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Original Article

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A feasibility analysis of digital interface to transfer information during doctors' handovers

Uma análise de viabilidade de interface digital para transferência de informações durante a passagem dos médicos

Análisis de viabilidad de la interfaz digital para apoyar los traspasos de turnos medicos

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Keywords: Handover; communication; Continuity of Patient Care; Patient Care Team; Electronic Health Record

ABSTRACT

Objective: To report the pre-deployment analysis of a digital system to transfer patient information during physicians' obstetric shift sessions. **Methods:** A literature review explored evidence concerning electronic handover applications in hospitals. A survey met local approaches used to shift changing and the expectations of managers' stakeholders. To explore local practices, we analyzed a sample 251 obstetric handovers. Finally, requirements for the system were listed, and end-users evaluated mockups of the proposed design. **Results:** From the literature review, easy-to-use and integration with existing systems were the most critical requests to achieve user adherence. The main system requirement was using the hospital infrastructure to ensure full access to the current medical record. Mockup validation by end-users pinpointed items to improve a complete implementation and the positive acceptance of prefilled structured entries. **Conclusions**: There are blockages to overcome deficits in the quality of the information in clinical handovers to safely transfer patient care between doctors' shifts.

Descritores: Transferência; Comunicação; Continuidade do Cuidado ao Paciente Equipe de Assistência ao Paciente; Registro Eletrônico de Saúde

RESUMO

Objetivo: Relatar a análise pré-implantação de um sistema para transferência de dados clínicos durante as sessões de plantão obstétrico. **Métodos**: Uma revisão de literatura explorou evidências sobre sistemas hospitalares em uso. Um questionário levantou abordagens empregadas e as expectativas das partes interessadas. Para explorar as práticas, analisamos uma amostra de 251 transferências de plantão. Os requisitos para o sistema foram listados e os usuários finais avaliaram protótipos de interface. **Resultados**: A partir da revisão da literatura, a facilidade de uso e a integração com sistemas eletrônicos existentes foram os quesitos mais críticos para alcançar a adesão dos usuários. O principal requisito de sistema foi utilizar a infraestrutura do hospital para garantir o acesso ao prontuário eletrônio. Na validação das interfaces, identificaram-se itens de melhoria antes da implementação plena e uma aceitação de entradas estruturadas, pré-preenchidas. **Conclusões:** Há desafios para superar déficits na qualidade da informação clínica trocada em sessões de transferência de plantões médicos, para garantir a segurança do atendimento ao paciente.

Descriptores: Pase de Guardia; comunicación; continuidad de la atención al paciente; Grupo de Atención al Paciente; historia clínica electronica

RESUMEN

Objetivo: Reportar el análisis previo al despliegue de un sistema digital para transferir información de pacientes durante las sesiones de turno de médicos obstétricos. **Métodos**: Uma revisión de literatura explorou evidencias sobre sistemas hospitalares em uso. Um questionário levantou abordagens empregadas e as expectativas das partes interessadas. Para explorar las prácticas, analizamos una muestra de 251 transferencias de planta. Los requisitos para el sistema de listados y los usuarios finales para evaluar los prototipos de la interfaz. **Resultados**: partir de la revisión de la literatura, la facilidad de uso y la integración de los sistemas electrónicos existentes para las preguntas más críticas para alcanzar el objetivo de los usuarios. O principal requisito de sistema para utilizar una infraestructura del hospital para garantizar o acesso ao prontuário eletrônio. Na validação das interfaces, identificaram-se itens de melhoria antes da implementação plena e uma aceitação de entradas estruturadas, pré-preenchidas. **Conclusiones**: Há desafios para superar los déficits en la calidad de la información clínica trocada en sesiones de transferencia de plantas médicas, para garantizar una atención segura al paciente.

