Supplementary Appendix A Categorization scheme for usability flaws

Categories of usability flaws	Descriptions
1. Graphical user interface issues ($n = 19$)	
Close options ($n = 1$)	Order options too close to each other on the screen
Lack of highlight ($n = 1$)	Markers not sufficiently visible on images
Load of information ($n = 12$)	Excess of extraneous and irrelevant information on the interface or in orders, long labels, unstructured information, dropdown menu with numerous options, grid, or text on images
Typeface issues ($n = 5$)	Small font size, uniform font (no highlighting)
2. System behavior issues ($n = 36$)	
Lack of protection against errors ($n = 33$)	The system does not have enough protection against use errors or violations (e.g., displaying several patients simultaneously, changing fundamental units, having two records for a single patient, entering dates out of a given range or aberrant doses, removing alerts, multiple ordering of the same medication), or the existing protections can be easily overridden (e.g. password). Existing warning and alerts may be not appearing. The user may lack information of what the system has done or is doing (lack of transparency)
Lags ($n = 3$)	The system lags or gets frozen
3. System not supporting practice ($n = 221$)	
Supporting information issues ($n = 135$)	
Missing information ($n = 23$)	The system does not display the necessary information to perform the tasks: missing references (flags, markers on images), medications ordered (old, recent, dose, form, volumes, dates), lab results, time of acquisition of images, part of images, allergies; fragmented messages, incomplete intakes, and results
Information not up-to-date ($n = 1$)	List of medications in order menus not updated
Data inconsistency ($n = 6$)	The system displays values inconsistently depending on the module of the system or the support used; displays altered version of orders simultaneously to original version; displays different names of the medications; makes the results inconsistently available
Inaccurate information ($n = 36$)	The system displays flipped images, images with orientation markers reversed, incorrect information on images (e.g., date of exam, view position, size information, positioner angle, triangulation position). It provides incorrect value of lab results, incorrect information in patient files[a], erroneous status of studies (locked/read), and wrong information on medications
Data mixed up between patients' records ($n = 29$)	Data and requests are attached to the wrong patient or to other ID of the patient, reminders appear for the wrong patient A given patient file may have the right name but contain data of another patient (history, images, study results), or may be fully of another patient[b] The system may print the file of another patient, two patients' files may be printed on the same page under the name of one patient
Data mixed up within patient's record ($n = 8$)	The system presents intermixed lab results, images, dates, or data in the wrong record but of the right patient
Unrequested data changes ($n = 32$)	The system discontinues or changes orders (instructions, exam, medications, regimens, strengths, doses, instructions, dates, excessively rounds small doses), cancels orders and tests, changes lab results, and names of the provider. The changes may occur during transmission of information It deletes the strength of medications, studies, images, thumbnail, and patient data; it overwrites data, appendix, and allergies It marks studies as read, or exam as dictated, or accept results, without the user being aware of it It removes special characters in the lab results and adds extra space in files' names
Supporting features issues ($n = 86$)	
Inadequacy between the systems and the tasks of their users ($n = 17$)	The features of the systems and their organization do not fit clinicians' habits of work, the collaborative part of their tasks (e.g., display first the oldest results, absence of accepted terminology, counterintuitive way to discontinue medications, increase of tasks complexity) The system displays information in an unconventional or irrelevant way compared to users' habits
Inefficient functionality ($n = 47$)	The system opens another file, image, or patient's record than the one requested, or prints another file than the one required

(*Continued*)

Supplementary Appendix A (*Continued*)

Categories of usability flaws	Descriptions
	The system does not save/archive automatically files and data Orders are not completely accessible to all clinicians The system spontaneously opens patient record or tilts the scanner table The system is unable to display an existing file or image Several features of the system are inefficient (e.g., burning CD, entering sentences in a record, discontinue medications, filters, abnormality detection features, flip images, discharge feature, order changes notifications, logging out)
Issues in transmitting information (*n* = 22)	The system does not transfer or forward messages, requests, orders, and changes in orders on telephone lists, work lists, or nurses' lists. The system changes the order during its transmission to nurses' list. The system sends the message to the wrong clinician
4. Unspecified usability flaw (*n* = 11)	Usability flaw mentioned ("user unfriendliness" or "interface defects") but not detailed enough to be analyzable

[a]Could be data mixed up between patients but it is not detailed enough.
[b]Here we consider only cases in which the system displays data from different patients. When the system displays another patient's record, it is considered as an inefficient functionality

