Supplementary Appendix 1

Study Instrument Description—DOCTimer

After reviewing existing software for behavior/task-tracking, there were no suitable solutions that would allow efficient digital timing and counting of a large number of activities on a single tablet screen with support for concurrently running timers. We thus developed a simple HTML/JavaScript data collection instrument to conduct our study, called DOCTimer (Direct Observation Counting Timer). All the timing/counting inputs were organized on a single screen and required only one tap by the observing study staff to start/stop timers or counters, which allowed highly efficient recording of EHR workflow events in real time despite the need for manual input by study staff (see Supplementary Fig. 1).

The data collection instrument contained over 120 distinct elements within three broad categories: clinical data, (software) application, and interruptions. See Appendix 2 for a full description of captured elements. The clinical data section was the focus of our study and contained a hierarchy of common clinical data types including clinical notes, imaging/radiology studies, vital sign data (including heart/pulse rate, blood pressure, body temperature, respiration rate, oxygen saturation, and ventilator-related data—subsequently referred to as “vitals”), laboratory studies (diagnostic testing of blood-based samples—subsequently referred to as “labs”), nonimaging/laboratory diagnostic studies, medications, etc. Top-level categories for “search/scroll” and “dashboards” were also included, which captured if the user was searching/scrolling through a list of metadata or looking at a multimodal dashboard of information that did not fit well into a single data category, respectively. Top-level categories (e.g., “imaging”) were timed for the duration the clinician spent reviewing data, while subgroups (e.g., “chest X-ray”) were counted for the number of unique reports the clinician reviewed. Top-level categories also contained an input to record the most-historical datum reviewed within a given category. As a clinician participant navigated the EHR, the study personnel would watch and manually record their chart review using the data collection instrument. Interruptions were permitted and recorded but did not count toward the total “chart review” time if they caused deviation of gaze away from the computer screen. Handwritten personal notes taken during the review process were included as part of the chart review process and recorded.

ICU Chart Review Observation Protocol

1. At the beginning of the observation period, explain study description and obtain oral consent from each ICU team member individually, in private.
2. Based on the balance of study participants by training level, choose and notify which team member you are likely to observe for the next admissions.
   (a) Link to tool
   i. Link to this page is located in DOCTimer application
   (b) aiming for even balance consultant-NPPA-Fellow
3. Give clinical team your pager number/contact number and remain in or around ICU for immediate availability when notified of a new admission to observe—let them know you want to observe chart review from the very beginning when they open the medical record.
4. Bring up DOCTimer application on computer/iPad so that it is already pre-loaded for a new observation session
   (a) Link to tool
   (b) When a new observation session begins, just start timing/counting—observation session information can be entered afterward.
5. Using DOCTimer
   (a) There are three core features—Interruptions (red), Applications (blue), and Data Elements (black). The Data Elements are captured either as “timers” or “counters”—the “timers” are the most important, and “counters” provide additional granularity on what sort of data are being reviewed. During active chart review, both a single Application timer and “Data Element” (Black) timer MUST be selected (with the exception of “Paper” chart review, during which “Data Elements” are NOT recorded). Only one Application timer can be active at a time (can’t simultaneously browse two Applications during chart review).
   (b) There is built-in logic that turns the background bright red to notify you if something is wrong with the timers:
      i. If an Application timer is running without a running Data Element timer
         • Data Elements are NOT captured during “Paper” chart review, so background turns red when “Paper” is running and a Data Element is selected
      ii. If a Data Element timer is running without a running Application timer
      iii. More than 1 Application timer is running
      iv. More than 1 Interruptions timer is running
(c) If an Interruption timer is started/running at the same time as an Application/Data Element timer, the background turns light red to notify you that multitasking is occurring.

(d) Each main Data Element timer will stop all other Data Element timers when selected (no need to stop one Data Element timer before starting another—it will stop the former automatically).

(e) Starting a “child” timer or counter element will start its “parent” elements, and stopping a parent will stop all child elements—no need to start/stop each timer individually within a Data Element group.

(f) If a timer element is erroneously started, just start the correct one and make a note in the “observation notes” section afterward.

(g) If a counter element is erroneously “ticked,” click the “Undo Last Count” button to undo.
   i. Note this function only works for “counters” not “timers.”

(h) When a chart review observation is complete, ensure all timers are STOPPED.

(i) Complete observation notes (if any).

(j) Enter observation session information.
   i. Use Clinician ID lookup to show the names/IDs of clinicians who have already been observed—if so use the same clinician ID, otherwise assign them a new ID (if last clinician ID = 12, assign new clinician ID as 13).
   ii. If not recording “real” data, use dummy testing clinician ID = 1.

(k) Follow steps 1 to 4 at the bottom of page to upload data:
   i. Observation session information—make sure “success” response appears on lower right page.
   ii. Observation data—make sure “success” response appears on lower right page.
   iii. Generate and send backup email with observation data.
   iv. Generate and send postobservation survey (need to change email address and salutation, otherwise pre-filled).

(l) Note that data for the observation session info or observation data may be re-uploaded if necessary (if data accidentally uploaded before chart review finished) using buttons 1 and 2 again.
   i. There is also a button to “redisplay tracking form” to re-enable the data collection section.
   ii. Make sure you receive “success” responses for data uploads, otherwise something went wrong and try re-uploading.

(m) When complete, refresh the page to start a new observation session, or open a new browser tab with a fresh load of DOCtimer application.