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INTRODUCTION

The hospital environment involves a dynamic nature that is prone to breakdowns in communication[1]. Handoffs or transfers of patient care from one care provider to another are known to be vulnerable to communication failures[2]. The clinical briefings are used to handover responsibility for patient care between professionals on a periodic basis[3]. The patients move among different hospital beds and specialist medical services within a hospital, and their clinical history passes through several shift changes[4]. In such a context, an effective communication is critical to the safe change of health information[5]. According to the Joint Commission International (JCI), the handoff communication "refers to a real-time process of passing patient/client/resident-specific information from one caregiver to another or from one team of caregivers to another with the purpose of ensuring the continuity and safety of the patient/client/resident's care[6]. To put proper communication into practice, mnemonics systems are commonly used to adjust key information in oral or written speech between caregivers. Situation, basement, assessment and recommendation (SBAR), and derivatives provide a structured process to follow, which are quite common in handoffs[7].

The implementing of an electronic handover has the challenge of ensuring the dynamism of clinical sessions, as well as enabling the safest updating of information on care and patient-related behaviors[8]. Electronic approaches have been described to overcome the deficits of varied and unstructured forms of clinical handover[9]. These have proven to provide better continuity of patient care than paper-based handovers, with the advantage of using a display to show the data, which attracts the attention of all the team during the clinical discussion, fostering the achievement of a consensus about the patient care plan[10].

Each health service determines where the specific information must be maintained in electronic systems and how to promptly retrieve this information using the best local solution, involving the users in all solution development steps[11]. To address this gap, a connected interface was proposed to support handovers, considering all stakeholders and a previous exploration of the clinical scenario.

OBJECTIVE

This feasibility study seeks to report a pre-deployment scenario analysis to support the development of a digital handover to the information transfer of patient care during doctors' shift sessions.

METHODS

The steps to support the system development were: a literature review explored evidence and lessons learned concerning electronic handover applications in hospitals and real scenarios, exploratory analysis. A literature review searched evidence reported in electronic transfers during doctors' shift sessions. The research question that guided the study was: Does the handoff supported with information technology improve the continuity of patient care in hospitals? The databases included PubMed, BVS, and IEEExplore, with a 10-year limit for analysis and no language restrictions. The search strategy was performed using the following keyword combination for the composition of PICO query: (Clinical Handoff OR SBAR OR Handover) AND (Impact OR Time OR Communication OR Information) AND (Continuity of Patient Care OR After-hours OR Continuity of care).

Exploratory visits to confer with local leaders, stakeholders, and end users considered institutional expectations for the selection of system requirements. In addition, an anonymous qualitative survey evaluated local practices during medical handovers. Instruments used for data collection during this exploratory step were accessible at Protocols.io's. With these elements and considering lessons learned from previous reports, the system requirements and an architecture for the handover connected interface were defined.

In a sequence of the system's pilot development, end users evaluated mockups of the application. Using a simulated scenario of a shift change with a fictitious clinical history, a sequence of three interfaces induced the users to express their opinion and perception of the prototype. A semi-structured questionnaire with an open space for free expression provided an opportunity for suggestions and ideas. The University Ethics Committee approved the trial protocol, with a national registration number in Plataforma Brazil: CAAE 82095517.3.0000.5149.

Material and settings

To assess local practices of medical handovers, the quality of written information used during handovers was analyzed. The scenario of this study was a tertiary care university-affiliated maternity ward, with 2,900 births/year and 31 beds. A staff of novice and senior physicians consisted of five doctors working 12 hours on duty, one of whom was the leader in charge. Verbal and written handovers occur twice a day, at 7 am and 7 pm.

Randomly selected handover sessions evaluations assessed the quality of health information, considering a three-month period in 2018. Four trained researchers selected a clinical briefing and analyzed the written medical histories. Specific metrics estimated endpoints of interest. The quality of the clinical information in written handover documentation was assessed by the researchers, based on the SBAR communication parameters[7]. The completeness of demographics data evaluated the authenticity of information and traceability of the reports. The length of the handover briefing was the secondary outcome. For this, 18 handover sessions will be selected in each group, with the expectation of 10 individual clinical reports per handover. An electronic system randomly chose 18 daytime handovers, in a list of 180 consecutive handovers between April and June 2018, to formulate the control group.

