Barriers and Enablers for Sustaining Nurse-Led Use of Clinical Decision Support Tools for Antibiotic Stewardship: A qualitative analysis

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Abstract

Background: Clinical decision support (CDS) tools embedded in electronic health records (EHRs) in the form of integrated clinical prediction rules (iCPRs) provide a potentially effective intervention to reduce inappropriate antibiotic prescribing for acute respiratory infections (ARIs). Still, their effectiveness has been limited by workflow barriers and low adoption by healthcare providers. Nurses are well-positioned to implement evidence-based protocols using clinical decision support (CDS) tools. In a multicenter randomized controlled trial, a nurse-led implementation strategy for ARI iCPRs was evaluated for use in primary care and urgent care settings.

Objective: After trial completion, this study examined nurse and nurse leader perspectives on the sustainability of an EHR-integrated clinical decision support tool for antibiotic stewardship and explored factors influencing its potential long-term integration into ambulatory nursing practice.

Methods: We interviewed 22 nurses and nurse leaders from clinics that participated in the clinical trial. Two semi-structured interview guides, one for nurses and one for nursing leadership, were developed to understand the barriers and facilitators to implementing a decision-aid tool for nurses and to elicit challenges specific to nursing interactions with the CDS tool. Interviews were recorded and transcribed. Using thematic content analysis and iterative coding, our team collaboratively identified emerging themes related to sustainability and refined the results with consensus.

Results: Five themes emerged: 1) importance of staffing stability and capacity; 2) impact of dedicated clinic resource availability; 3) variable nurse readiness with CDS-guided clinical care; 4) influence of openness to change and a nurse-supportive clinic culture; and 5) ongoing need for training and support. Specific recommendations for future actions were also noted.

Conclusions: Our findings revealed specific barriers and facilitators to the sustainability of a CDS tool from the nursing perspective that can inform further implementation of nurse-led delegation protocols in the ambulatory setting. Future solutions should consider mapping physical workflows, scheduling specific to nurse visits, continuing education, and treating cough and sore throat as two distinct processes.

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Introduction

Antibiotic resistance is a growing global health concern, exacerbated by the overprescription of antibiotics for acute respiratory infections (ARIs).[1] Despite available evidence-based guidelines and clinical decision support (CDS), physicians often prescribe antibiotics inappropriately due to perceived patient expectations, time pressures, and cognitive fatigue.[2] To address this issue, clinical prediction rule (CPR) systems have been developed and integrated (iCPR) into electronic health records (EHRs) to assist physicians in making informed antibiotic prescribing decisions.[3,4] However, their impact has been limited by low provider adoption rates.[5,6] Evidence suggests that nurses have the potential to implement evidence-based protocols,[7,8] achieving high patient satisfaction and symptom resolution,[7] and demonstrate higher adoption rates of CDS tools than physician-led initiatives.[9]

Building on this potential, the multicenter, step-wedge, cluster-randomized controlled study (iCPR3) evaluated whether registered nurses (RNs) could effectively use iCPR tools to guide evidence-based care for patients presenting with ARIs in ambulatory care settings.[10,11]

An early implementation assessment of the iCPR trial identified several potential barriers and facilitators to adopting the nurse-driven CDS tools.[9] As the study concludes, we sought to understand whether nursing departments would consider continuing to use the iCPR tools in clinical practice, regardless of the trial's effectiveness outcomes. We also aimed to identify barriers that may hinder its sustained use within ARI workflows. By examining these perspectives, our goal was to identify strategies to enhance the integration of iCPR tools into clinical practice and improve patient outcomes.[12]

Methods

We used semi-structured interviews and thematic analysis, to examine the perspectives of RNs and nurse leaders regarding the implementation, usability, perceived impact, and sustainability of the iCPR tools. The study protocol and procedures were approved by the NYU Langone Health

Institutional Review Board (IRB), which served as the study's single IRB. We received a waiver of written informed consent for this study. All study data reported in this manuscript are de-identified.

Nurse iCPR Intervention

The nurse intervention used a structured delegation protocol, wherein the accountability for specific clinical tasks was appropriately transferred from a physician to a registered nurse. This protocol consisted of triage followed by in-person CDS-guided RN visits for patients with low-acuity ARI symptoms. The EHR-integrated CDS tool included a triage note template to assess symptoms and acuity, and two reason-for-visit-specific (i.e., sore throat or cough) note templates with iCPRs that guide RNs during visits to complete an evidence-based risk calculator.[11] The resulting risk score is linked to an order set for diagnostic testing, prescriptions, and patient instructions.

