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BRIEF REPORT

Engaging Patients and Caregivers in a Transdisciplinary Effort to Improve Outpatient Parenteral Antimicrobial Therapy

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We worked with patients, caregivers, and healthcare workers to prioritize barriers and propose solutions to outpatient parenteral antimicrobial therapy (OPAT) care. Unclear communication channels, rushed instruction, safe bathing with an intravenous catheter, and lack of standardized instructions were highly ranked barriers. Outpatient parenteral antimicrobial therapy programs should focus on mitigating barriers to OPAT care.

Keywords. catheter complications; FMEA; home infusion; OPAT; patient-involved research.

In the United States, home-based outpatient parenteral antimicrobial therapy (h-OPAT) frequently involves patients and their caregivers performing routine daily medication infusions and intravenous (IV) catheter care. Although patients and caregivers receive support and training from home infusion therapy agencies, they have no formal training in administering IV medications and performing IV catheter maintenance. Patients receiving h-OPAT are at risk of complications from the IV catheter, the antimicrobial agents, and the underlying infection, especially if they do not appropriately perform IV catheter maintenance or infusions [1, 2]. Understanding how to prevent these adverse effects is essential.

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Recent work has highlighted the importance of close monitoring by infectious diseases physicians within 2 weeks of hospital discharge to reduce adverse outcomes [3–5]. National and international guidelines recommend close monitoring of OPAT patients [1, 2]. However, in reality, limitations in care coordination across healthcare systems frequently results in the suboptimal care of h-OPAT patients [6]. Identifying barriers to and strategies for safe h-OPAT care is essential in improving care.

As patients and caregivers perform day-to-day antimicrobial delivery and IV catheter maintenance in h-OPAT, understanding the patient experience is necessary to identify barriers to and strategies for safe h-OPAT care. We have previously performed semistructured interviews and home-based observations among adult patients on h-OPAT and have demonstrated that barriers including performing IV catheter care outside of the well structured setting of the hospital or office, the complicated nature of h-OPAT-related tasks, and confusion over the roles of healthcare workers are barriers to safe h-OPAT care [7–9].

Barrier identification and mitigation (BIM) is a manner of systematically identifying and prioritizing barriers to safe care, in a focus group-style interaction, by ranking those of the highest importance [10], through use of participatory design [11]. However, it has been infrequently used to assess barriers to patient safety in the home or with input from patients and caregivers. We performed a proactive risk assessment using an interactive in-person BIM from both healthcare workers and h-OPAT patient and caregiver perspectives to prioritize barriers and strategies for safe h-OPAT.

METHODS

Johns Hopkins Hospital (JHH) discharges more than 2000 patients on h-OPAT annually. Eligible patient and caregiver participants included (1) any patient who had received h-OPAT after discharge from JHH or (2) the caregiver of the patient. Eligible healthcare worker participants included those involved in the referral or care of patients on h-OPAT including home care coordinators, home infusion pharmacists, home infusion nurses, and home infusion administrators. The Institutional Review Board at the Johns Hopkins University School of Medicine approved the study.

We previously identified barriers to the safe provision of h-OPAT based on semistructured interviews with 40 patients receiving h-OPAT and through the observations of 20 patients in the home while performing OPAT-related tasks (Appendix) [7–9]. For the current work, we convened 4 groups to go through an in-person group BIM between May and July 2019. Each contained 4 to 8 participants and each session lasted approximately

2 hours. Participants were provided a $50 gift card for their efforts. Each group was led by an infectious diseases physician with expertise in OPAT (S.C.K.) and a research coordinator (A.S.). Two groups included patients who had received h-OPAT and their caregivers, 1 included home care coordinators, and 1 enrolled home infusion staff members. Eligible patients and caregivers included those who enrolled in a prospective cohort of h-OPAT patients [12] or in the semistructured interviews or home-visit observation studies within the last year (of 29 patients approached).

Group members were first presented with a list of barriers to rank on a scale of 0 to 10 to anchor the later discussion (Appendix). For frequency, low scores meant the barrier never occurred. For significance, low scores meant the barrier was of no concern. For ease-of-mitigation, low scores meant the barrier would be too difficult to mitigate due to cost, manpower, resources, legal or insurance constraints, or other factors. Participants were then asked to multiply the frequency, significance, and ease-of-mitigation scores and to note the 3 highest-scoring barriers. After participants completed the ranking process, each verbally presented the 3 barriers with the highest rankings to the group. Participants then discussed each of the barriers and suggested strategies. Ranked barriers and strategies were consolidated across the 4 groups.

