinsic factors influences the performance of individual HCPs, including organisation skill, fear of failure, response to positive reinforcement and empathetic considerations towards peers; (6) good clinical care is underpinned by a sound domain knowledge, which can be acquired through training, mentorship and experience.

Conclusion The insights gained in this study originate from frontline staff who were interviewed about successful work-as-done. This strengths-based approach is an understudied area of healthcare, and therefore offers authentic intelligence which may be leveraged to effect tangible improvement changes. The methodology is not

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The source data in this study were obtained from frontline staff who have accomplished successful work-as-done in antimicrobial stewardship.
- ⇒ This study examines work from the seldom explored perspective of success, providing novel opportunities for eliciting insights.
- ⇒ The interviews were conducted with a diverse range of staff, capturing a broad spectrum of perspectives.
- ⇒ The source data consisted of field notes recorded by researchers, which may be susceptible to recall and observer bias.
- ⇒ This study did not include interviews with team members who did not achieve excellence in antimicrobial stewardship, potentially limiting exploration of novel ideas concerning barriers to good practice.

limited to AMS and could be applied to a wide range of healthcare settings.

INTRODUCTION

Antimicrobial resistance (AMR) is widely recognised as a major global health problem. The primary driver of AMR is the use of antimicrobial agents, and therefore efforts to mitigate the risk of AMR tend to prioritise antimicrobial stewardship (AMS). AMS is a set of interventions and strategies to ensure that patients receive appropriate choice of antimicrobial agent, dose and duration of therapy.¹

Methods to improve practice in AMS include audit with feedback; technological solutions including decision support and restrictions of access to antimicrobial agents.² The first of these methods, audit



with feedback, is recommended as standard practice in national and international guidance for healthcare practitioners.¹ Feedback to professionals in AMS is typically negative or normative; it is designed to change behaviours by highlighting deficiencies in practice, or by comparing practice with peers.³ Positive feedback for good practice is rarely used to drive improvement.

Prioritising attention to deficiencies is also typical of efforts to improve quality and safety in healthcare more generally. Improvement efforts typically start with the identification of failure, and interventions are then designed to mitigate or eliminate these failures.⁴ This approach may overlook the fact that failure represents a very small part of the overall spectrum of interventions in healthcare, the vast majority of which are successfully performed.⁵ Success does not occur automatically: adaptations in work are required in order to avoid failure in the context of dynamic working conditions. Understanding these adaptations may provide insight about the conditions which enable success and identify novel improvement interventions.⁵

Learning from the entire spectrum of work, including both success and failure, is the aim of Safety-II: a concept from safety science in which safety is considered a condition in which as many things as possible go right⁵—contrasting with the prevailing view in which safety is a condition in which as few things as possible go wrong. Practical applications of Safety-II require study and analysis of everyday work in order to understand how work is done^{6,7}: in Safety-II everyday work is referred to as work-as-done, contrasting with the work described in guidelines and standard operating procedures: work-as-imagined.

Learning from excellence (LFE) is a strengths-based initiative in healthcare which aims to identify excellent practice for the purposes of learning and providing positive feedback to professionals.⁸ This approach is aligned with Safety-II as it necessitates recognition and enquiry into successful work-as-done.

In 2019, we reported improvements in AMS in a paediatric intensive care unit (PICU) following implementation of interventions derived from the LFE initiative.⁹ These improvements included a reduction in antimicrobial use (most notably a reduction in broad-spectrum antimicrobial consumption by 17.6%); improved documentation of antimicrobial prescription and administration and rate of daily review of antimicrobials on PICU ward rounds. The interventions comprised positive feedback and appreciative inquiry (AI) interviews following episodes of successful AMS practice.⁹ The data obtained from the AI interviews was not systematically analysed as part of the previous quality improvement (QI) study, since the primary purpose of the interviews was a psychological intervention to reinforce positive feedback and generate improvement ideas.

Therefore, the purpose of the present study was to examine the AI interview data to seek a more profound understanding of the conditions which underpin excellent practice. This approach is complementary to the

prevailing approach to improvement which tends to focus on understanding failure. A recent systematic review identified a lack of high-quality empirical evidence to support the effectiveness of AI to inform positive change in the quality and safety of healthcare,¹⁰ so we intend the results of this study to build on the research in this area.