(n) Caveats:
   i. “Refreshing” the web page will permanently delete all data and lose the observation session.
      1. It is ok to close/sleep the device or switch to a different application so long as the browser page containing DOCtimer is not refreshed.
   ii. Launching DOCtimer from a desktop shortcut will cause any existing DOCtimer sessions (in existing browser pages) to be reloaded and all data will be deleted.

6. If there are any issues with the program or questions about the study, call/email MN.

**ICU Chart Review Observation Rules**

**General:**

- Be immediately available (present or close) on intensive care unit so that chart review will not begin before observation session can commence.
  - If observer shows up > 60 seconds “late” to a chart review session, do NOT perform the observation.
- Stay out of direct visual field of clinician to minimize observation effect.

**Interruptions/Multitasking:**

- Multitasking “interruptions” are allowed during chart review if the clinician’s apparent mental focus remains on the chart review process.
- If interruptions cause clinician to look away from screen for > 10 seconds, then stop the running chart review timers (interruption timer continues) until clinician resumes reviewing electronic record information.
  - Lengthy handwritten notes are excluded from this rule if clearly part of chart review process—i.e., continue the running application/data timers.
- “Interruption” timers capture the cause for an interruption, categorized as whether the clinicians “stays” or “leaves” the clinical workstation.
• For “leave” interruptions, only capture the initial reason for interruption (a bedside patient evaluation may turn into a procedure, etc., but we’re not going to capture that.

  o Don’t follow clinicians around unless they anticipate resuming their chart review at a different computer – we’re only interested in work done reviewing the EHR

**Counting/timing:**

• For counting purposes, each note/report is ‘counted’ only once even if clinician re-reviews the note/report
  • e.g., clinician views CXR, counter is ticked, clinician views laboratories, then returns to SAME CXR report—do NOT “tick” the CXR counter again, but DO restart the main “Imaging” timer.
• When chart review is active, always choose an information (i.e., black-outlined) timer in addition to Application timer.
  • Such as when browsing clinical notes, list, or AWARE dashboard but not looking at a single note or report in particular.
• When viewing a dashboard (e.g., AWARE with no specific data element selected), ALWAYS use “Dashboard” timer.
• When browsing/scrolling (or keyword “searching”) through a LIST of documents (e.g., AWARE documents/images list), ALWAYS use “DocList” timer, not “Clinical Notes.”
• Constantly recheck running timers to ensure accurate (could forget to start/stop an application or interruption if task switches).
• If a tab/screen is clicked inadvertently or in process of navigating to another tab/screen (spending < 2 seconds), no need to record the intermediate screen as no information was being reviewed.
• All use of “Other” or “NOS” timers should have an “observation session note” submitted that defines what information was reviewed that did not fit into existing categories.
• If a timer is activated and later realized was miscategorized or a better label fit (i.e., “Other_NOS_1” used when it was actually a “CDM” Clinical Note), just make a note and MN can manually fix the records in the database.
• For counters, the “undo last count” button should allow you to fix most immediately recognized button presses.
• All timers must be OFF/STOPPED before submitting observation session or results report.
• Dictation activities are excluded if the primary chart review has already been completed and reference back to EHR is only for purposes of dictation.
• “MIS” miscellaneous note types are recorded under “MIS_TOM,” not as a primary/consult/social work/pharmacy/etc. note.
• Textual “FLOW” notes should be classified as clinical notes under respective department (i.e., Nursing or Therapy_PTOT).
• Viewing of the combination MAR/active/EOP list in AWARE should be timed using the main “Meds” timers alone.
• “Observation” notes should be classified as “Admission” notes.

**“Historicalness” dropdowns should be captured whenever possible**

• If clinician is viewing a list of documents in chronological order (or individual documents), the “most historical date” is the earliest note/report scrolled-to/viewed.
• If clinician searches/sorts the document/report list for a specific document type, then the “most historical date” is the maximum time window for the list because they effectively searched over the entire interval.

**Observation session information:**

• “Census” percentage number EXCLUDES observation patient if already admitted to unit.
• Ask clinician if they anticipate looking up new information during dictation, if not, observation session ends.
• If dictation is a part of ongoing chart review, document it as multitasking and interrupt under “documentation.”
• Relay the postobservation survey instructions to complete survey AFTER rounding on the observation admission patient.
Supplementary Fig. 1 DOCtlmer data collection instrument.
Supplementary Fig. 2 Total electronic chart review duration among 32 observation sessions (24 unique clinicians). Box plots represent the 25th, 50th (median), and 75th percentiles, with whiskers extending to 1.5 times the interquartile range. ICU, intensive care unit; APP, advanced practice provider.

Supplementary Fig. 3 Counts of individual notes/reports were tracked for each observation session and tallied by category. “Diagnostic studies” refers to any nonimaging diagnostic study that generates a text report.
Supplementary Fig. 4 Four representative electronic chart reviews are shown to illustrate workflow sequence, from two attending physicians, one fellow, and one advanced practice provider (all different patients). “Personal Notes” = handwritten personal notes transcribed during the chart review process. “Leave workstation” = an interruption that required the clinician to pause the chart review and leave the workstation, then return to complete the review later. “Critical Care Dashboard” = a standalone application that provides an organ-system–based viewer to access EHR data. “Dashboard” data category = viewing a multimodal data window. “Search/scroll” = time spent scrolling through lists of note/report metadata before actually selecting a document to read. “Diagnostic Studies” = nonlaboratory, nonimaging diagnostic study that generates a text report. “Labs” = primarily blood-based laboratory testing. “Medications” = active outpatient and inpatient medication lists, and inpatient medical administration record (MAR). “Allergies” = allergy and immunization list.