RESULTS

Table 1 demonstrates the composition of each of the 4 groups. Of a total population of 24 participants, 7 were patients and 3 were caregivers. Overall, 75% of the participants were women and 70% were white.

Participants identified barriers and mitigation strategies when receiving h-OPAT (Table 2). The top 2 barriers across the 4 groups were each proposed by 10 of the 24 participants and were as follows: (1) "Healthcare providers may not always communicate with each other about a patient's care, so may be unaware of how the patient is doing," and (2) "Instruction is rushed." Suggestions to improve healthcare worker communication included standardizing communication protocols for OPAT care options, expanded access to medical records for home infusion agencies in different health systems, scheduling follow-up appointments before discharge, and having patients assist with transmitting information by providing documentation to members of the healthcare team. To ensure that instructions are not provided hastily at the time of hospital discharge, suggestions included identifying patients requiring parenteral therapy early in their hospital course and development of a discharge plan as soon as patients potentially requiring parenteral therapy are identified, providing instructions to patients targeted to the patient's education or abilities well before hospital discharge, and providing written and visual instruction including handouts and videos.

Eight participants listed "The patient is unsure how to keep their IV line dressing dry while bathing" as one of the most significant barriers, including 6 patients and caregivers. Several products for keeping IV dressings dry and intact were discussed, including adherent cling wrap and taping clean plastic bags over dressings. Other suggestions included providing supplies to patients in the hospital upon discharge, evaluating dressings more frequently, and using a detachable shower head to direct the flow of water away from the dressing.

Six participants listed a lack of standardized instructions. Solutions included having standardized instructions available

Table 1. Composition of Groups Performing Failure Mode and Effects Analysis

Characteristic	Home Infusion Employee Group (N = 8, %)	Home Care Coordinator Group (N = 6, %)	Patient-Caregiver Group 1 (N = 4, %)	Patient-Caregiver Group 2 (N = 6, %)	Total (N = 24, %)
Role					
Infusion Nursing	3 (37.5%)	0 (0%)	0 (0%)	0 (0%)	3 (12.5%)
Administration, Scheduling	1 (12.5%)	0 (0%)	0 (0%)	0 (0%)	1 (4.2%)
Pharmacist	2 (25.0%)	0 (0%)	0 (0%)	0 (0%)	2 (8.3%)
Pharmacy Technician	1 (12.5%)	0 (0%)	0 (0%)	0 (0%)	1 (4.2%)
Infection Preventionist	1 (12.5%)	0 (0%)	0 (0%)	0 (0%)	1 (4.2%)
Home Care Coordinator	0 (0%)	6 (100.0%)	0 (0%)	0 (0%)	6 (25.0%)
Patient	0 (0%)	0 (0%)	3 (75.0%)	4 (66.7%)	7 (29.2%)
Caregiver	0 (0%)	0 (0%)	1 (25.0%)	2 (33.3%)	3 (12.5%)
Gender: Female	6 (75.0%)	6 (100.0%)	3 (75.0%)	3 (50.0%)	18 (75.0%)
Race/Ethnicity					
White	6 (75.0%)	5 (83.3%)	3 (75.0%)	3 (50.0%)	17 (70.8%)
African American	2 (25.0%)	0 (0%)	0 (0%)	2 (33.3%)	4 (16.7%)
Asian	0 (0%)	1 (16.7%)	0 (0%)	0 (0%)	1 (4.2%)
White Hispanic	0 (0%)	0 (0%)	1 (25.0%)	1 (16.7%)	2 (8.3%)

Table 2. Barriers Ranked Highly by at Least Two Participants and Proposed Strategies