We conducted a thematic analysis of the data obtained from the AI interviews in order to answer the following research question: ‘What factors in the workplace enable success in AMS practices in PICU?’ We propose that identification of these factors may provide insights to inform changes based on success, to complement existing improvement efforts.

METHODS

We carried out a thematic analysis of AI interviews with healthcare staff who had achieved success in AMS practices in PICU. The interviews were conducted during a previously reported QI project, which took place in a 31-bedded PICU in a tertiary children’s hospital in the UK, over a period of 12 months from January 2017 to January 2018. Full details of the QI project methodology and results are published elsewhere,⁹ and elements of the methodology which are relevant to the present study are detailed below.

During the QI project study period, successful practice in AMS, defined by national guidance, was identified daily in the PICU. AMS practices included behaviours relating to the prescribing, timely administration and de-escalation of antimicrobials. Healthcare professionals (HCPs) who achieved success in AMS practice during the study period were invited to take part in an interview to discuss factors which enabled the successful practice.

Research team

A multidisciplinary research team was formed at the start of the present study. The team comprised a consultant paediatric intensivist with experience in leading QI projects and AI; a clinical researcher with experience in QI, AI and coordination of clinical trials and a postgraduate doctor in training in paediatric intensive care medicine. All members of the team were working in the same PICU as the study participants and were recognised as being affiliated with the LFE movement.

Study participants

A convenience sampling method was used: PICU staff members who were identified as achieving good practice in AMS during the QI study period were invited to participate in the interviews. The HCP workforce in PICU at the time of the study comprised 230 nurses and 35 prescribers, including postgraduate doctors in training and advanced nurse practitioners. Staff members who achieved good practice in AMS on more than one occasion were invited to a single interview, that is, repeat interviews were not

Table 1 Interview schedule

Date of interview	Responses/Notes
Definition: Purpose of meeting	To discuss excellence in AMS practice
Discovery: Please describe what happened that day? What was it about you and/or the team that made it happen? What were the challenges and what techniques did you use to overcome them? How did it feel?	
Dream: Imagine, in 2 years' time, that situation is routine. What has changed? What are the smallest steps we could take to make that happen?	
Design/Destiny: How can we promote and share this excellent practice?	
AMS, antimicrobial stewardship.	

offered. Verbal assent was obtained from each participant prior to each interview. Anonymity and confidentiality of participants were upheld throughout the study.

Interviews

The interview schedule (table 1) was designed using principles of AI¹¹—an asset-based action research methodology which aims to identify and to build on strengths, and therefore suitable for addressing the research question of the present study.

AI was selected as a framework for the interviews because it encourages participants to reflect on their successful work.¹¹ AI can influence understanding and change simultaneously; thus, the interviews were a data collection tool and an intervention to reinforce good practice in AMS. Therefore, the number of interviews undertaken was not driven by data saturation but by the intention to deliver this intervention to as many staff as possible within the study period. To increase the number of interviews, and the associated positive reinforcement intervention, an additional team member (research nurse from PICU) received training in AI and conducted interviews for the last 3 months of the intervention period. The interviews were conducted around two core areas of antimicrobial stewardship: (1) prescribing practice (appropriate antimicrobial choice and documentation of indication and review date) and (2) timely administration of antimicrobials (administration of antimicrobial within 1 hour of decision to commence treatment).

A total of 71 interviews were conducted, from a pool of 153 HCPs who had been identified for good AMS practice on at least one occasion. Identification of these HCPs was carried out via a daily screening process which comprised review of medication charts and a brief conversation with bedside clinical staff, to determine if good AMS practice was adhered to. The screening was carried out by research nurses using a daily proforma, described in detail in the previous report.⁹ Of the 71 interviews, 28 interviews were conducted with prescribers (20 postgraduate doctors in

training, 6 advanced nurse practitioners and 2 consultants) and 43 interviews were conducted with nurses involved in antimicrobial administration. Age of participants was not recorded. Sixty-five of the interviews were held face-to-face at a time convenient to the participant, the remaining 6 interviews were conducted by telephone at the request of the participants. The duration of interviews ranged from 5 to 25 min, with median duration of 10 min. No staff members declined an invitation to interview; however, six invited interviews could not be conducted because of lack of availability of interviewee or interviewer (annual leave or change of employment). A preprinted interview schedule was taken to each interview. Field notes were handwritten on the schedule during the interviews by the interviewer and subsequently transcribed into a secure, anonymised database.

