Adjusting for SNF HIE capabilities, SNFs have a higher probability of usable electronic information available at the point of care if their top partner hospital reports participation in a community HIO (+7.6%; *P* = 0.018).

Conclusions: Hospital information portals increase SNF access to HIE infrastructure, but community-level HIOs increase the likelihood that SNFs actually have accessible, usable electronic information from hospitals at the point of care.

Implications for Policy or Practice: Community HIOs appear to play a critical role in SNFs having usable, timely access to outside sources of health information. HIOs have significant opportunity to bolster their value proposition through greater engagement with SNFs and other postacute providers on supporting their informational needs and transitional care processes with hospitals.

Primary Funding Source: Office of the National Coordinator for Health IT.

Exploring the Impact of the Digital Health Drug Repository in Ontario

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Research Objective: Central repositories of drug-related information have the potential to reduce adverse events and inappropriate prescribing by enabling clinicians to access relevant details at the point of care. In 2016, the Ontario Ministry of Health developed the Digital Health Drug Repository (DHDR) to support clinicians in developing a best possible medication history (BPMH). We conducted a formative evaluation of the DHDR to understand (1) the perceived clinical value DHDR; and (2) the barriers and enablers to adoption and meaningful use.

Study Design: A multimethod approach including semistructured interviews and an online clinician survey. Interview data were thematically analyzed, and survey data were analyzed using descriptive statistics.

Population Studied: Clinicians included physicians, nurses, pharmacists, and allied health providers who were eligible to use the DHDR (irrespective of use).

Principal Findings: Thirty-three interviews were conducted. Most participants were female (60%, n = 20), worked in acute care settings (46%, n = 15), and self-reported using the DHDR > 4 times (78%, n = 26). Participants were satisfied with the DHDR as source of secondary information, but the absence of specific data such as medication instructions and prescribed medications that were not dispensed limited its utility. Poor integration with point-of-care systems further limited potential, with no perceived impact on the development of a BPMH. Of the 167 survey participants, the majority were female (82%, n = 137) and worked in acute care settings (58%, n = 90). Only 24% (n = 40) were actively using DHDR. DHDR users were neutral in their perceptions of the utility of DHDR (mean scores ranged 4.11-4.76 on a 7-point adjectival scale). Of the 76% (n = 127) who were not using the DHDR, many found access to medication information very important (mean scores ranged 6.22-5.97). Reasons for not using DHDR included cumbersome process to gain access to DHDR and the perception that the repository was incomplete.

Conclusions: Findings from this evaluation suggest that there is potential untapped value if a digital centralized medication repository is operationalized to align with clinician needs. Specifically, (1) integration with point-of-care systems; (2) comprehensive clinical data; and (3) quick and streamlined onboarding processes would facilitate meaningful use.

Implications for Policy or Practice: Digital drug repositories can be a valuable tool for clinicians when determining a BPMH for a patient. Access to comprehensive medication information across the health care system can improve efficiency and reduce medical errors. These applied insights can inform the operationalization and implementation of system-wide strategies to improve their uptake and impact.

Primary Funding Source: Ontario Ministry of Health Canada.

Measuring the Scale of Hospital Health Record System Fragmentation in England

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Research Objective: Many patients experience a fragmented health care journey that involves transitions of care between different hospitals. Ineffective sharing of health data between hospitals can impair the delivery of safe, high-quality care. This study aimed to identify the unmet need for interhospital data sharing by quantifying the movement of patients between acute hospital trusts and health record systems in the NHS in England.

Study Design: This retrospective observational review examined Hospital Episode Statistics (HES), a national hospital administrative dataset relating to patient encounters with the NHS in England. Outcome measures included the frequency of patient encounters with multiple hospital trusts and the frequency of consecutive encounters with hospitals using different health record systems.

Population Studied: All adult patients with inpatient, emergency department, or outpatient encounters at acute hospitals in the NHS in England during the 12-month period from April 2017 to April 2018 were included.

Principal Findings: 21,286,873 patients were involved in 121,351,837 encounters at 152 included NHS trusts over the one-year period. There was limited regional alignment of electronic health record

(EHR) systems in the 117 (77.0%) hospital trusts that were using EHR systems. 15,736,863 (73.9%) patients had two or more encounters with the included trusts and 3,931,255 (25.0%) of those attended two or more trusts. Over half (53.6%) of these patients had encounters shared between just 20 pairs of hospitals. Only two of these pairs of trusts used the same EHR system. On 11,017,767 (9.1%) occasions, patients presented to a hospital using a different EHR, or paper record system, to their previous hospital attendance.