For the mockup validation, the analysis of problems required at least five voluntary end users, physicians from the university setting invited by convenience[12].

Data analysis

The numerical variables were described using minimum

and maximum values, average, and standard deviation. Qualitative variables were presented using absolute and relative frequencies. All data were stored in an excel database and analyzed in IBM SPSS 22.0 (SPSS Inc, Chicago, IL, USA).

RESULTS

Literature review

The computerized search retrieved 85 articles. Seventeen articles met inclusion criteria in the title and abstract screening, and 10 were included and reviewed for extraction. Subsequently, improvements in the quality of clinical information[10,11,13-15] and patient safety[13,16] with handover supported by the informatics technology were reported, as detailed in the Table S1 (Appendix A).

System requirements

The primary requirement included the use of the infrastructure of the hospital to ensure full access to the EHR. The handover-connected interface will be fully integrated with this system as a modular functionality. The advantages were the current protective system of the user's identification as well as the fact that users were already familiar with the system.

Obstetric histories were dynamic, and the possibility to provide editions in the SBAR structure of the entries, when retrieved from the EHR, was a property planned for the connected interface. Three options to foster a collaborative work of doctors during the handover preparation and briefing will provide access to the system by individual cell phones, from the existing computers in the hospital, and by viewing on a widescreen.

Analysis of information from written handovers

The number of histories corresponded to 251/615 (41%) of the all-impatient women in the ward, an average of 14 (1.7) individual reports per session; 163/237 (64.9%) of these were recovered from handovers at 7am and 88/237 (35,1%) at 7 pm. The patient chosen by the staff to transfer information had status: 109 (43.4%) inpatients,

Table 1 - Written obstetric history analyses

Outcomes	n	Present n(%)	Absent n(%)
Quality of information			
Situation Current problems or health condition	245	199 (81.2)	46 (18.8)
Background Facts since hospital admission	250	248(99.2)	2(0,8)
Background Obstetric history: prenatal care, complications, previous gestations	245	201(82.0)	44(18.0)
Background Past history of diseases	246	117(47.6)	129(52.4)
Assessment Critical values	236	126 (53.3)	110 (46.4)
Assessment Severe condition	229	166 (72.4)	63 (27.5)
Assessment Clinical risk assessment	224	129 (57.6)	95 (42.4)
Recomendation Patient care plan	237	204 (86.1)	33 (13.9)
Authenticity of data and traceability of the handover report			
Patient identification: name and surname	251	249 (99.2)	2 (0.8)
Patient identification: hospital bed number	251	186 (74.1)	65 (25.9)
Patient identification: age or birth date	251	241 (96.0)	10 (4.0)
Physician that prepares the briefing identification: name or registration number	251	0	251 (100)
Is there a traceable backup of the history by date?	251	245 (97.6)	6 (2.4)

Table 2 - Outcomes when evaluating the prototype interface considering simulations in mockups

	Agree or strongly-agree n (%)	Neutral n (%)	Disagree or Strongly-disagree n (%)
Mockup 1 – Structure of SBAR entries			
Was it easy to find the patient's name?	5 (71)	0	2 (29)
Was it quick to realize the meaning of the risk-signs	2 (29)	0	5 (71)
Was it useful to have clinical information that came from the existing EHR?	5 (71)	0	2
Mockup 2 – Pre-completed entries			
Was it easy to complete a patient's history using structured data entry?	6 (86)	0	1 (14)
Was it quick to realize that the pre-completed information came from the existing EHR?	6 (86)	0	1 (14)
Was it useful to have clinical information that came from the existing EHR?	6 (86)	0	1 (14)
Mockup 3 – List of patients			
Was it easy to see relevant clinical information of one patient using this data visualization model?	7 (100)	0	0
Was it quick to realize that the pre-filled information came from existing EHR, and that is possible to complete or edit it?	7 (100)	0	0
Is it useful to see the list with all the clinical histories organized by clinical-obstetric risk during handovers?	6 (86)	0	1 (14)

EHR: electronic health record

139 (55.4%) unknown, and 3 (1.2%) discharged.