Analysis

The database of field notes was accessed by the three members of the research team. Analysis was conducted using reflexive thematic analysis (RTA).¹² RTA is a type of thematic analysis which makes use of the researchers' role in producing knowledge. This approach was chosen to facilitate identification of meaningful patterns in the data, acknowledging the expertise and domain knowledge of the researchers, each of whom worked in the environment under study in a unique role. Each member of the research team read and coded the data independently, while considering the research question: 'what are the factors which enable success in AMS in PICU?' During a series of research meetings beginning in May 2019, individual codes were shared and, through iterative discussion, interpretive themes encompassing areas of meaning across the whole dataset were agreed.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

Six themes were identified from the data, within three overarching domains, system, team and individual factors:

System factors:

1. Cultural factors including psychological safety, leadership and positive attitude are important enablers for delivering good clinical care.
2. Ergonomic design of the physical environment and ready availability of tools and resources are key elements to support good practice and decision-making.

Team factors:

1. Expertise and support from members of the multidisciplinary team contribute to good care delivery.
2. Clarity of verbal and written communication is important for sharing mental models and aims of care within the clinical team.

Individual factors:

1. A range of intrinsic factors influences the performance of individual HCPs, including organisation skill, fear of failure, response to positive reinforcement and empathetic considerations towards peers.
2. Good clinical care is underpinned by a sound domain knowledge, which can be acquired through training, mentorship and experience.

System factors

Cultural factors including psychological safety, leadership and positive attitude are important enablers for delivering good clinical care.

Cultural factors enabling psychological safety in the workplace were identified as important facilitators of good practice. Empowerment to raise concerns with senior colleagues and the ability to politely respond to interruptions to care delivery were both cited as demonstrative of the presence of psychological safety.

- ▶ Bedside nurse: ‘doctors [are] always listening to concerns’ (45883).
- ▶ Postgraduate doctor in training: ‘I’m empowered to ask’ (44044).
- ▶ Postgraduate doctor in training: ‘empowered to tell people when they are disturbing me’ (43018).
- ▶ Advanced nurse practitioner: ‘staff interrupting, [I] politely ask them to give me a minute’ (42968).

Other relevant, enabling cultural factors included a prevailing sense of expectation regarding high quality of care, visible positive leadership, role-modelling and championing of good practice.

- ▶ Postgraduate doctor in training: ‘expectations high on PICU’ (43019).
- ▶ Consultant: ‘increased awareness this is the standard’ (43308).
- ▶ Advanced nurse practitioner: ‘good examples in sight’ (42968).
- ▶ Bedside nurse: ‘consultant seen as “sepsis” man’ (45101).

Ergonomic design of the physical environment and ready availability of tools and resources are key elements to support good practice and decision-making.

Some elements of the physical environment were identified as enablers for effective team-working and care delivery. Examples included proximity of colleagues in the clinical area to neighbouring bed spaces, and easy access to medications for timely administration. The latter point was also contrasted with difficulty accessing medication as a barrier to care delivery. Standalone, purpose-built prescribing space was identified as an enabling factor for success in AMS by some interviewees.

- ▶ Advanced nurse practitioner: ‘ownership of prescribing areas with regard to keeping them fit for purpose’ (43388).
- ▶ Bedside nurse ‘... in a cubicle it is difficult to get and give antibiotics’ (44935).

HCPs reported the ready availability of material tools and resources designed to support best practice: for example, annotations on clinical observation charts (bespoke stickers) to assist documentation of decision time and administration time for antimicrobials, medication charts with prompts for indication and review date for antimicrobials, ready availability of antimicrobial guidelines and formularies and smartphone applications:

- ▶ Bedside nurse: “[the]sticker was a good prompt, felt [I] needed to give antibiotics within the hour then” (45101).
- ▶ Postgraduate doctor in training: ‘the drug charts are well designed’ (43258).

