Transferring Process Knowledge and Protocol Structure in a Continuous Remote Patient Monitoring Program: Heart Failure to Ileostomy Clinical Use Case Study

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Background

- Transfer learning refers to the transfer of knowledge between different machine learning models or application domains with a similar aim.
- Law and Chuah[1] have characterized a learning organization as possessing a process of continuous "Driving, Enabling, Learning, Outcome,"
- Little is known of transfer learning in the context of transferring process knowledge and structure in complex healthcare delivery settings.
- NorthShore University HealthSystem deployed Cascade study series which utilizes a continuous remote patient monitoring (cRPM) platform with structured cascading and escalation pathways for at-home monitoring of patients.

Objective

Guided by transfer learning concepts, the knowledge learned from Cascade HF deployment was adapted to support an intra-hospital start-up of the Cascade Ileostomy study.

Research Design

- Cascade studies use non-invasive wearable biosensors to collect patients' ambulatory physiological data which is analyzed by machine learning algorithms to alert the likelihood of patient deterioration.
- Home health nurses review the monitoring platform daily and escalate patient abnormal status and alerts to the clinical team for early intervention.
- The first cRPM use case was deployed in heart failure (HF) patients in Dec 2020.
- Cascade HF design was informed by Consolidated Framework for Implementation Research (CFIR)[2] to guide the Cascade HF protocol development, workflow design, and deployment.
- We collected and evaluated Cascade HF implementation data, workflow and communication processes, and alerting structure to reconfigure the protocol and workflow[3].
- Informed by the findings, we transferred the HF study protocol structure, alerting structure, and workflow process to the ileostomy study, with minimal tailoring of the finer details to adapt to the ileostomy clinical team and patients' needs.

Figure 1: Cascade Study Series General Workflow

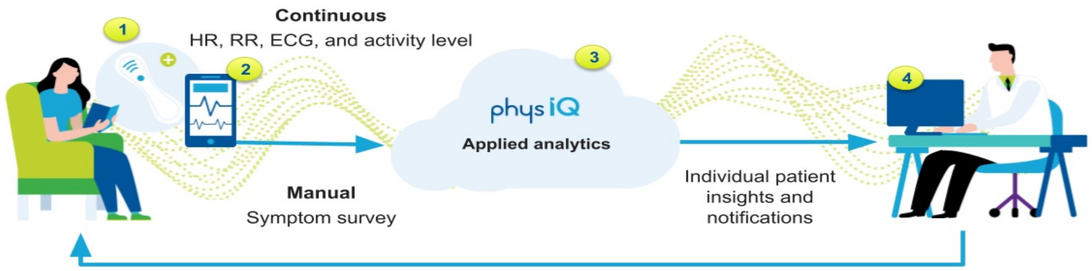
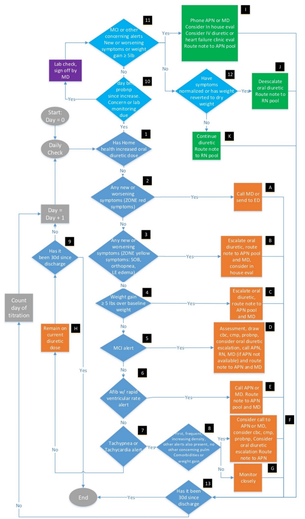
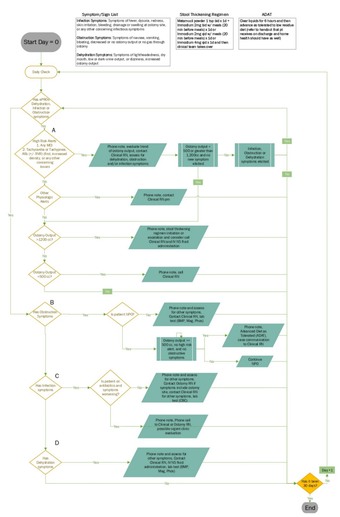


Table 1: Process, Protocol, and Alert Structured from Cascade HF to Ileostomy

CFIR Framework	Cascade HF	Findings with HF deployement	Actions associated with findings	Transferred to Cascade Ileostomy
Planning	Co-developed workflow with HF attending	Design phase did not include all key stakeholders	Paused study and involved HHNs and HF APPs to redesign workflow	Involved all clinical tream members in design phase
Engaging	2 study kick off education meetings to support engagement	Complex training materials and low attendance rate	Personalized training materials and multiple training sessions	• Flexible training schedules and personalized training material • Surgery team champion encouraging engagement
Executing	HHN escalation workflow	• HHN escalating to HF RN who does not take care of patients • No standardized HF team intervention	• HHN escalate cases to HF APP and HF attending • Created standardized workflow for HF team	• Tailored escalation pathways to ostomy RN, clinical RN, and surgeons • Created standardized workflow for surgery team
Technology	EHR smart note with logic built in	Inconsistent usage of the EHR note	Re-designed EHR note with clinical team	1. Personalized training 2. Co-developed EHR note with colorectal clinical team
Alerting structure	Created a monitoring protocol using the previously validated MCI alert	Additional key alerts showed potential in identifying patient deterioration	Created customized workflow for additional key alerts	Ileostomy workflow includes MCI and key alerts

Results





	Cascade HF	Cascade Ileostomy
Start up time (months)	10	3
Protocol finalization time (months)	10	4
Number of significant deviations during soft launch	18	5

Conclusions

Transfer learning from process modeling and protocol structures can potentially increase the efficiency in project start-up, inform tailoring of protocol pathways, and improve operation quality

Future Plans

More research is needed to determine the scope, extent and adaptability of transfer learning between different clinical use cases.

References

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2. Damschroder, LJ, Aron, DC, Keith, RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implementation Sci. 2009. doi: 10.1186/1748-5908-4-50
3. Chi WN, Reamer C, Gordon R, et al. Continuous Remote Patient Monitoring: Evaluation of the Heart Failure Cascade Soft Launch. Appl Clin Inform. 2021;12(5):1161-1173. doi:10.1055/s-0041-1740480