All tasks performed by RNs in this protocol – triage, symptom assessment, use of CDS tools, and execution of evidence-based care pathways – are well within the scope of nursing practice and align with their clinical training. The iCPRs used in the delegation protocol were previously found to be effective for reducing inappropriate antibiotic prescribing when used by physicians.[2,4,10] The intervention aims to standardize care delivery and reduce unnecessary antibiotic use in outpatient settings.

The intervention was implemented as a pragmatic stepped-wedge cluster randomized trial across 43 primary and urgent care practices in three academic health systems affiliated with the University of Utah, the University of Wisconsin, and NYU Langone. To be eligible for participation, practices were required to have at least one RN full-time equivalent capable of performing triage within the EHR and conducting RN on-site visits. Nurses in the intervention group received one hour of online training prior to one hour of in-person training on how to use the iCPR tool, including background on the iCPRs, EHR-based walkthroughs of using the iCPR tool, demonstration videos simulating the tool in a live clinical encounter, and clinical training for physical exams.[10] Complete study procedures are reported elsewhere.[13]

Study Design

We conducted remote video interviews lasting approximately 30 minutes, remotely via Zoom, between September 2024 and January 2025. Each participant was interviewed by a trained research team member from the corresponding health system (NH, KM, VT) using one of two semi-structured interview guides. Our team developed these interview guides, one for RNs and one for nursing leadership, based on a series of open-ended structured questions previously used to understand the barriers and facilitators to implementing a lupus decision-aid tool for nurses.[14] We adapted the interview guide to explore relevant Consolidated Framework for Implementation Research (CFIR) constructs, as well as address conditions specific to the ambulatory care environment and the iCPR intervention.[15] Interviews consisted of questions to understand barriers and facilitators related to the use of the tool, clinical team interactions, what worked well, any competing priorities, strategies for mitigating issues, and future adoption sustainability (Appendix A). Probing questions were used to verify the interpretation of the participant responses and recommendations were solicited for the continued use of the iCPR tool in clinical workflows.

Participants

We recruited a convenience sample of RNs and nurse leaders from primary care clinics and urgent care centers participating in iCPR3. Participants were considered eligible if they expressed familiarity with the iCPR tool and if a nurse participant completed a nurse visit using the tool. Participants were recruited via email by study personnel at each site. Recruitment procedures varied slightly by study site due to local policies and conditions. Specifically, given the proportionately large number of clinics at the University of Wisconsin (21 sites vs. 9 and 7 sites at NYU and Utah, respectively), participants were recruited from the top and bottom 5 performing clinics, based on the average number of nurse visits completed per week / clinic volume at randomization. In addition, University of Utah participants were offered a $25 gift card as an incentive, whereas other study sites did not provide financial incentives. A member of the study team verbally reviewed the study

information with each participant to ensure understanding; all participants then provided verbal agreement to participate.

Thematic Analysis Procedures

We conducted a thematic content analysis to uncover themes related to sustainability by extracting high-level themes from within data, while examining the frequency of concepts or keywords.[16] Each interview was audio-recorded and transcribed using an automated service (Landmark Associates). One team member (NH) reviewed each file for transcription accuracy prior to analysis. Transcripts were analyzed and a code book was developed using Dedoose.[17]

We first conducted a joint analysis of two interviews to allow the study team members to become accustomed to the codebook, make updates to codes, and resolve conflicts. Next, two team members coded each transcript independently and then all coders (VT, NG, MB, KM, AT) met as a team to compare and resolve disagreements. During this process, we also reviewed for thematic saturation, ensuring our sample met this criterion based on the diminishing need to update code definitions. Our analysis focused on the barriers and facilitators to the sustainability of iCPR tool use beyond the study protocol end date. Once all transcripts were coded, we reviewed the data code-by-code to ensure definitions had remained consistent. All coders then reviewed each excerpt to collectively derive emerging themes related to barriers and facilitators as well as recommendations for solutions. Emerging themes were grouped into high-level categories through consensus.