Adequate time and staffing were considered vital resources to support good practice. The provision of dedicated time to complete tasks, such as preparation of medications, without interruption and the availability of colleagues to support the process of ‘second-checking’ (colleague checking of prescription, preparation and administration of medications) were both identified as key working processes which enabled success in this area.

- ▶ Bedside nurse: ‘prior to having break went and got antibiotics and brought back into cubicle to check with nurse covering break’ (45102).
- ▶ Bedside nurse: ‘as it was handover there were two nurses in the bed space to check antibiotics’ (45101).
- ▶ Bedside nurse: ‘in a cubicle but got the antibiotics in within an hour. Nurse came to check when asked’ (44369).

Team factors

Expertise and support from members of the multidisciplinary team contribute to good care delivery.

Availability of team members with expertise, including specialty input from outside the PICU team, such as microbiology and pharmacy, were key to supporting good practice. Assistance from peers, including provision of support for second-checking, along with general collaborative support was identified as an important enabling factor.

- ▶ Bedside nurse: ‘phone call received from microbiology with positive result and advice’ (45886).

- ▶ Postgraduate doctor in training: ‘pharmacy have tremendous knowledge...them being approachable’ (43018).
- ▶ Bedside nurse: ‘there was a plan for cultures and change of antibiotics if “carried on spiking [a temperature]”. Helpful staff next door’ (46243).

Clarity of verbal and written communication is important for sharing mental models and aims of care within the clinical team.

Clear verbal communication within the multidisciplinary team was recognised as a key component in successful practice. Examples of good practice in verbal communication included sharing of clear instructions for anticipated deterioration (contingency planning); emphasis on the importance of prioritising antimicrobial therapy in patients with life-threatening infection and the use of recognised specific clinical words at the bedside, to share clinicians’ mental models:

- ▶ Bedside nurse: ‘there was a clear plan—made it easy for communication in the night when patient did spike’ (45667).
- ▶ Bedside nurse: ‘clear instructions from xxx, set parameters—if temperature goes above “x” give antibiotics. Pre-empting deterioration’ (42944).
- ▶ Bedside nurse: ‘clear instructions and clear communication from MDT’ (45886).
- ▶ Bedside nurse: ‘decision time explicit—when decision time clear it helps me to prioritise antibiotics’ (43679).
- ▶ Bedside nurse: ‘consultant said “I think we’re septic”’ (43679).
- ▶ Bedside nurse: ‘the word “sepsis” puts people of thinking an infection could lead to sepsis’ (45658).

Written communication was also highlighted as important to support good practice; particularly with respect to prompting good practice (eg, through visual documented reminders for specific action) and providing reassurance that good practice has been adhered to:

- ▶ Bedside nurse: ‘sticker is a good prompt to administer antibiotics within the hour’ (45102).
- ▶ Bedside nurse: ‘good that the documentation was accurate and up to date and that I had done the right thing’ (44353).

Individual factors

A range of intrinsic factors influences the performance of individual HCPs, including organisational skill, fear of failure, response to positive reinforcement and empathetic considerations towards peers.

Staff recognised several self-identified intrinsic traits associated with success including the ability to effectively batch and prioritise competing tasks, and a high level of attention to detail and meticulousness. Feedback following success was recognised to have a positive impact on motivation and successful team working. Intrinsic motivation was also influenced by negative factors, such as fear of failure. This fear of failure extended beyond individual failure to concern about the effect of failure

of others, including potential reprimand for mistakes and loss of professional licence, indicating an element of empathy for colleagues. Assertiveness was an enabler for gathering rapid help when required.