Barrier	Number of Votes	Proposed Strategies	Cost of Strategies (Resources, Financial, and Personnel)
Healthcare providers may not always communicate with each other about a patient's care, so may be unaware of how the patient is doing.	10 (6 home infusion employees; 1 home care coordinator; 3 patients or caregivers)	Standardization of communication protocols; expectation for communication from designated physician identified before discharge with home health staff; expanded access to EHR; schedule follow-up appointments for patients before discharge; patients assist with providing information; stay in one healthcare system.	No cost and minimal personnel time required for standardized communication protocols, EHR-based solutions, or ensuring follow-up appointments scheduled.
Instruction is rushed.	10 (4 home infusion employees; 3 home care coordinators; 3 patients or caregivers)	Early identification of patients who may require OPAT followed by immediate initiation of instruction; algorithms for specific infusion cases; consider patient's prior experiences; consider letting patients stay overnight for more training; ensure a home infusion nurse is present at the patient's home on the day of discharge; practice infusion before discharge; provide written and visual instruction.	No cost and minimal personnel time for algorithm development or to develop instructional materials; additional personnel time required for immediate instruction initiation in hospital and ensuring personnel in patient home immediately on discharge.
The patient is unsure how to keep their IV line dressing dry while bathing.	8 (1 home infusion employee; 1 home care coordinator; 6 patients and caregivers)	Use sticky cling wrap; use clean dry bags; ensure patients given supplies in the hospital on discharge; evaluate dressing integrity frequently; standardized instructions; detachable shower head; not washing chest or arm.	Minimal supply costs required.
There is a lack of standardized instructions provided to the patient or caregiver(s); for example, nurses in hospitals give different instructions than home infusion nurses in the home.	6 (1 home infusion employee, 4 home care coordinators; 1 patient or caregiver)	Standardized instructions provided to patients; require checklists at the time of discharge for the nurse, at arrival to the home for the home infusion nurse, and for the patient that include constant re-teaching and reinforcement.	Minimal personnel costs required for standardized instruction and checklist development and implementation.
The patient receives different supplies than they were expecting.	4 (3 home infusion employees; 1 patient or caregiver)	Teach using the same supplies in hospitals as in the home; improve processes in the warehouse; explain shipping process to patients; use a video to show how to use the supplies.	No additional cost required; likely personnel time savings due to more efficient processes.
The patient and caregiver(s) struggle to contact healthcare providers about complications that arise or questions related to the patient's care.	4 (2 home infusion employees; 2 home care coordinators)	Collaboration across health systems; have one designated infusion worker to follow up with each patient.	No additional cost required; likely personnel time savings due to more efficient processes.
The patient's or caregiver's physical condition makes the IV therapy task difficult to perform, such as flushing the IV line or attaching the medication.	4 (1 home infusion worker; 1 home care coordinator; 2 patients or caregivers)	Choose caregivers with physical abilities that will allow them to perform tasks.	No additional costs to the health system.
The patient and caregiver(s) struggle with understanding medical terms or instructions.	3 (1 home infusion worker; 2 patients or caregivers)	Do not discharge patients late in the evening; repeat instructions; ensure understanding with teach-back.	Additional costs for late discharge; minimal additional personnel time for enhanced instructions.
The patient may sweat, which may make it harder for the IV line dressing to stay in place.	3 (1 home infusion worker; 2 patients or caregivers)	Ensure close follow-up to ensure IV line dressing remains intact; evaluate dressing more than weekly for need for change.	Additional personnel time required for closer evaluation of IV line dressing, but telehealth could reduce additional personnel time.
The patient or caregiver(s) does not understand the purpose of the IV line, the risks of the IV line, or what to expect from IV therapy in the home at the time of hospital discharge.	3 (1 home infusion worker; 1 home care coordinator; 1 patient or caregiver)	Improved communication between infectious diseases clinicians and patients before discharge.	Minimal additional personnel time.