Results

We invited 56 eligible individuals to participate and conducted 22 individual interviews across the three sites, each lasting 15 to 45 minutes. Participants included 9 nurses (1 NYU, 8 Wisconsin) and 13 nurse leaders (4 NYU, 2 Utah, 7 Wisconsin); demographic information was not collected from either group. No nurse participants from the University of Utah elected to participate in the interviews.

Through our thematic analysis, we identified five overarching themes related to nurses' and nurse

leaders' perspectives on the implementation, effectiveness, and sustainability of the iCPR intervention as a part of standard care processes. The five themes that emerged included: 1) importance of staffing stability and capacity; 2) impact of dedicated clinic resource availability; 3) variable nurse readiness with CDS-guided clinical care; 4) Influence of openness to change and a nurse-supportive clinic culture; and 5) ongoing need for training and support.

1. Importance of staffing stability and capacity

One of the most prominent themes in our analysis concerned the need to have sufficient trained RNs staffed and available in the clinic to support the time needed to triage patients and conduct nurse visits. In addition to nurse staffing, participants also emphasized concerns related to physician and support staff levels. Contributing to these concerns, many participants (20, 91%) discussed issues related to staff turnover, including the challenges of retaining staff, training new staff, and implications for using the iCPR tool workflows.

When questioned about barriers to using the iCPR tool, one nurse mentioned,

> *"We are staffed with only three nurses, which is not a lot... One of our nurses left in May of last year to work elsewhere. Then, we hired a new nurse. Our third nurse went on maternity leave. Then when she came back, the other nurse had to leave for other reasons too. We've kind of just been at this [struggle] of not being able to consistently have a good number of staffing." N 3.18*

The shortage of nursing support staff often required nurses to cover multiple roles, making it challenging to prioritize tasks and manage their workload effectively. One participant stated,

> *"…some clinics can't handle it…they don't have enough people to even answer the phones." N 3.3*

With full staffing, nurses expressed confidence in executing the iCPRs and shared,

"We are pretty much fully staffed…it has not been a burden to participate and be a part of this survey and process...it's certainly helped our patients" N 3.3

"We could have two nurses and visits at the same time and patients aren't having to wait." N 3.2

Additionally, staff turnover was linked to challenges in familiarizing and educating new staff with the iCPRs due to limited training time. Increasing awareness among new nurses completing orientation, who lacked exposure to the study, was discussed, and one nurse revealed,

"Now that I'm thinking about it, there's a whole bunch of nurses that started that they weren't probably there when it first started. They don't even know about it, and I don't know if it's part of their orientation packet." N 1.7

A key subtheme involved virtual triage coordination, where nurses working remotely were able to triage patients by phone, and monitor clinic appointment availability. Approximately one quarter of the participants (6, 27%) felt that this workflow disrupted nurse visit appointment availability.

"It's a small nursing team so you have anywhere from two to three nurses working on a given day and then with the nurses that have the option to work remote now sometimes you only have one RN [registered nurse] in clinic. That impacts availability for appointments, so I think that is always a challenge." N 3.11

Another participant expressed difficulties with coordinating with colleagues not physically in the same place since the phone triage nurse was typically a different nurse from the nurse who conducts in the in-person nurse visit, highlighting staffing coordination in a hybrid care setting.

"Sometimes, if you're at home triaging the patient, and they could use a nurse visit, trying to

coordinate that with colleagues can be hard if it's a busy day. You don't really know what's

going on over there [in the clinic]…" N 3.15

2. Impact of dedicated clinic resource availability

The impact of clinic resource availability, including physical space for nurse visits and scheduling accessibility, was identified as a barrier to the uptake of the in-person nurse visit component of the iCPR workflow. The ability to manage the patient care continuum was disrupted when exam rooms were unavailable. One nurse stated,

"…we don't necessarily have a place to go with our patients…again, sometimes we are just

running around trying to find a location for the patient to be assessed in and to complete the

visit in." N 3.4

Discussion of the physical clinic setup highlighted that the lack of available exam rooms posed challenges. One RN stated,

"We've always had to kind of just find a room on the fly for any of our nurse visit types each

day, whether they're iCPR or not. A day like today, all of our exam rooms are occupied by the

providers that are here. Our plan is just when the patient comes, if there is an available

room, just kind of quickly utilize that." N 3.18

Alternatively, when the clinic set aside dedicated rooms for nurse visits and triage, it reportedly streamlined workflows and supported iCPR tool uptake.