- ▶ Advanced nurse practitioner: “fear of losing my job!” (43093).
- ▶ Bedside nurse: “I felt like I’d done well. Really pleased” (44086).
- ▶ Postgraduate doctor in training: “seeing poor prescriptions that I don’t understand makes me not want to put someone else in that position” (43031).
- ▶ Postgraduate doctor in training: “I want to protect nurses who are giving medications” (43258).
- ▶ Bedside nurse: ‘assertive enough to ask for help—doctor to stay, nurse to come and check’ (45100).
- ▶ Advanced nurse practitioner: “I am meticulous, print everything, xxx’s training re antibiotic prescribing, I’ve had to give drugs from bad prescriptions” (42970).

Good clinical care is underpinned by a sound domain knowledge, which can be acquired through training, mentorship and experience.

Training, mentorship and exams were important to support good practice, including knowledge of sepsis pathways. The departmental newsletter (published weekly and distributed to all PICU staff) was cited as an important modality for sharing important information. Reflections on witnessed good and bad practice enabled practitioners to acquire useful knowledge and experience, particularly in the clinical domain of recognition of sepsis. Familiarity, gained through repeated exposure to clinical cases, accessing guidelines and reflection led to development of clinical skills.

- ▶ Bedside nurse: ‘Support Group Study Day research update; sepsis awareness is good here anyway, really good on this unit; had seen sticker in newsletter’ (43313).
- ▶ Postgraduate doctor in training: ‘an experience of poor prescribing’ (43018).
- ▶ Postgraduate doctor in training: “familiarity with drugs and processes from guidance—gives you ‘mental model’ with more experience you have the mental space to hone skills” (43809).

DISCUSSION

Statement of key findings

We have identified six overarching themes within three domains (system, team and individual) from an analysis of interviews with team members describing factors that enable success in the context of antimicrobial stewardship in paediatric intensive care. The interview data captured views from a broad spectrum of the workforce including nurses, advanced nurse practitioners and doctors with varying degrees of experience, enhancing the validity of the findings. Studying insights from the perspective of success is important for two reasons. First, this perspective is often overlooked and could reveal novel information for improving quality. Second, the participants provided

a credible and authentic view of how frontline healthcare work is done successfully.

Comparison with existing literature

From a similar clinical setting to our study (PICU),¹³ Merandi *et al* studied behaviours which contribute to a very low adverse drug error rate. In their qualitative, exploratory study of safety behaviours in paediatric intensive care, the authors identified four important themes, some of which overlap with the findings in our study: individual characteristics, relationships and domains, structural and environmental factors and innovation approaches. The authors suggest that these themes contribute to safety, specifically in relation to adverse drug event rates, by underpinning resilience and performance. Our findings are complementary to those of Merandi *et al*, as both studies identify insights for improvement by making the paradigm of success in a high-risk workplace the main research focus. The mutual confirmation and corroboration of themes between the two studies adds validity to the findings.

A recent qualitative study from adult ICU settings identified 13 sociotechnical factors impacting medication safety in patients transitioning from ICU to ward environments.¹⁴ These factors, grouped into five themes, align with our study's findings, including the importance of diverse professional expertise, written communication, tool and technology availability, beliefs about consequences of medication errors and physical environment factors. However, the study also discovered additional factors not found in our research, such as the positive effect of patient and family involvement post-ICU discharge, and the role of prescription annotations. The differences between the two studies could be due to the context and methodology.

Broadening the view beyond the setting of intensive care, each of the themes identified in our study aligns with existing knowledge in several domains in healthcare:

The role of cultural factors in influencing healthcare performance and outcome is well recognised.^{15 16} Psychological safety, a key element of a positive and safe culture enables staff to challenge or question senior decisions and contributes to successful work.¹⁷ Our study shows a positive link between success and psychological safety, rather than a negative association between errors and its absence. Ergonomics has also been previously identified as important for safety and performance in healthcare: application of ergonomic theory into system and environmental design can reduce errors, injuries and fatigue.¹⁸ Our study points to the role of ergonomic and environmental factors in supporting successful care delivery, via insights gained from frontline staff.