Table 2. Continued

Barrier	Number of Votes	Proposed Strategies	Cost of Strategies (Resources, Financial, and Personnel)
The patient and caregiver(s) must devote a lot of time for tasks associated with IV therapy in the home, especially for frequently dosed medications.	3 (3 patients or caregivers)	Schedule medications to be taken at same time; use pumps; choose less frequently dosed medications; ensure home infusion nurses arrive at reasonable time intervals; use alarms.	No additional personnel time; slight additional cost for pump.
The IV line gets caught as the patient moves around the home.	3 (3 patients or caregivers)	Clear a path in the home; place extra line in their pocket or pump bag.	Minimal additional personnel time.
Delivery people leave supplies outdoors in the heat or cold, which may make medications less effective or expire sooner.	2 (1 home infusion employee; 1 patient or caregiver)	Provide more advance notice to patients and caregivers; ensure accountability by delivery staff.	Minimal additional personnel time.
Healthcare providers may be unsure who is responsible for certain aspects of a patient's care, or unsure who can place orders.	2 (1 home infusion employee; 1 home care coordinator)	Require a clear following physician to be assigned before discharge.	No additional personnel time.
Pets tug on IV lines, which may cause the IV line to come out.	2 (1 home care coordinator; patient or caregiver)	Provide guidance for patients who have pets.	Minimal additional personnel time.
The patient and caregiver(s) forget portions of the training.	2 (1 home infusion employee; 1 home care coordinator)	Provide checklists with instructions; provide video instructions.	Additional personnel time for checklist development.
The patient and caregiver(s) are unsure when medications are done infusing (eg, the bag is empty, when to start or stop a pump) and may stop infusions too early.	2 (1 home care coordinator; 1 patient or caregiver)	Provide guidance on infusion completion when patients are discharged; phone number to access help.	Minimal additional personnel time for enhanced education.
The covers used over the IV line dressing do not fit well, so the dressing becomes wet while bathing.	2 (2 patients or caregivers)	Use sticky cling wrap; use clean dry bags.	Minimal supply costs required.
The patient needs to prevent the IV line from getting exposed to soil or dirt in the outdoors.	2 (2 patients or caregivers)	Carefully cover IV line dressing as discussed for keeping IV line dressing dry while bathing; avoid gardening.	Minimal supply costs required.

Abbreviations: EHR, electronic health records; IV, intraveneous; OPAT, outpatient parenteral antimicrobial therapy.

to patients, caregivers, inpatient nurses, and home infusion nurses in the form of written checklists and videos.

DISCUSSION

Through a novel approach including patients and caregivers to undergo a formal BIM process to identify and mitigate barriers to safe h-OPAT, we identified important and often unrecognized obstacles to safety. Major barriers included practical challenges with protecting IV catheters from moisture, a lack of streamlined communication between healthcare providers, hastily provided instructions, and not providing relevant instructions to all relevant stakeholders (eg, patients, caregivers, and home infusion nurses). Although there was no consensus around the best approach to protect IV catheter dressings, several key strategies were identified to reduce communication barriers. Some of these included initiating training as soon as it becomes likely that a patient will need h-OPAT, tailoring instructions to a patient's previous experiences, practicing infusions and line care before hospital discharge, and ensuring that patients have access to written instructions and videos.

Communication barriers between healthcare providers (eg, home infusion staff and ordering physicians) were problematic. Therefore, (1) streamlined communication pathways and checklists for inpatient nursing, patients and caregivers, and home infusion nurses, (2) improving access of home infusion staff to medical records, (3) and clearly designating the ordering physician and their contact information were underscored as essential for improving communication.

By performing a structured assessment of barriers to safe h-OPAT, we showed that it was important to involve all stakeholders in the process, especially patients and caregivers. Opinions of OPAT patients and caregivers have been sought in prior qualitative research, but primarily in the United Kingdom, where most infusions are performed by home nurses [13–15]. With the exception of our group [7–9], few have used patients to identify specific barriers to appropriately maintaining the IV catheter and infusing medications. We found that patient insights were essential in identifying barriers and solutions, because they emphasized day-to-day management concerns (in particular, concerns about bathing) to a greater extent than the healthcare workers.

Our study has several limitations. Our findings are reflective of findings in a single hospital system using a single modality of OPAT delivery (home infusion), and barriers and solutions may differ across different populations and home environments (eg, urban versus rural) as well as OPAT delivery mechanisms (ie, outpatient infusion, skilled nursing facilities). In addition, patient and caregiver participants may not be representative of all h-OPAT patients because volunteers may be more engaged in their care. Our qualitative study was hypothesis-generating, and future studies should be performed to see whether the proposed strategies may be effective in preventing OPAT complications. Alternatively, organizations could perform BIM to identify barriers to and strategies for safe OPAT care in their setting.

