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Enhancing Clinical Practice: Creating Dynamic Medical Content in Electronic Medical Records

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Abstract. The integration of Electronic Medical Records (EMRs) revolutionized healthcare but often retained limitations from paper-based structures. This study proposes a framework for developing dynamic medical content specifically adapted to the clinical context including medical specialty and diseases. Tailoring content to this dynamic context offers several benefits, including improved access to relevant information, streamlined workflows, and potentially better patient outcomes. We applied our framework to develop neurosurgical content, focusing on brain tumors. The method involves defining the medical specialty, outlining user journeys, and iteratively developing artifacts like assessment forms, dashboards, and order sets. Standardized terminologies ensure consistency and interoperability. Our results demonstrate a successful development of content meeting user needs and clinical relevance. While initial implementation focused on neurosurgery, exploring scalability and AI integration offers promising avenues for further advancement. Future studies could quantitatively evaluate the impact of this method on user satisfaction and patient outcomes.

Keywords. Medical record, Problem-oriented, Health Information Interoperability

1. Introduction

In modern healthcare, Electronic Medical Records (EMRs) are essential. The paradigm shift from analog to digital documentation, facilitated by advances in computer technology, has ushered in significant advancements for EMRs, notably in terms of accessibility and data stewardship. Nevertheless, the early optimism was somewhat mitigated upon recognition that numerous EMRs merely replicated the architecture of their analog antecedents, architectures that are intrinsically circumscribed by the physical limitations of paper [1]. Such legacy configurations can inadvertently impede the exploitation of digital technology's full spectrum of capabilities within the healthcare domain.

The adaptability of dynamic medical content according to the clinical context is crucial for enhancing its utility. A clinical context is a dynamic amalgamation of diverse

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elements encompassing diseases, symptoms, comorbidities, the evolving stage of the medical issue, the corresponding stage of care, and distinct demographic patient characteristics [2]. This intricate tapestry varies not only between different patient records but also undergoes fluctuations within the different stages of a single patient's medical history.

Medical content encompasses a diverse range of components, comprising assessment forms, dashboards, workflows, and order sets integrated within EMR. Tailored medical content aligned with the clinical context enhances information collection (forms), medical data presentation (dashboards), and action definition (order sets) within a specific clinical scenario [3-5]. This approach and contextualization improve access to relevant clinical information at the point of care [6,7]. These dynamic medical records can enhance adherence to quality protocols and potentially improve patient outcomes through the integration of comprehensive and relevant healthcare information.

In this paper, we present the method that we used to define various implementable clinical content. While the methodological framework we describe here is applicable to any type of clinical content in any clinical context, we present our results for the example of the brain tumor assessment which is a part of neurosurgery content pack.

2. Methods

Medical specialty is a component within the clinical context. Creating content for each medical specialty needs to identify the specific application areas where different types of clinical content will be employed. We created a working group including relevant profiles, such as senior clinicians, subject matter experts, and clinical informaticians.

The following steps outline the development workflow:

2.1. Statement of Work (SoW)

- Requirements and Scope: Defined needs and functionalities for each medical area
- User(clinician)/Patient Journeys: Mapping interactions with the medical content

2.2. Artifact analysis and development

- Current state content analysis: Reviewing existing medical content (forms, dashboards, guidelines, and clinical practices)
- Source review: Identifying and citing relevant evidence-based sources including national/local standards and guidance
- Requirement identification: Aligning content with SoW definitions
- Draft creation: Developing initial versions of artifacts (assessment forms, dashboards, order sets, workflows)
- Prototyping and feedback: Development of prototypes of each artifact for review and iteratively refining them based on interdisciplinary feedback to ensure both clinical accuracy and user satisfaction

2.3. Medical concept coding

- Clinical concepts within the artifacts were coded using standardized terminologies like SNOMED-CT and LOINC to ensure consistency, interoperability, and accurate data analysis

2.4. Final Approval and Handover

- Gaining the approval by a committee comprising senior clinicians, informaticists, and user representatives
- Handover of the developed content to product management for final integration into the EMR

We applied this framework to neurosurgery, focusing on brain tumors, and developed content supporting key patient journeys in various clinical scenarios.

3. Results

The goal of SoW includes providing a basic content pack that supports the main patient journeys in a neurosurgery department. The SoW addresses content needs for integrated neurosurgical care in various clinical scenarios including stroke (ischemic or hemorrhagic), brain tumor, disc Prolapse (Cervical / Lumbar).