Our findings build on existing literature on successful teamwork in healthcare by drawing attention to two key factors: diverse expertise and shared mental models. Diverse expertise is the variety of knowledge and skills within a team,¹⁹ and shared mental models are the common understanding of team goals and roles.²⁰ These

factors are associated with successful performance, and depend on several other elements, including a collaborative culture, effective communication and mutual support throughout the team.²¹ They also align with human factor training programmes that aim to improve teamwork by enhancing coordination, situation awareness and decision making.²² Taken with the existing literature, our findings suggest that healthcare teams can benefit from developing a collaborative climate, sharing information with feedback, and promoting shared mental models.

We found that success of individual HCPs is influenced by a wide range of intrinsic factors; consistent with existing literature linking motivation and performance with factors such as motivation, ethical values, personal history and clinical confidence.^{23 24} These factors are necessarily personal and therefore depend on individual preferences and learning styles. The significance of these factors points to the need for relevant training for educationalists regarding the diversity of learning styles in the workforce. Our findings also highlight the importance of domain-specific knowledge for professional development, consistent with self-determination theory, which states that competence and self-efficacy are essential psychological needs for self-determined behaviour.²⁵

Transferability

By gaining an understanding of success factors, it may be possible to leverage them to enhance quality and safety. Our methods could be applied to various healthcare contexts, not only AMS. Although the insights derived from this method are most applicable at the local level, the alignment between the themes we have identified, and the existing literature suggests that there are some fundamental principles that transcend healthcare settings. Based on our findings, we can deduce feasible changes for local improvement: for example, using feedback from frontline staff to optimise environmental design and to ensure accessibility of resources; offering training for leaders that fosters psychological safety; supporting education and training programmes for healthcare workforce to augment domain-knowledge and improve communication for sharing mental models; coaching for HCPs on acknowledging diversity in individual motivational factors.

Related interventions have been described in the peer-reviewed literature, both as recommended and evaluated interventions, indicating that these ideas may have external validity. For example, using staff feedback in a healthcare setting has been shown to improve working environment and staff motivation²⁶; the importance of maintaining education for healthcare workforce in clinical placements to support Continuous Professional Development (CPD) was emphasised in the National Health Service (NHS) people plan²⁷; improving communication to share mental models in healthcare through the use of a standardised communication tool has been linked to a reduction in adverse events²⁸ and the importance of acknowledging diversity of HCP in order to improve

patient care has been highlighted by NHS England and the King's Fund.²⁹

Insights from this research should not be taken in isolation; the themes we have identified are interdependent. There was significant overlap between identified themes: for example, interviewees described proximity of a second check for safe medication administration—pointing to the importance of both team and environmental factors. This is consistent with the concept that healthcare is a complex adaptive system³⁰ and efforts to improve safety and performance may benefit from taking a holistic approach, to complement the prevailing reductive approaches typical of Safety-I. This is a key message from the concepts of Safety-II and resilience engineering, but practical applications of this approach have not been widely adopted in healthcare.³¹ By applying the methods used in this study, along with the broader idea of LFE, it may be possible to address some of the challenges of putting Safety-II into practice.

In relation to the core topic of our study—AMS—there is a growing body of research focusing on behavioural change in AMS, which seeks to develop interventions to change behaviour positively. A significant proportion of this research focusses on disseminating resources, educating and producing guidelines. While these are logical early steps, available evidence shows that behaviour change in healthcare requires additional interventions to integrate and reinforce new practices.³²

A recent consensus paper by Rzewuska *et al*³³ argues that behavioural science concepts are underused in antibiotic stewardship and suggests that ‘change is required at the individual, team, organisation and policy levels to change key behaviours’ associated with antibiotic use. Insights from our study, and future studies adopting similar methodology, may help inform intervention design at the levels of the individual, team and organisation.

Opportunities for future research

Our study demonstrates the feasibility of using AI to investigate success in a specific domain or area of practice. We suggest two main areas for future research:

First, within the specific area of AMS, we have identified some insights that could be further developed and tested within the local context and evaluated in a multicentre trial to assess their generalisability and impact. Second, this approach could be applied to other domains or areas of practice that could benefit from learning from excellence. Strengths-based approaches are rarely used in AMS (or in healthcare more generally), and we have shown that they can provide potentially valuable insights into how to improve practice and outcomes.