Supplementary Appendix B Categorization scheme for usage problems

Usage problems' category	Descriptions
Distrust in the system (*n* = 2)	The user lost confidence in the system
Error (*n* = 57)	
Diagnostic error (*n* = 2)	The user misdiagnosed a patient or concluded a disease had diminished when it had progressed
Identification error (*n* = 4)	The user misidentified the patients
Involuntarily validation/delete (*n* = 1)	The user signed or deleted inadvertently documents
Manipulation error (*n* = 1)	The user flipped an image inadvertently
Order execution error (*n* = 25)	The user does not process the order or failed to execute them accurately (changing drug, dose, not discontinuing an order, operate on the wrong part, give a contraindicated medication), or executes the order in impoverished condition
Ordering error (*n* = 20)	The user entered (or clicked on) the wrong dose, the wrong regimen, the wrong patient, the wrong test. (S)he duplicated medications, did not check orders in postoperative conditions, or ordered a contraindicated medication
Understanding error (*n* = 4)	The user misread, misinterpreted the order, the study, or the absence of markers on an image
Increased workload (*n* = 22)	
Unspecified (*n* = 1)	No details provided.
Additional tasks (*n* = 7)	The user had to perform additional tasks (e.g., scroll or review long lists, write on paper instructions for nurses, hunt for information, determine what was done or not, change data)
Increased cognitive load (*n* = 4)	The user thought was disturbed, his/her cognitive awareness blunted; the user must perform additional calculation, had to be more concentrate
Task redone (*n* = 5)	The user had to perform several times the same task
Time wasting (*n* = 5)	The user tried to perform tasks in vain, wasted his/her time
Involuntarily missed information (*n* = 17)	The user did not see or not get the relevant information (e.g., dose, regimen, results, full order, or studies) or was not aware data are available, that an error occurred, or of what must be done (e.g., which patient is under their charge, call up the admission records)
Uncertainty (*n* = 3)	The user was unsure of what the system had done, of the dose given to a patient, or of which file to choose
Violation of safety procedures (*n* = 2)	The user changed the status of medications or did not verify placement of an image

Supplementary Appendix C Categorization scheme for negative outcomes

Negative outcomes category	Descriptions
Harm to patient (adverse event) ($n = 29$)	
No details ($n = 1$)	The patient faced life threatening consequences related to his/her pacemaker. No further details were reported
Without consequences ($n = 12$)	The patient faced an incident (e.g., overdose, discontinued medications, delayed medications) but no injury was noticed
Non-lethal consequences ($n = 13$)	The patient was operated on the wrong side of his/her head, the patient experienced hypoglycemia, myocardial infection, asthma attack, allergic reaction, pulmonary edema, seizures, severe delirium, the wide spreading of his/her metastatic disease, chest pain, or ulcer requiring gastrectomy
Death ($n = 3$)	The clinicians missed the opportunity of diagnosing a life-threatening disease contributing to patient death; the patient developed fatal complications following overdoses; a premature baby died
Arrested or interrupted sequence (near miss) ($n = 3$)	Erroneous medications were almost given or infused to the patient
Incident with noticeable consequences with no harm ($n = 17$)	
No details ($n = 2$)	The care process was hampered (no details)
Delay ($n = 14$)	Care was delayed
Extra-costs ($n = 1$)	Insurance was paid for extra day
Incident with no noticeable consequences ($n = 0$)[a]	
Hazardous event or circumstance ($n = 8$)	The patient faced undetailed risks (it is not excluded that injury occurred)
Complaint ($n = 0$)[b]	
Action in response to incidents ($n = 6$)	
New procedure ($n = 5$)	The department provided advisory notes with instructions to avoid the problematic features, or other technology was used in replacement
Abandon of the technology ($n = 1$)	The department ceased to use the print
Drug diversion ($n = 1$)	An employee stole medications.

[a]This category is part of the categorization scheme used in the literature: no excerpts from the corpus analyzed matched it.
[b]This category is part of the categorization scheme used in the literature: no excerpts from the corpus analyzed matched it.

Supplementary Appendix D

Instance of incident report excluded from the analysis of the usability issues that gave rise to patient safety incidents
Number 253:
    "IT WAS FOUND THAT SOME TESTS THAT WERE ELECTRONICALLY ENTERED WERE CAPRICIOUSLY DISCONTINUED OR CANCELLED BY THE DEVICE PRIOR TO THE TEST HAVING BEEN COMPLETED. THIS CAUSED DELAYS AND DISRUPTIONS OF CARE WITH VARYING DEGREES OF ADVERSITY FOR THE PTS AND DISTRUST FOR THE FUNCTIONALITY OF THE SYSTEM BY THOSE USING IT. THE ABSOLUTE INCIDENCE OF THIS OCCURRING HAS NOT BEEN DETERMINED BUT IS FREQUENT."
    Capitalization as written in the original report; usability flaw in green, usage problems in blue, and negative outcome in red.