The workflow high level phases for brain tumor includes nine phases : 1) Planned outpatient visit and initial assessment, 2) the phase in which diagnostics are performed (lab & imaging results), 3) planned outpatient visit-wrap up with results of first line investigations, 4) decision for treatment : a) surgery for biopsy or excision, b) hospitalization for medical treatment, 5) starting treatment path with involvement of multidisciplinary team, 6) daily evaluation of post operative status and progress or recovery, 7) discharge, 8) rehabilitation, and 9) follow-up.

In each phase, we identified content artifacts, including assessment forms, dashboards, and order sets, as well as clinical multi-disciplinary role actions (doctor and nurse), pain points, touchpoints, and scenarios. As an example, table 1 provides a selection of these items corresponding to each phase.

Table 1. A cross section of content items according to some of the identified phases related to brain tumor content package

Phase / Item	Planned outpatient visit and initial assessment	diagnostics are performed (lab & imaging results)	planned outpatient visit-wrap up with results of first line investigations
Scenario	Patient has been referred to hospital to reconfirm working diagnosis of brain tumor. Neurosurgeon assesses the patient and decides on necessary diagnostics	Tests, studies and examinations are performed either on the spot or in Diagnostic Services (in-house or external)	When all results are available, staging and grading can be performed to determine further treatment options, including the (usual) need to present the case at a tumor board
Artifact	Patient self-assessment - brain tumor context	Dashboard: diagnostic service	Assessment: Adult intracranial tumor
Artifact	Assessment: Adult intracranial tumor	Dashboard: intracranial tumor workup	Assessment: Brain Tumor Staging
Artifact	Unit View configuration for outpatient departments	Dashboard: Patient Summary Neurosurgery	Dashboard: intracranial tumor workup

Artifact	Dashboard outpatient department	Order Set: Intracranial tumor investigation	Assessment: CNS tumor - check list for tumor board enrolment
Artifact	Dashboard: Patient Summary Neurosurgery	Rules: Alert on Order Fulfilment delayed	Assessment: CNS tumor staging and grading - Prognostic factors
Artifact	Order Set: Intracranial tumor investigation	Rules: Redundant/refractory tests	
Artifact	Patient Self-Assessment: General History		
Artifact	Outpatient Department performance Dashboard		
Neurosurgeon action	Inform about overall clinic situation	Waiting for results to be available, possibly call the service departments to get more information	View result reports
Neurosurgeon action	Interview & examine Patient Review existing results and Define necessary diagnostic tests		Perform tumor staging (in cooperation with radio oncologist) Schedule patient for tumor board

Scope approval for each item especially artifacts was granted based on adherence to requirements, clinical relevance, and user acceptance.

4. Discussion

In this study, we outlined an approach to developing medical content within a clinical context. Beginning with the selection of the medical specialty, the subsequent steps in the workflow, including the Statement of Work (SoW), patient journey mapping, and artifact analysis, ensure a clear understanding of requirements and scope. The incorporation of clinical concepts using standardized terminologies enhances consistency and interoperability. The application of the proposed framework yielded tangible results in the development of medical content for neurosurgery. The Statement of Work (SoW) aimed at creating a foundational content pack supporting key patient journeys within a neurosurgery department.

Studies have shown that the dynamic nature of embedded forms and dashboards in EMR systems according to the clinical context can significantly enhance clinical workflow and improve user experience and increase efficiency in capturing and retrieving patient information [8]. When EMR systems align with the clinical context, healthcare professionals can make more informed decisions. A study by Middleton et al. [9] recommends the adoption of best practices for EHR system implementation and ongoing management to allow end-users to adopt best practices based upon the evidence to guide implementation of the EHR system and ensure safe and effective use. Another study showed that using EHRs with dynamic and correctly structured problem lists increases the odds of healthcare providers making the correct clinical decision [10]. Smart forms enable writing a multi-problem visit note while capturing coded information and providing decision support in the form of tailored recommendations for care [3].

Scope approval for each artifact was contingent on meeting criteria related to requirements, clinical relevance, and user acceptance. This iterative process ensures that the developed content aligns with the intended clinical applications and is well-received by the users.

5. Conclusions

A quantitative evaluation of the impact of the medical contents provided by this method in terms of satisfaction of target users and patient outcomes would be of considerable interest.

While the results demonstrate successful implementation in one area, exploring the method's scalability and adaptability to diverse content types and healthcare settings would be beneficial. Integrating AI and machine learning technologies into the framework could enable advanced content analytics and personalization, offering further avenues for exploration and contextualization.

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