Strengths and limitations

The strengths of this study lie in the strengths-based approach and its diverse data sources. The focus on the successful work-as-done in antimicrobial stewardship, as reported by frontline staff, is seldom explored in research, thus providing novel opportunities for gathering insights.

The study benefits from the diversity of the interviewees, representing a broad spectrum of perspectives and thus enriching the findings.

The study has several limitations. The primary data were sourced from field notes taken by researchers, which introduces the potential for both recall bias³⁴ (inaccuracies in data due to the imperfect recall of participants) and observer bias³⁵ (researchers’ expectations or prejudices may influence the data recorded). These biases could potentially impact the accuracy of the data. Our attempt to mitigate the risks of these biases included the use of a standardised interview schedule designed for simplicity and replicability prior to study commencement. We did not directly assess inter-rater reliability measurement between the two AI interviewers. The primary interviewer (AJ), experienced in AI usage and responsible for most interviews (n=53) also trained the secondary interviewer (PICU research nurse) to conduct some additional interviews (n=18) to augment the study’s scope.

The study did not include interviews with team members who did not achieve excellence in antimicrobial stewardship, which could limit the breadth of perspectives considered.

CONCLUSION

In conclusion, we have identified six themes within three overarching domains (system, team and individual factors) that contribute to successful practice in AMS in a PICU. The insights gained in this study originate from frontline staff who were interviewed about successful work-as-done. This strengths-based approach is a relatively understudied area in healthcare, and therefore offers authentic, novel intelligence which may be leveraged to effect tangible improvement changes.

The methodology used in our study is not limited to AMS; it could be applied to a wide range of settings in healthcare.

Twitter Adrian Plunkett @Ifecommunity

Contributors AP conceived, designed and supervised the study. Staff interviews were conducted and supervised by AJ. AP, AJ and ER analysed the data and interpreted the themes. ER wrote the first draft of the manuscript. AJ and AP edited the manuscript. AP is the guarantor.

Funding The original study was funded by a Health Foundation Innovation Grant (Health Foundation Innovating for Improvement grant "Innovating for Improvement Round 5"), but the present secondary analysis did not receive any funding.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The primary (quality improvement) project was designated as service evaluation by the Institutional Research and Development Department; therefore, formal ethical approval was not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Anonymised data are available on reasonable request. All data in this study consist of field notes from staff interviews. The source data are not available for dissemination.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Adrian Plunkett <http://orcid.org/0000-0003-0703-2649>