According to the SBAR communication technique, the following information was retrieved from semi-structured documents: 199/245 (81.2%) situation registers, 249/250 (99.6%) background, 193/249 (77.5%) assessment, and 204/237 (86.1%) recommendation topics of communication, from the unstructured contents of the clinical histories. Table 1 summarizes details of pre-implementation outcomes of the clinical trial.

None of the written reports had the name or another identification of the health professional that prepares the document. The storage of all written briefings was in a open accessible domain, on the hospital network, with no definition of the length of time for their storage.

End-user validation of mockups

Concerning the profile of seven physicians who experimented using the mockups, the age varied from 26 to 32 years of age, with 2 to 6 years of experience working in an obstetric emergency ward. All of the doctors were experienced in preparing written handovers (more than 50 times), and, during real briefings, 3/7 (42.8%) reported a positive experience when sharing information with good quality. Table 2 summarizes the frequency of responses stimulated by a fictitious clinical history. The main barrier for the users was to recognize the meaning of the risk-signs in the interface. The access of the SBAR structured history from a list of inpatients names proved to be well accepted.

DISCUSSION

The findings from this study will provide relevant insights for the full computational implementation of a new tool in the maternity-hospital patient care routine. The expected result of this digital handover is to provide a useful connected interface to enable physicians to promptly achieve individual clinical data and easily prepare an electronic written summary of patients. Pre-implementation results pinpointed hindrances to overcoming the quality of information deficits in written forms, turning them into system requirements. Nonetheless, clinical studies to assess pre- post-impact of the use of inpatient data systems with health information exchange on the continuity of care are still scarce[17]. The pre-implementation of a pilot software contributes to give value to the introduction of handover tools in health care.

From the literature review, as well as from stakeholders' expectations, the implementation of structured interfaces to improve the quality of information was the core issue to be resolved by the connected interface for handover. Structured narratives have the advantage of increasing data consistency[18]. The quick viewing of pre-completed information that came from local EHRs, together with completion or editing functionalities, met the objectivity expectations and SBAR standards for clinical communication. Such items showed a 100% approval in the validation of mockups. The obstetric clinical histories were quite dynamic. The ability to be able to edit in the SBAR structure retrieved from the EHR became a relevant property of the pilot-connected interface. The importance of mnemonics during the processes of assistance relies on the enhancement of the memorization of relevant information and on effective communication, as pointed out by Riesenberg et al.[7].

Moreover, the analysis from previous reports guided us to the requirements to attend to end-user expectations concerning integration with existing systems. Flemming et al. reported the relevance of the integration with the system already in production in the hospital environment[19]. Our study added to prior work published in the literature using the architecture of the connected interface for handovers, which incorporated the existing EHR. Such connection can provide demographic and clinical data sharing, as well as the security of the existing system user access profile. The feasibility of the new implementation was achieved through end-user validation of mockups, due mainly to the advantages of full-integration.

Electronic systems that are well-planned to support the transfer of patient care can have an impact on the quality of clinical information[10,13,15-17] and patient safety[15,18]. Another point to highlight during the development of the system was the fostering a collaborative work, providing three viewing options to timely access the clinical histories to support handovers. Using a personal mobile or computer terminals around the maternity ward, the physician can log into the interface. The head managers of the clinics, though absent at clinical briefings, could follow the handover processes. This fluid point of communication in electronic handovers promotes collaborative work during the transfer of patient care[19].