CONCLUSIONS

Home-based outpatient parenteral antimicrobial therapy is a complicated process with numerous potential barriers that may impact patient safety. We found that BIM can successfully identify barriers as well as potential solutions through the inclusion of patients and caregivers and diverse healthcare providers. This work serves as a road map to investigate other processes in healthcare where understanding patient experiences is integral to identifying barriers.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Author contributions. S. C. K. designed the study and study tools, collected data, analyzed data, interpreted data, and wrote the manuscript. P. T. assisted in data interpretation and reviewed the manuscript. A. S assisted in study tool design, collected data, and reviewed the manuscript. D. W. assisted in data interpretation and reviewed the manuscript. S. E. C. assisted in study design, data interpretation, and reviewed the manuscript. A. P. G. assisted in study design, data interpretation, and reviewed the manuscript.

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References

1. Norris AH, Shrestha NK, Allison GM, et al. 2018 Infectious Diseases Society of America clinical practice guideline for the management of outpatient parenteral antimicrobial therapy. Clin Infect Dis **2019**; 68:e1–35.
2. Chapman ALN, Patel S, Horner C, et al. Outpatient parenteral antimicrobial therapy: updated recommendations from the UK. J Antimicrob Chemother **2019**; 74:3125–7.
3. Huck D, Ginsberg JP, Gordon SM, et al. Association of laboratory test result availability and rehospitalizations in an outpatient parenteral antimicrobial therapy programme. J Antimicrob Chemother **2014**; 69:228–33.
4. Shah A, Petrak R, Fliegelman R, et al. Infectious diseases specialty intervention is associated with better outcomes among privately insured individuals receiving outpatient parenteral antimicrobial therapy. Clin Infect Dis **2019**; 68:1160–5.
5. Saini E, Ali M, Du P, et al. Early infectious disease outpatient follow-up of outpatient parenteral antimicrobial therapy patients reduces 30-day readmission. Clin Infect Dis **2019**; 69:865–8.
6. Hamad Y, Lane MA, Beekmann SE, Polgreen PM, Keller SC. Perspectives of United States-based infectious diseases physicians on outpatient parenteral antimicrobial therapy practice. Open Forum Infect Dis **2019**; 6:ofz363.
7. Keller SC, Cosgrove SE, Arbaje AI, et al. It's complicated: patient and informal caregiver performance of outpatient parenteral antimicrobial therapy-related tasks. Am J Med Qual **2020**; 35:133–46.
8. Keller SC, Cosgrove SE, Arbaje AI, et al. Roles and role ambiguity in patient- and caregiver-performed outpatient parenteral antimicrobial therapy. Jt Comm J Qual Patient Saf **2019**; 45:763–71.

9. Keller SC, Cosgrove SE, Kohut M, et al. Hazards from physical attributes of the home environment among patients on outpatient parenteral antimicrobial therapy. Am J Infect Control **2019**; 47:425–30.
10. Agency for Healthcare Research and Quality. Barrier Identification and Mitigation Tool. AHRQ Safety Program for Surgery. **2017**. Avaliable at: https://www.ahrq.gov/hai/tools/surgery/tools/surgical-complication-prevention/bim.html. Accessed 24 March 2020.
11. Xie A, Carayon P, Cox ED, et al. Application of participatory ergonomics to the redesign of the family-centred rounds process. Ergonomics **2015**; 58:1726–44.
12. Keller SC, Williams D, Gavgani M, et al. Rates of and risk factors for adverse drug events in outpatient parenteral antimicrobial therapy. Clin Infect Dis **2018**; 66:11–9.
13. Tonna A, Anthony G, Tonna I, et al. Home self-administration of intravenous antibiotics as part of an outpatient parenteral antibiotic therapy service: a qualitative study of the perspectives of patients who do not self-administer. BMJ Open **2019**; 9:e027475.
14. Mitchell ED, Czoski Murray C, Meads D, et al. Clinical and cost-effectiveness, safety and acceptability of community intravenous antibiotic service models: CIVAS systematic review. BMJ Open **2017**; 7:e013560.
15. Twiddy M, Czoski Murray CJ, Mason SJ, et al.; CIVAS study team. A qualitative study of patients' feedback about outpatient parenteral antimicrobial therapy (OPAT) services in Northern England: implications for service improvement. BMJ Open **2018**; 8:e019099.