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1.Please propose an effective workflow integrated EHR design for ensuring hand-off accuracy among physicians caring for a patient.

Patient hand off is a real time patient specific information transition process from one care giver to another care giver for the purpose of ensuring the continuity and safety of the patient's care. Patient hand offs can be internal within the hospital departments or external between a primary care and a hospital. Hand-off during shift changes in the emergency department or incentive care unit can have adverse effect on patients due to poor communication or missing information. Among the factors that could cause miscommunication are time pressure, high noise levels, the need for multitasking, rapid turnover, fatigue etc. Paper based hand off documents are subject to omissions, typos, incomplete updating and erroneous medical information. Physicians can miss information or neglect to cover an important topic, and therefore can be unclear about the transfer of responsibility.

An EHR can provide a standardized structure and process that is necessary to ensure that critical elements are not omitted during handoff communication. My proposed EHR consistently provides a patient summary in a familiar format and articulate contingency planning for every patient. The EHR integrated hand off features can improve hospital work flow by eliminating the note taking personnel for writing hand off notes, reviewing and filing the notes. This will save time, less interruptions and immediate access to the patient data by the physicians. The EHR can allow automatic integration of patient identifier, demographics, vital information, problem list, medication list, allergy list, insurance information, and care members into the hand off screen. The user have options what kind of patient information will be available in the hand off section.

The caring doctors complete a check list pertaining to patient diagnoses, key issues, potential safety concerns and pending tasks. To help physicians and residents with their busy work load, the hand off process requires only fewer clicks and provides a user friendly single screen for simplicity. The hand off features can be tailored to each practice, department or team based on their unique work flow. The design also offers massaging, scheduling, and alarm systems to notify the clinical team members or patient family. The design also offers optional note taking and voice recording features.

The proposed EHR design also offer patient information exchange between remote referring physician and the hospital care provider. The external physician can log on to the web portal through VPN tunnel and transfer patient information using HL7 messaging standards. The referring physician can provide the patient data such as demographics, insurance information, current level of dx, allergy list, medication list, available test, imaging information, problem list etc. Once the data is imported to the hospital data repository, the patient record can be updated and integrated into the EHR.

2.Perform an FMEA for your hand-off system including at least 5 failure modes.

FMEA's systematic approaches can be used in many clinical systems as a preventive measure to reduce errors and improve continuity of care. For my newly designed hand-off system, a FMEA based proactive and recovery protocols can be used for the continuation of patient care in case the hand-off fails to perform its desired functions. For this , FMEA will first identify failure modes - how and where the hand-off system may fail. Failure modes can be determined by inductive analysis on possible single point of failures.

Once failure modes have been identified, the medical team would determine the likelihood of a mistake occurring and the potential consequences of an error. A FMEA worksheet can be completed for all the hand-off process steps and corresponding failure modes. For each failure mode, the following rating criteria will be used:

Severity: How serious are the consequences of this failure on patient care? 1 (no effects) to 5 (Severe)

Probability of occurrence: How frequently is this failure likely to occur? 1(Less likely) to 5 (Most likely)

Detectability: How easily is the failure recognized before the care. 1 (Immediately) to 5 (Hard to detect)

Failure modes will be then prioritized for further investigation and action by calculating the Risk Priority Number (RPN) = (Severity x Probability x Detectability)

A predetermined RPN threshold value of 64 will be used to determine a failure mode status as high or low priority. Further actions and investigations will be required if the RPN value is equal or greater than the threshold value of 64.

The following table captures the potential FMEA analysis:

Process	Failure-Mode	Cause	Effect	Sev	Prb	Det	RPN	Action (s)
1.Transfer patient information to the referring physician	The EHR receives poor information from external referral	External referral source not familiar with patient or process	Results in obtaining wrong information about patient	5	4	4	80	Educate external referrals
2.External provider sends the right patient record	Wrong patient record shows up in EHR	The external user input error	Time waste, frustration, wrong treatment	5	3	4	60	Proof read, error checker, peer feedback, supervision
3. Complete hands-off information before shift change	Incomplete Hand-off report at shift change	Missing hand-off info in EHR	Miscommunication, poor patient care	5	4	2	40	Peer feedback, supervision
4. Internal hand-off	Hand-off is assigned to	Distraction due to	Miscommunication, wastes of time,	3	3	3	27	Peer feedback, supervision,

must be transfer to the right care provider or dept.	the wrong provider or dept.	multitasking, fatigue, not paying attention to the details	delay in patient care					meticulousness
5. Hand-off feature is integrated in the EHR	System outage causes hand-off unavailable	power outage, software glitch, network down etc.	EHR is not accessible; loss of information	5	4	5	100	Hand-off process will be documented using paper and forms until the HER system is restored

Table: FMEA Failure-Mode Analysis