"Structurally, we had a room all ready to do nurse visits that we do for other things. That

was easy enough to adopt this [iCPR] into that." N 3.3

"We have a designated room for nurse visits every day 'cause we have nurse visits every day,

and it's an exam room at the front of the clinic, and we have everything that we need in

there." N 3.10

Coupled with dedicated room space, time set aside for nursing appointments facilitated iCPR care workflows. One clinic workaround included having patients with sore throats or coughs come in at prescheduled time slots so that nurses and testing resources (such as throat swabs) were available. This allowed the clinic to structure the schedule in a way that allowed nurses to complete patient care activities.

> *"I know that one of the things that we tried to focus on and try to do too, as far as our department, is we tried to make sure that we had like the 11:00 and 1:00 p.m. slots available for the nursing and cough and sore throat visits..." N 3.4*

3. Variable nurse readiness with CDS-guided clinical care

Among RNs that received training, there was variability in their comfort when providing clinical care guided by the iCPR tools. This was expressed as resistance to the delegation protocol regarding adherence to the iCPRs, staying within their scope of practice, and compatibility with their clinical skills.

Some nurses felt organizational resistance to the delegation protocol, which required nurses to practice to the full extent of their qualifications. One nurse leader expressed that the iCPRs enable nurses to function within the bounds of what they are licensed to do, but existing clinic workflows may not be able to accommodate them.

> *"It's asking our nurses to work at the top of our license. The problem is that it takes—the way that they've worked in urgent care for so many years, it causes a change in that workflow… Some of the leaders have been more willing to facilitate that process, and some have not." L 2.14*

Nurses expressed discomfort and uncertainty when triaging patients with cough-related symptoms,

particularly when required to perform comprehensive respiratory assessments such as auscultating lung sounds. This hesitation often stemmed from a fear of missing critical findings and potentially causing harm, which made them reluctant to fully engage with the iCPRs designed for these cases.

"…there's a lot of nurses who do not like the cough part. They don't like to listen to lungs and the reason is they're afraid they're going to miss something and harm patients." L 3.20

Educating nurses was highlighted as a potential means of addressing these barriers, one nurse leader shared,

"Training of new people training is huge, so I think and many people have to be hands on… mixture of hands-on CBT [Computer Based Training] all of that to reach the nurses…but I think training is key." L 3.20

Conversely, nurses reported a strong sense of satisfaction with the sore throat iCPR, noting its simplicity and efficiency, allowing patient assessments to be completed in as little as 15 minutes.

"The sore throat one we'll use constantly. That is very much something that has been, in my opinion, and I think our providers, everybody really, has been very successful." N 3.3

4.   Influence of openness to change and a nurse-supportive clinic culture

A supportive clinic culture, openness to change, and positivity towards nurse support influenced the use and sustainability of the iCPR-guided nurse delegation workflow. Within clinic culture, the perceptions of support from providers and patients emerged as subthemes, and leadership support was seen as crucial in facilitating the usage of the iCPR tool. Participants reported that leaders who actively listen to nurses and maintain ongoing dialogue foster a supportive environment, encouraging new practices. Nurse leaders agreed that supporting staff was a success factor.

"I think just making sure that staff are feeling confident and comfortable with the process, hearing where there's issues...I think just hearing what the staff is experiencing, trying to

support them through any issues that are coming up, and making sure that they're confident

in their training to conduct the visits." L 3.11

Ongoing discussions with the nursing team to make sure that they feel supported. L 3.1

The overall clinic culture was perceived to be particularly critical. One nurse described the culture of being open to novel processes.

"…I think that our culture, to use that term for sure, is exceptional in that way. As far as being open to adopting things. Moving forward with nursing skills and nursing involvement in clinic practice is certainly something we focus on as a group and with our leadership." N 3.1

Another reported the benefit of a shared value system within the clinic.

"We have an excellent connection between each other. I think we all work for each other and with each other. There is a shared value system there that was very apparent and that is healthy in many ways… If my boss wasn't that interested in this, I think that we as a group would still be very interested together. We would have just done it by ourselves." N 3.1

Moreover, nurses expressed aspects of professional fulfillment due to spending more time with patients.