The current analysis of the quality of the information in written handovers presented opportunities for practice improvements. For instance, Situation and Background topics of the SBAR were expected in all of the reports. However, they achieved only 81.2% and 82.0%, respectively. Assessment topics were present in even fewer cases. However, it was not possible to differentiate missing information from negative information. Thus, improvements on the completeness of clinical alerts (Assessment) will be evaluated by comparing this information with data from the post-implementation outcomes. A further point for the future is the choice of the patient that deserves special attention. Not all women had their stories told during the clinical briefing. Specific scores of the obstetric risk can add value to this selection.

Regarding the authenticity of data and traceability of the handover reports, there are gaps to overcome in both patient identification and the registration of the physician that prepares the briefing. As a medical record, legal issues deserve attention, even inside the written handovers. The analysis found a high level of fragility in the authorship of the text and the storage of identified documents. The assurance of a secure process of preparation, information storage, and retrieval is an essential element of the quality of the transference of health care, thus contributing to patient safety[8]. This study contains several limitations that should be considered. Coincidentally, the SBAR technique has been implemented in this hospital, which is in the preparation stage to raise its level of JCI accreditation. Concerning the system validation, the questionnaires did not contain enough elements of the real systems for user

evaluation. It is not possible to predict the real impact of this implementation, since this nature of an electronic information system involves several factors. Issues, including the velocity of the internal network connection, how easily users will access the system using mobiles, and the remote access by the head managers of clinics, are on the agenda for future studies. The practical acceptability of the system should be repeated after full implementation.

The present evaluation provided initial information on the impact and feasibility of implementing a connected interface to promote continuity of the obstetric care transfer. Real data analysis of hospitalized patients and experimental validation of the new interface provide a pre-deployment scenario analysis. Results indicated hindrances to overcome the quality of information deficits from written forms for clinical handover to safely transfer information between doctor's shifts. The full implementation of the interface for information transfer should include continuous feedback from end-users and stakeholders, considering the physician's experience and patient needs.

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Table S1 - Descriptive summary of the literature review

Study	Scenario	Study design	Intervention	Data sharing	Outcomes	Lessons learnt
White-Gibson et al., 2018[16]	Department of General Surgery	Pre- vs. post-intervention with numerical outcome analysis	Introduction of face-to-face handover accompanied by an electronic template with a red-flag system, after an on-call weekend	No reference	147% increase in the number of adverse events recorded, allowing for earlier management.	Development is feasible in compliance with work shift.
Till et al., 2014[13]	General Hospital	Pre- vs. post-intervention with survey analysis	Introduction of standard proforma for handovers with patient risk assessments and prompts for verbal handover in an electronic handover	Intranet connected	40% improvement in the overall quality of handover. 87% of medical staff felt a reduction in risk to patient safety, and 80% felt it increased continuity of care.	Without guidance, doctors omit key information required for effective handover. Electronic handover system as a viable, sustainable, and safe solution to handover of patient care.
Flemming et al., 2014[20]	Community hospital	Document analysis and handover observation	Introduction of the handover EHR based on an information model during nursing handover sessions	No reference	Aggregated information was highly important in the clinical case, opinions and meta-information such as the relevance of an item during handovers.	Electronic tool during face-to-face meetings does not substitute direct personal communication.
Smeulers et al.[21]	Nursing handover styles in hospital settings	Systematic review	Any intervention to improve nursing handover as compared to a previous or existing nursing handover practice or an alternative intervention, including an electronic system	No reference	There was no evidence available to support conclusions about the effectiveness of nursing handover styles to ensure the continuity of information in hospitalized patients.	Face-to-face communication, structured documentation, patient involvement and use of information technology to support the process are principles to apply when redesigning the nursing handover process.
Flemming et al., 2013[19]	Handover EHR*	Systematic review	The role of handover EHR and the effects of its implementation.	Integration with EMR or independent solution	Integrated electronic handover tools provide more and better information to the teams involved in handovers than paper based handovers.	Choices as structured instruments, the size of screen, boards for collaborative work must be put into practice and evaluated in real settings.
Collins et al. 2011[18]	Nurse and Physician Handoff Artifacts**	Systematic review	Utility of the CCD standard as a framework for organizing hospital-based handoff information for use in EHR.	Standard for sharing	The CCD standard was useful in categorizing 80% of the information elements of the assessed handover frameworks.	An EHR handoff tool based on structured narrative format, organized by the CCD standard, increases the consistency of data shared across all handoffs.
Ryan et al., 2010[15]	Emergency department	Pre- vs. post-intervention with numeric outcome analysis	Introduction of the handover EHR with standardized template implementation.	Intranet connected using a secure email	Reduction in median length of stay: from 5 to 4 days (p= 0.047). No difference was found in the mean time to first intervention: 21.2 ± 10.3 versus 28.2 ±7.8 hours (p= 0.059) .	Elements of quality to support the continuity of care for patients are user-friendly, low-cost of the intervention transferring patient details among staff teams.