REFERENCES

- HM Government. Tackling antimicrobial resistance 2019–2024: global and public health group emergency preparedness and health protection policy directorate. *GovUk* January 1, 2019.
- Davey P, Marwick CA, Scott CL, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients (updated protocol). *Cochrane Database Syst Rev* 2017;2.
- NICE guidance: antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. *JAC-Antimicrobial Resistance* 2019;1.
- Passarella C. Failure modes and effects analysis. *Control* 2018;31:72–3.
- Hollnagel E, Wears RL, Braithwaite J. From safety-I to safety-II: a white paper. 2013.
- Plunkett A, Plunkett E. Positive approaches to safety: learning from what we do well. *Paediatr Anaesth* 2022;32:1223–9.
- Ham DH. Safety-II and Resilience Engineering in a Nutshell: an Introductory Guide to Their Concepts and Methods. *Saf Health Work* 2021;12:10–9.
- Kelly N, Blake S, Plunkett A. Learning from excellence in Healthcare: A new approach to incident reporting. *Arch Dis Child* 2016;101:788–91.
- Jones AS, Isaac RE, Price KL, et al. Impact of positive feedback on antimicrobial stewardship in a pediatric intensive care unit: a quality improvement project. *Pediatr Qual Saf* 2019;4.
- Merriell A, Wilson A, Decker E, et al. Systematic review and narrative synthesis of the impact of appreciative inquiry in Healthcare. *BMJ Open Qual* 2022;11:e001911.
- Stavros JM, Godwin LN, Cooperrider DL. In: practicing organization development [Internet]Implementing the 4D cycle of appreciative inquiry in health care: a methodological review. *J Adv Nurs* 2015;96:116.
- Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2006;3:77–101.
- Merandi J, Vannatta K, Davis JT, et al. Safety II behavior in a pediatric intensive care unit. *Pediatrics* 2018;141:e20180018.
- Bourne RS, Jeffries M, Phipps DL, et al. Understanding medication safety involving patient transfer from intensive care to hospital ward: a qualitative Sociotechnical factor study. *BMJ Open* 2023;13:e066757.
- Mannion R, Davies H. Understanding organisational culture for healthcare quality improvement. *BMJ* 2018;363(November):k4907.
- Braithwaite J, Herkes J, Ludlow K, et al. Association between Organisational and workplace cultures, and patient outcomes: systematic review. *BMJ Open* 2017;7:e017708.
- Edmondson A. Psychological safety and learning behavior in work teams. *Administrative Science Quarterly* 1999;44:350–83.
- Carayon P, Xie A, Kianfar S. Human factors and Ergonomics as a patient safety practice. *BMJ Qual Saf* 2014;23:196–205.
- Körner M, Lippenberger C, Becker S, et al. Knowledge integration, teamwork and performance in health care. *J Health Organ Manag* 2016;30:227–43.
- McComb S, Simpson V. The concept of shared mental models in Healthcare collaboration. *J Adv Nurs* 2014;70:1479–88.
- Westli HK, Johnsen BH, Eid J, et al. Teamwork skills, shared mental models, and performance in simulated trauma teams: an independent group design. *Scand J Trauma Resusc Emerg Med* 2010;18:1–8.
- Leonard M, Graham S, Bonacum D. The human factor: the critical importance of effective teamwork and communication in providing safe care. *Quality and Safety in Health Care* 2004;13(suppl_1):i85–90.
- Veenstra GL, Dabekaussen K, Molleman E, et al. Health care professionals' motivation, their behaviors, and the quality of hospital care: a mixed-methods systematic review. *Health Care Manage Rev* 2022;47:155–67.
- Moyo M, Goodyear-Smith FA, Weller J, et al. Healthcare practitioners' personal and professional values. *Adv Health Sci Educ Theory Pract* 2016;21:257–86.
- Deci EL, Ryan RM. Self-determination and intrinsic motivation in human behavior. *Plenum Press* 1985.
- Frampton A, Fox F, Hollowood A, et al. Using real-time, anonymous staff feedback to improve staff experience and engagement. *BMJ Qual Improv Rep* 2017;6.
- NHS England. New ways of working and delivering care, Available: <https://www.england.nhs.uk/our-nhs-people/online-version/new-ways-of-working-and-delivering-care/educating-and-training-our-people-for-the-future/> [Accessed 27 Dec 2023].
- Shahid S, Thomas S. Situation, background, assessment, recommendation (SBAR) communication tool for Handoff in health care – A narrative review. *Saf Health* 2018;4.
- West M, Dawson J, Kaur M. Making the difference: diversity and inclusion in the NHS. NHS England. Available: <https://www.nwpgmd.nhs.uk/sites/default/files/Making%20the%20difference%20diversity%20and%20inclusion%20in%20the%20NHS%20pdf.pdf> [Accessed 27 Dec 2023].
- Braithwaite J, Churrua K, Ellis LA, et al. Complexity science in Healthcare - aspirations, approaches, applications and accomplishments: a white paper. 2017.
- Verhagen MJ, de Vos MS, Sujan M, et al. The problem with making safety-II work in Healthcare. *BMJ Qual Saf* 2022;31:402–8.
- Johnson MJ, May CR. Promoting professional behaviour change in Healthcare: what interventions work, and why? A theory-led overview of systematic reviews. *BMJ Open* 2015;5:e008592.
- Rzewuska M, Charani E, Clarkson JE, et al. Prioritizing research areas for antibiotic stewardship programmes in hospitals: a behavioural perspective consensus paper. *Clinical Microbiology and Infection* 2019;25:163–8.
- Khare SR, Vedel I. Recall bias and reduction measures: an example in primary health care service utilization. *Fam Pract* 2019;36:672–6.
- Mahtani K, Spencer EA, Brassey J, et al. Catalogue of bias: observer bias. *BMJ Evid Based Med* 2018;23:23–4.