"Talking to the patients is great. Sometimes it's nice, the ones that you talk to, then you get to do a nurse visit." N 1.7

"Once again, I think it's great for us. It's great for the patient. I think being accessible and giving our patients what they need is—just been a really nice experience." N 3.2

4.1 Provider factors. Factors related to the provider were found to be an essential sub-theme of the

clinic culture. Overall, the provider's acceptability of the processes was viewed as necessary for the sustainability of the iCPR3 tool.

"We'd have to get the… medical director on board to really get the providers engaged with this. I do feel like providers are one of the bigger barriers. The nursing teams can do this work, but unless we work in collaboration, it'd be pretty hard to have it be sustainable." L 2.14

When medical directors showed interest in teaching and experimenting with new workflows that incurred time-savings, the tool's adoption by RNs was supported.

"If they perceive, or if it's a reality that this program takes visits away from them, rather than gives them more time to see other patients. Then that could be a deterrent and also just their own understanding of how nursing practice can be used. I think in ambulatory it's sometimes disinterested." L 1.13

"When the doctors like to teach…then it's very helpful. Some doctors… don't even want to do the study…but the ones that want to teach then, that's very helpful." N 1.7

Engagement from a medical director through collaboration was deemed important to facilitating clinic change.

"It's doable, it's just, again, it's change management. It's really having everybody on board. Probably something that would help it move along better would be all the leaders and medical director meeting and deciding this is the right process...." L 2.14

4.2 Patient factors. Patient engagement varied by location and was viewed as tightly connected to the clinic culture. Some nurses reported challenges in communicating the iCPR outcome to patients, especially when the patient had certain expectations connected to receiving antibiotics as part of the

visit.

> *"We have a low compliance rate in our clinic. When they come to see us, sometimes even when you're like, "You're not gonna see a doctor. You're just gonna see a nurse." They just want to come in and get antibiotics… When they come in and see us, I'm really like, "You're not gonna [get antibiotics]", but sometimes does not go over well with our patient population."* N 3.10

A number of issues also described a conflict between the delegation process and the patient's preference for provider type.

> *"We do get some that are not interested in having the nurse visit type because they are looking to discuss other remedies or other treatment options, or their complexity medically is sometimes a barrier."* N 3.18

> *"I think our patient population is different than other clinics. I think that that has made it a little bit harder... We do get pushback from our patients. They're like, 'Well, you're not a doctor,'..."* N 3.10

However, some patients appreciated the extra access to appointments and were willing to have and were satisfied with the nurse visit.

> *"I feel like patients are very agreeable and willing to come in to see a nurse, after we've explained exactly what's gonna happen... Patients have been really appreciative. No cost, they get in the same day, which is really what they're looking for..."* N 3.2

4.3 Clinic Communication. General clinic communication was the final subtheme related to clinic culture. A nurse leader expressed interest in having more usage data about the study's progress to communicate with the staff for positive reinforcement.

"…if people know the why we're doing it that helps…It really comes down to great patient care, antibiotic stewardship, how many visits we did. All of that. I think if we have that data, then as we train, we can bring that forward and show people why we're doing it." L 3.20

Nurse participants also reported satisfaction connected to the receipt of feedback on the iCPR use.

"I think it's been very positive and we—you guys send out the statistics and it reinforces that we are doing a good job and that always obviously makes me feel good that you are making a difference and… because obviously it's helping everybody. It's helping our patients. It's helping us." N 3.2

Group communication and decision-making as a team were noted as key to the sustainability of clinic initiatives.

"Again, it's about everyone deciding together that this is the right path and the way we want to go. Then moving it forward as a group so that it's not over here at this clinic but not at this clinic…It's just making sure you've got both nursing and operations, if we're going to really operationalize something and put it into permanent status." L 2.14

Another participant emphasized the importance of teamwork among colleagues, noting the ability to share experiences and seek advice from others to navigate challenges.

"My co-workers, my colleagues, us working together was another really important piece… Have you done this? Did you run into that?" N 3.3

In addition, communication tools were reported to provide support beyond programmatic issues and were seen as helpful in solving acute technology issues.

" the Webex group was helpful troubleshooting technology issues. They were really good with the patient care part, but, if a technology issue came up, the Webex group was really

helpful." N 3.6

5.   Ongoing need for training and support

Participants felt that additional training, specifically hands-on training, would enhance the program's sustainability.