Study	Scenario	Study design	Intervention	Data sharing	Outcomes	Lessons learnt
Raptis, et al., 2009[10]	Acute care tertiary hospital	Pre- vs. post-intervention, comparing the quality of handover from day to night staff.	Introduction of the handover EHR projected on a screen, retrieving information introduced from any computer terminal.	Integration with the central electronic information system	Improvement in the median number of patients in the handover list 7 (9–40) versus 13 (13–29) p = 0.0001. Improvement in the completeness of information fields (p<0.05): patient details from 34% to 100%; patient location from 86% to 86%; primary diagnosis from 86% to 93%; plan of action from 93% to 97%; day-team details from 52% to 96%. More workload during the nightshift providing the redistribution of tasks during day and night working hours.	Motivational implementation with formal training in the software provided low resistance to change. The projection of the handover for general display facilitated team discussions and consensus regarding the input of information.
Cheah et Al., 2005[11]	Regional teaching hospital	Pre- vs. post-intervention with survey analysis	Introduction of the handover EHR with minimum dataset for surgical handover	Integration with existing electronic information systems	***100% report the importance of an electronic handover system as well as a standard format; 85% felt that they received support to remind key investigations for patient care; 41% felt an adequate information availability.	Solution must easily provide a view of handover information on a personal digital assistant. Intervention must avoid excessive extra work for the doctors.

*One of four research questions was extracted. **One of two research questions was extracted. *** Results were extracted from a list according to the author's perception of the importance. EHR: electronic health records. CCD: continuity of care document. EMR: electronic medical record.

