MACHINE LEARNING FOR HEALTH

CDS and Implementation: The Last-Mile Challenge

How to turn models into useful, safe, and acceptable clinical support

TECHNICAL HANDOUT · SESSION 13

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Academic teaching material based exclusively on the PDFs available in the project

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Introduction

Clinical decision support systems produce value only when information, user, timing, channel, and action are compatible. A technically strong model can fail if it disrupts workflow, arrives late, creates noise, or offers a recommendation that no one can verify. [1]

This session treats CDS as a sociotechnical system in which knowledge, data, integration, interface, organization, and governance operate jointly. [1]

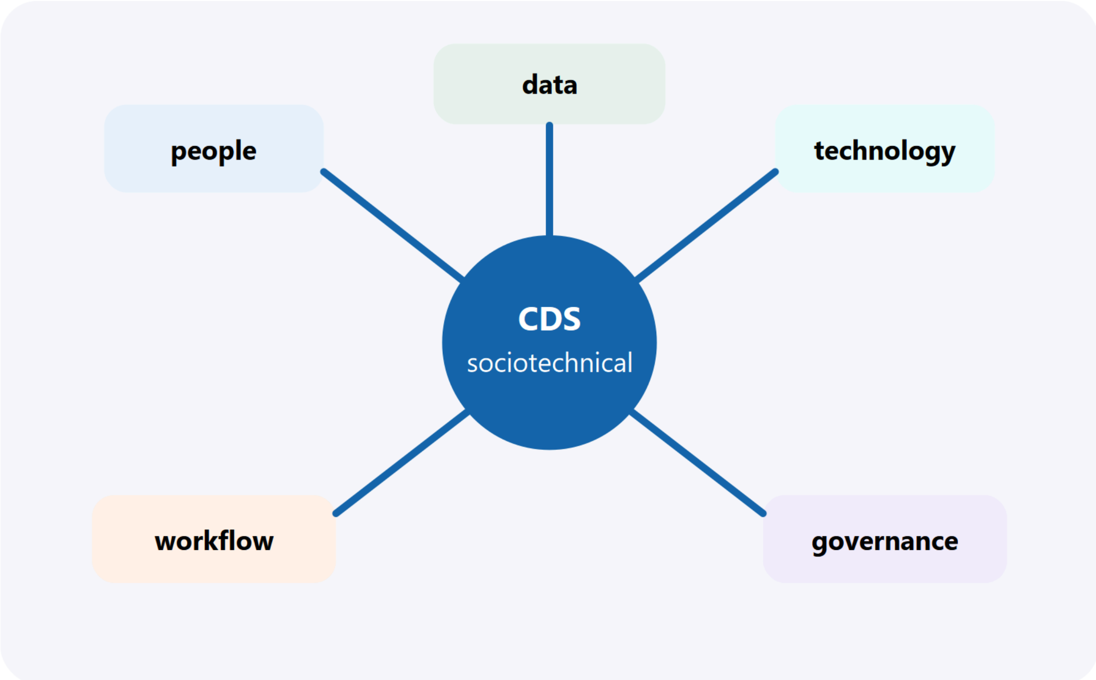

Figure 1 — CDS as a sociotechnical system. Source: original illustration based on [1]–[5].

1. CDS as a workflow intervention

CDS includes alerts, reminders, orders, summaries, recommendations, and other forms of support. The well-known "five rights" formulation states that the right information must reach the right person in the right format, through the right channel, and at the right time. Content alone is not enough [1].

Degrees of automation range from presenting information to carrying out actions. The lower the independent verifiability and the greater the risk of an action, the more important supervision, traceability, and regulation become [2].

KEY CONCEPT
CDS includes alerts, reminders, orders, summaries, recommendations, and other forms of support.

2. Technical integration and interoperability

CDS may be embedded in the health record or run as an external service. FHIR and REST APIs provide access to standardized data; knowledge artifacts can process them and return results to the clinical application. SMART on FHIR supports integrated, authorized applications in the EHR environment [1].

Integration must provide sufficient context, control versions, and handle missing data. A correctly calculated result based on inadequate information remains unsafe [1].

3. Usability, situational awareness, and fatigue

Usability encompasses effectiveness, efficiency, and satisfaction in the context of use. Evaluations include inspection, observation, interviews, and user testing. The goal is to understand real interaction and reduce mismatches between intention, mental model, and interface [3].

Excessive alerts can produce fatigue and high override rates. Prioritization should consider severity, urgency, certainty, the action available, and the cost of interruption. Integrated displays can support perception, comprehension, and projection of the patient's state [4].

4. Life-cycle governance

CDS requires accountable owners for knowledge, rules, the model, integration, and incident response. Changes in guidelines, populations, or systems can alter performance. Iterative evaluation should accompany design, implementation, and operation [5].

SOURCE LIMITATION
The Fall TIPS, AWARE, and potassium-overdose cases were kept out of the main text because they are not described adequately in the local PDFs.

Session summary

CDS as a workflow intervention: cds includes alerts, reminders, orders, summaries, recommendations, and other forms of support.
Technical integration and interoperability: cds may be embedded in the health record or run as an external service.
Usability, situational awareness, and fatigue: usability encompasses effectiveness, efficiency, and satisfaction in the context of use.
Life-cycle governance: cds requires accountable owners for knowledge, rules, the model, integration, and incident response.

References

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[2] Visweswaran, S.; King, A. J.; Cooper, G. F. Integration of AI for Clinical Decision Support. In: Intelligent Systems in Medicine and Health. Springer, 2022. External link

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[3] Patel, V. L.; Kaufman, D. R.; Kannampallil, T. Human-Computer Interaction, Usability, and Workflow. In: Biomedical Informatics. Springer, 2021. External link

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[4] Herasevich, V. et al. Patient Monitoring Systems. In: Biomedical Informatics. Springer, 2021. External link

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[5] Shortliffe, E. H.; Sepúlveda, M.-J.; Patel, V. L. Framework for the Evaluation of Clinical AI Systems. In: Intelligent Systems in Medicine and Health. Springer, 2022. External link

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