"… Can we retrain? Can we have champions at the site who can help. Training of new people training is huge, so I think and many people have to be hands-on. Is it a mixture of hands-on CBT [computer-based training]… I think training is key." N 3.2

And another participant reported that recurrent training would help with maintaining skills,

"offering skills' refreshers every once in a while if this is gonna be an ongoing thing would be helpful too." N 3.15

"I think education and I think not just a one and done education…at the time of hire, at the time of roll out or sustainability, but then I almost think something yearly just for people to review, ask questions, do hands on skills again" L 3.20

In the context of simulation training, a playground or safe, interactive environment was described to bridge this gap, providing a way for learners to practice skills without real-world consequences. One nurse leader was enthusiastic about ways to integrate hands-on training with the iCPR protocols.

"I would say the hands-on training was fantastic for the nurses. They really appreciated it. It made them feel much more comfortable… in a setting where they can use the playground and practice the swabbing and stuff… making sure we can do a real-world, full-picture visit for practice would be really helpful." L 3.6

We found that both nurse and nurse leader participants considered nursing leadership support to be a

part of sustainability of this program. One of the nurse leaders described their approach as,

> *"Just making sure the nurses are comfortable and have the training and education that they need. If the cough part is a barrier, working to get them hands-on training, making sure they've got swabs that they need, stethoscopes that they need, and just being support for them. If they don't have a buddy in the clinic that day, maybe I step in and do it with them." L 3.6*

Recommendations Based on Participant Feedback

Participants provided several recommendations to enhance the sustainability of the iCPR tool in nursing practice (Table 1).

Table 1. Recommendations

Recommendation	Representative Quote
Identify Clinic Champions	"have champions at the site.", "we're going to need a provider champion."
Educate Patients	educate the patients more on, "This is what we're doing."
Organize Frequent Lunch and Learns	"circling back to another … skill driven practice type session might be helpful just to make sure…we still feel confident that we can conduct it and not feel too flustered."
Perform Triage in Advance	"When the first person that gets the [triage] call says, "Oh, they have a cough or a sore throat." That's very helpful because right away it's identified..."
Map Physical Workflows	"…in the future…you can see the layout of how things are, then you can maybe give a suggestion or tell us something to make a different flow that works somewhere else."
Incorporate into Routine Practice and Policy	"…has to make it a delegation process…more than anything."

Discussion

The examination of the perceptions of nurses and nurse leaders familiar with the implementation of an CDS-guided nurse delegation protocol for ARIs revealed several barriers and facilitators to the

sustainability of the program. Factors perceived as contributing to sustainability emerged within five themes including the 1) importance of staffing stability and capacity; 2) impact of dedicated clinic resource availability; 3) variable nurse readiness with CDS-guided clinical care; 4) Influence of openness to change and a nurse-supportive clinic culture; and 5) ongoing need for training and support. By touching on the characteristics of the intervention, clinic setting, and individuals, these themes highlight several implementation domains to be considered when seeking to develop a sustainable CDS-guided nurse delegation protocol intervention.[18]

As seen with many healthcare interventions, staffing levels were perceived as a key factor influencing sustainability.[19] Inadequate ambulatory clinic nurse staffing impedes staff's mastery of new protocols, restricting training time, and hindering comprehension of essential tools (such EHR CDS modules).[20] Moreover, the increased complexity of ambulatory nursing requires nurse leaders to proactively adjust outpatient staffing models to meet evolving demands.[21] Staffing models were not adjusted to accommodate iCPR3; instead participating units were only required to have at least one nurse. This model worked well for some clinics but not all. In settings with limited staffing, nurses may be forced to prioritize urgent clinical tasks over engaging with new initiatives, making it difficult to implement interventions effectively. Our findings suggest that a 'one size fits all' approach may be inadequate. Instead staffing models should be tailored to the needs of each clinic, particularly when new interventions are introduced. Due to national nursing shortages, calibrating nurse staffing is more important than ever before.[21] Adequate staffing enables nurses to focus on their patient care activities,[22,23] allowing for better adherence to the CPRs. Study participants highlighted encountering challenges integrating new hires, resulting from turnover, and upskilling nurses that have transferred from other specialty areas. Prior to intervention implementation, analyses of turnover rates, percentage of new hires, and overall patient volume should be considered to ensure appropriate staffing availability. Strategic planning should incorporate anticipated staffing fluctuations and allow for flexibility in response to sudden staffing interruptions. Moreover, the use

of alternative staffing models, such as virtual nursing resources, needs to be considered. While an efficient use of nursing resources in some settings,[24] hybrid work environments may contribute to barriers to care coordination and in-person visits.