REFERENCES

1. L. I. Horwitz, T. Moin, H. M. Krumholz, L. Wang, and E. H. Bradley, "Consequences of inadequate sign-out for patient care," (in eng), Arch Intern Med, vol. 168, no. 16, pp. 1755-60, Sep 2008, doi: 10.1001/archinte.168.16.1755.
2. C. Beach, P. Croskerry, M. Shapiro, and C. f. S. i. E. Care, "Profiles in patient safety: emergency care transitions," (in eng), Acad Emerg Med, vol. 10, no. 4, pp. 364-7, Apr 2003.
3. ACQHC, "Australian Commission on Safety and Quality in Health Care: Improvement Guide Standard," 2012.
4. T. K. Gandhi, "Fumbled handoffs: one dropped ball after another," (in eng), Ann Intern Med, vol. 142, no. 5, pp. 352-8, Mar 1 2005.
5. R. Sorokin, J. M. Riggio, and C. Hwang, "Attitudes about patient safety: a survey of physicians-in-training," (in eng), Am J Med Qual, vol. 20, no. 2, pp. 70-7, 2005 Mar-Apr 2005, doi: 10.1177/1062860604274383.
6. CBA, "Consórcio Brasileiro de Acreditação: Padrões de Acreditação da Joint Commission International para Hospitais," Rio de Janeiro: CBA, 2010.
7. L. A. Riesenberg, J. Leitzsch, and B. W. Little, "Systematic review of handoff mnemonics literature," (in eng), Am J Med Qual, vol. 24, no. 3, pp. 196-204, 2009 May-Jun 2009, doi: 10.1177/1062860609332512.
8. S. M. Alhamid et al., "Implementing electronic handover: interventions to improve efficiency, safety and sustainability," (in eng), Int J Qual Health Care, vol. 28, no. 5, pp. 608-614, Oct 2016, doi: 10.1093/intqhc/mzw082.
9. S. L. Barnes, D. A. Campbell, K. A. Stockman, and D. Wunderlink, "From theory to practice of electronic handover," (in eng), Aust Health Rev, vol. 35, no. 3, pp. 384-91, Aug 2011, doi: 10.1071/AH10926.
10. D. A. Raptis, C. Fernandes, W. Chua, and P. B. Boulos, "Electronic software significantly improves quality of handover in a London teaching hospital," (in eng), Health Informatics J, vol. 15, no. 3, pp. 191-8, Sep 2009, doi: 10.1177/1460458209337431.
11. L. P. Cheah, D. H. Amott, J. Pollard, and D. A. Watters, "Electronic medical handover: towards safer medical care," (in eng), Med J Aust, vol. 183, no. 7, pp. 369-72, Oct 2005.
12. N. Jakob, "Why You Only Need to Test With 5 Users," Alertbox,
13. A. Till, H. Sall, and J. Wilkinson, "Safe Handover : Safe Patients - The Electronic Handover System," BMJ Quality Improvement Reports, vol. 2, no. 2, p. u202926.w1359, 2014, doi: 10.1136/bmjquality.u202926.w1359.
14. V. P. Patel et al., "Development of electronic software for the management of trauma patients on the orthopaedic unit," (in eng), Injury, vol. 40, no. 4, pp. 388-96, Apr 2009, doi: 10.1016/j.injury.2008.10.006.
15. S. Ryan, J. M. O'Riordan, S. Tierney, K. C. Conlon, and P. F. Ridgway, "Impact of a new electronic handover system in surgery," (in eng), Int J Surg, vol. 9, no. 3, pp. 217-20, 2011, doi: 10.1016/j.ijsu.2010.11.012.
16. A. White-Gibson, C. Manole, D. Kearney, and D. Kavanagh, "Weekend surgical handover enhances early management of acute clinical changes using a red flag system," (in eng), Ir J Med Sci, vol. 187, no. 2, pp. 297-300, May 2018, doi: 10.1007/s11845-017-1675-z.
17. Z. S. N. Reis, T. A. Maia, M. S. Marcolino, F. Becerra-Posada, D. Novillo-Ortiz, and A. L. P. Ribeiro, "Is There Evidence of Cost Benefits of Electronic Medical Records, Standards, or Interoperability in Hospital Information Systems? Overview of Systematic Reviews," JMIR Medical Informatics, 2017 2017, doi: 10.2196/medinform.7400.
18. S. A. Collins, D. M. Stein, D. K. Vawdrey, P. D. Stetson, and S. Bakken, "Content overlap in nurse and physician handoff artifacts and the potential role of electronic health records: a systematic review," (in eng), J Biomed Inform, vol. 44, no. 4, pp. 704-12, Aug 2011, doi: 10.1016/j.jbi.2011.01.013.
19. D. Flemming and U. Hubner, "How to improve change of shift handovers and collaborative grounding and what role does the electronic patient record system play? Results of a systematic literature review," (in eng), Int J Med Inform, vol. 82, no. 7, pp. 580-92, Jul 2013, doi: 10.1016/j.ijmedinf.2013.03.004.
20. D. Flemming, M. Paul, and U. Hübner, "Building a common ground on the clinical case: design, implementation and evaluation of an information model for a Handover EHR," (in eng), Stud Health Technol Inform, vol. 201, pp. 167-74, 2014.
21. M. Smeulers, C. Lucas, and H. Vermeulen, "Effectiveness of different nursing handover styles for ensuring continuity of information in hospitalised patients," (in eng), Cochrane Database Syst Rev, no. 6, p. CD009979, Jun 2014, doi: 10.1002/14651858.CD009979.pub2.