Conclusions: This study found that nearly four million patients accessed care at two or more different NHS hospital trusts over the one-year study period, highlighting the demand for effective interhospital data sharing. Most of the pairs of hospital trusts that commonly share patients do not use the same health record systems. The fragmented distribution of health record systems that exists in the NHS in England represents a significant barrier to interhospital data sharing and interoperability.

Implications for Policy or Practice: To make informed and safe decisions for patients negotiating increasingly complex health care systems, clinicians need the right information about the right patient in the right place at the right time. The findings from this study provide guidance for policy makers, clinicians, service managers, researchers, software providers, and patients to better understand and improve how data may be shared between hospitals. The methods used in this research could be applied to health care systems in other settings to guide the procurement and coordination of EHR systems to promote interoperability and effective data sharing.

Primary Funding Source: National Institute for Health Research (UK).

Natural Language Processing for the Extraction of Patient Symptoms during Cancer Radiotherapy

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Research Objective: On-treatment evaluation of patients undergoing radiation therapy (RT) and chemoradiation (CRT) is important for managing symptoms related to disease, RT, or systemic therapy. Automated extraction of clinical symptoms from free-text documentation can enable the implementation of machine learning (ML) or artificial intelligence (AI) tools such as our previously developed pretreatment ML algorithm to predict ED visits and hospitalization during treatment. We present analysis of extracting on-treatment symptom data from clinical notes via a natural language processing (NLP) pipeline.

Study Design: We obtained free-text note data for 6,918 outpatient RT or CRT courses for adult patients (for any indication) at Duke from 2013 to 2016. The Apache clinical Text Analysis Knowledge Extraction System (cTAKES) default clinical pipeline was used to extract SNOMED terms identified as explicitly present, absent, or not mentioned. These were converted to NCI Common Terminology Criteria for Adverse Events (CTCAE) v5.0 terms via the Observational Health Data Sciences and Informatics (OHDSI) Athena vocabulary. CTCAE is the current standard for oncology toxicity encoding and grading.

The performance was evaluated in 100 randomly selected notes in comparison to gold standard manual abstraction of CTCAE toxicities by two senior radiation oncology residents with adjudication by an attending radiation oncologist. Reviewers were instructed to identify all mentioned symptoms and were blinded to each other's identifications. We created a thesaurus to harmonize overlapping CTCAE terms. Interrater reliability (IRR) was assessed based on unweighted and weighted Cohen's kappa coefficients between reviewers and versus the consensus. Detected symptoms in notes with both positive and negative mentions were considered positive. Sensitivity and specificity were calculated on a per symptom basis.

Population Studied: Clinical notes for patients undergoing cancer RT.

Principal Findings: One hundred notes representing diverse disease sites revealed disagreements between physician reviewers in symptom identification in 93 of 100 notes, with median 4 per note (range 1-12). Unweighted kappa was 0.68 (95% CI 0.65-0.71) and weighted kappa 0.59 (0.22-1.00).

Based on consensus symptom identification, NLP had strong detection performance for a number of symptoms with positive mentions in notes, including radiation dermatitis (80% sensitivity, 98% specificity), fatigue (74%; 100%), and nausea 85%; 99%). Detection of pain (63%; 64%) was more limited. In contrast, negated mentions had low rates of sensitivity across symptoms, such as radiation dermatitis (19%), pain (7%), and soft tissue fibrosis 0%.

Conclusions: Interobserver identification of acute toxicities during cancer therapy is highly variable. Natural language processing can provide systematic identification of toxicity during therapy, particularly for positive mentions. Computational detection of negated symptoms is more challenging and represents an area for continued development.

Implications for Policy or Practice: NLP can facilitate systematic automated characterization of adverse events during cancer therapy at scale. Inclusion of symptom information from clinical notes allows for better characterization and understanding of nuances in patient symptom trajectories and without any additional burden (eg, structured data capture or workflow adjustments) by the care team. This enables real-time opportunities for improved surveillance, quality measurement, and supportive care in clinical practice with minimal burden.

Comparison of Data Science and Qualitative Approaches for Variable Selection of County-Level Social Determinants of Health

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Research Objective: Health services researchers' use of social determinants of health (SDOH) variables in quantitative models is