Availability of clinic resources, especially physical space, was emphasized as a barrier more than expected. Success with the iCPR workflow hinged on ready access to supplies, designated rooms for nurse consultations, a supportive physical layout, and timely provider availability. Compared to inpatient hospital care, the outpatient environment is known to often lack infrastructure support.[25] When nurses had to search for appropriate locations to assess patients upon arrival, both efficiency and patient experience suffered. In contrast, clinics that reserved rooms specifically for nurse visits reported smoother workflows and better outcomes. Future implementations should therefore include a thorough assessment of space and workflow needs, ensuring that dedicated nurse-visit rooms and adaptable layouts are built into the design from the onset.[26]

Our analysis highlighted that nurses expressed lower confidence when using the iCPR tool for conditions requiring more complex or subjective clinical assessments, such as listening to breath sounds, compared to workflows perceived as more straightforward like those for sore throat evaluations. Indeed, several participants indicated a preference for sustaining use of the sore throat iCPR workflow only. This gap in confidence suggests a need for targeted skill development. Simulation-based training offers a valuable strategy to build these skills in a realistic, low-risk environment. Regular simulations can help nurses practice nuanced assessments, receive real-time feedback, and strengthen clinical judgment. Incorporating iCPR-related scenarios into onboarding and ongoing education can reinforce competence and confidence. Fostering a culture of continuous learning, with structured supervision and feedback, is essential for supporting effective and sustained implementation.[27]

Clinics with positive experiences using the iCPR tools often reported a strong organizational culture characterized by teamwork, openness to change, and leadership that valued nurse autonomy, clinical expertise, and collaborative practice. Supportive leadership and a team-based approach further enabled the effective coordination between nurses and providers required to implement and sustain a delegation protocol. Participants also emphasized the importance of involving patients in shared decision-making, underscoring the need to respect patient preferences and set clear expectations during care encounters. This finding suggest that fostering a culture that empowers nurses, supports interdisciplinary collaboration, and centers patient engagement may be key elements to the successful nurse adoption of CDS tools in the ambulatory care setting.[28]

Limitations

Several limitations should be noted. This study was conducted within academic medical centers, which are typically characterized by greater infrastructural resources and institutional support, potentially limiting the generalizability of findings for community or resource-constrained settings. Additionally, we did not account for the different institutional policies, patient populations, or resource constraints as part of our examination. While thematic saturation was achieved, the final sample size was relatively small and the sample skewed toward nurses at one site and toward nurse leaders rather than frontline nursing staff, which may have introduced a hierarchical bias in perceptions of implementation. Also, participant selection may have been subject to response bias, as we used a convenience sample and did not stratify responses based on participants' familiarity with technology, experience, or frequency of tool usage. Lastly, this analysis does not include an examination of tool utilization or patient-level outcomes and their influence on perceived sustainability.

Conclusion

This qualitative analysis underscores the multifaceted nature of sustaining a CDS-guided nurse

delegation protocol for ARIs in ambulatory care settings. The findings reveal that sustainability hinges not only on the design of the intervention but also on contextual factors such as staffing adequacy, resource availability, nurse confidence, organizational culture, and ongoing training. Importantly, the variability in nurse comfort with CDS tools and the differential success across clinic settings suggest that tailored implementation strategies are essential. Future efforts should prioritize clinic-specific readiness assessments, targeted skill development, and leadership engagement to enhance the long-term viability of nurse-led CDS interventions.

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Conflict of Interest

The authors declare no conflicts of interest for this study, financial or non-financial.

Data Availability

The datasets generated during this study are not publicly available due to privacy restrictions but may be made available from the corresponding author upon reasonable request.

Author Contributions

All authors are responsible for the conceptualization, design, and methodology used in this study. Dr. Tiase, Dr. Stevens, N. Henning, M. Braga; K. McHugh, and A. Tovar participated in data acquisition, analysis, and interpretation. Dr. Tiase, A. Tovar, and Dr. Stevens contributed to drafting the manuscript. All authors critically revised the manuscript and approved the final version. Drs. Feldstein, Mann, and Hess obtained the funding.

Abbreviations

CDS – clinical decision support

CPR – clinical prediction rules

iCPR – integrated clinical prediction rules

ARI – acute respiratory infection

EHR – electronic health record

RN – Registered Nurse

iCPR3 – title of randomized controlled study

IRB – Institutional Review Board

CFIR – Consolidated Framework for Implementation Research

CBT – computer-based training

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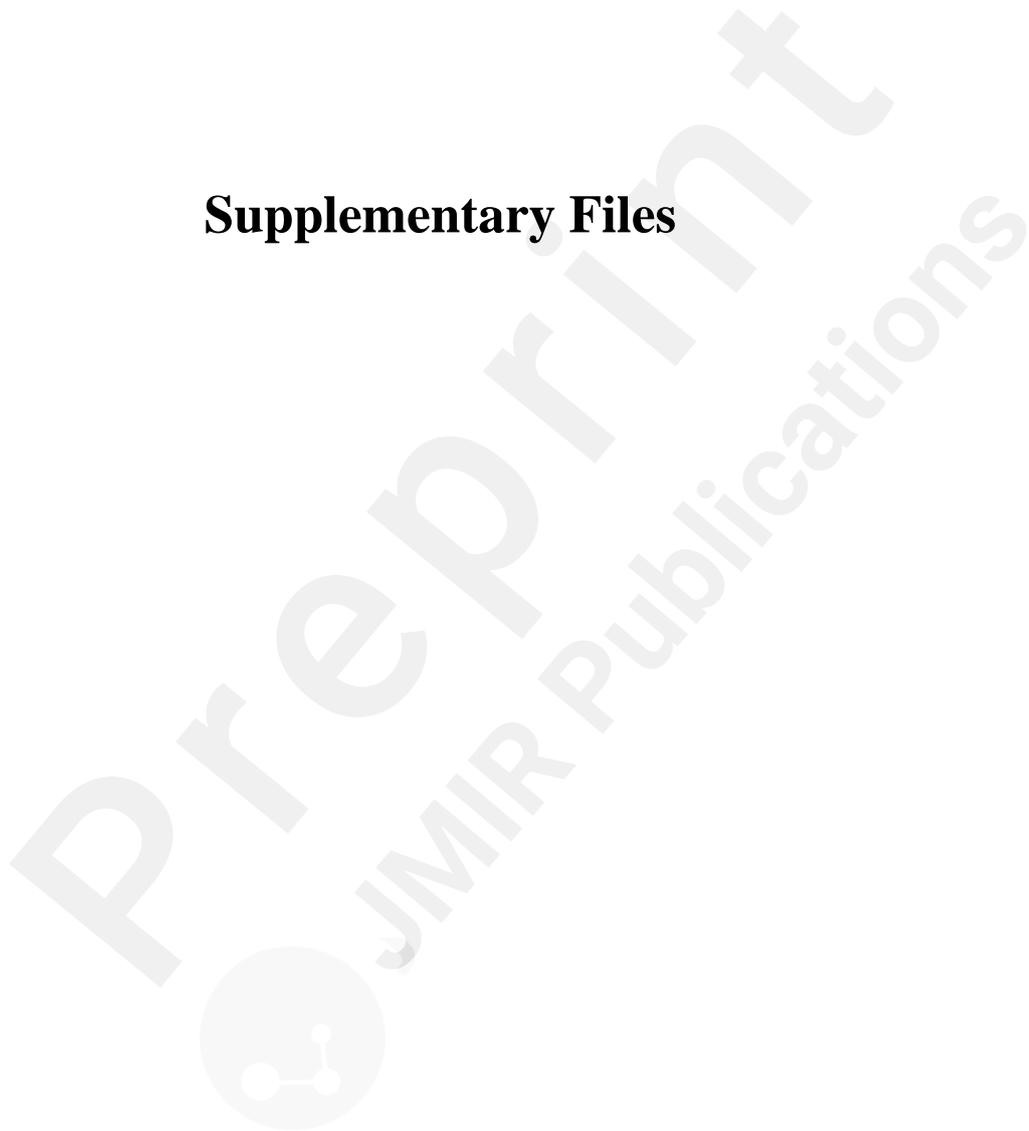
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Supplementary Files

Multimedia Appendixes

Icpr Survey Tool Questions.
URL: http://asset.jmir.pub/assets/af9c0dae83cdb8d49c747c50fc7df8c8.docx