Camilla Bjørnstad and Gunnar Ellingsen

Norwegian Centre for E-health Research

Data work: a condition for integrations in health care

Abstract

Integration and interoperability between different ICT systems are crucial for efficient treatment and care in hospitals. In this paper, we are particularly interested in the daily local work conducted by healthcare personnel to maintain integrations. A principal aim of our paper is therefore to contribute to an understanding of how context and history have impact on how integrations are solved and implemented, and how this affect the "data work" that is embedded in the integration of healthcare systems. Theoretically, we draw on the concepts of "information infrastructures" and "articulation work," and we discuss how social status may influence the invisible articulation work. Further, we show how historical decisions and existing systems both nationally and regionally have impacts on the daily work of local actors. Empirically, we have studied the formative stages of a large-scale electronic medication management system (EMMS) project in the Northern Norway Regional Health Authority.

Introduction

Integration and interoperability between different ICT systems are crucial for efficient treatment and care in hospitals.[1,2] Integration is often depicted as a straightforward technical issue between two or several information systems where data is easily exchanged between the systems. Unfortunately, this represents a too simplistic view. Targeting only the technical challenges has led to more failures than success stories (see, for instance,[3–5]). Several problems might hamper integration efforts: the systems are typically developed for different purposes, the data to be integrated may not be completely identical, and the data may have different precision levels. In addition, adapting one or both of the systems to smoothen the integration may be difficult due to vendor policies, existing deployment and interdependencies with other systems and practices.[6] This suggests that social factors and the broader context tend to be overlooked in integration efforts.[3,7] In this paper, we are particularly interested in the consequence of this, namely, the daily local work conducted by healthcare personnel to maintain integrations. We denote these efforts as "data work." We aim to show that this kind of work is largely hidden out of sight from the prescribed models of integration that is often recognized as a seamless activity untouched by humans. A principal aim of our paper is to contribute to an understanding of how context and history have impact on how integrations are solved and implemented, and how this affect the "data work" that is embedded in the integration of healthcare systems. We proceed with the following research questions: What type of daily "data work" is embedded in the

integrations in healthcare? How is this work shaped by existing ICT portfolios, the larger context and former decisions? And how does the professional belonging of persons performing the data work shape our understanding of it?

Theoretically, we draw on the concept of information infrastructures[8,6,9] and the notion of articulation work.[10–12] Empirically, we have studied the formative stages of a large-scale electronic medication management system (EMMS) project in the Northern Norway Regional Health Authority that was initiated in 2014. We focus particularly on the integration challenges between the EMMS and the existing electronic patient record (EPR) system residing in the northern healthcare region. This integration requires that physicians engage quite extensively in data work to maintain the integration. In the remainder of this paper, we begin by conceptualizing integration and data work in health care. After that, we elaborate on our methodological approach. Next, we describe the large-scale EMMS project followed by some empirical case vignettes. After that, we continue with a concluding discussion.

Theory

Integration in healthcare is considered a foundation for efficient treatment and care in hospitals as well as for functional cross-departmental patient pathways. In the hospital wards, an integrated solution is supposed to give clinicians easy access to data from multiple information sources, thus providing a complete picture of the patient's/client's medical history.[13] Many challenges exist in this regard. Integration typically implies interconnecting systems developed with different tools that reside on a variety of technological platforms[14] and that are developed for very different purposes. Key systems in hospitals include electronic patient records (EPRs), electronic medication management systems (EMMS), laboratory systems, radiology systems, patient administrative systems and electrocardiography (ECG) systems. There are also many more special-purpose systems.

To deal with this proliferation of information systems, several integration mechanisms have been put into action; these include enterprise resource planning (ERP) systems, enterprise application integration (EAI), middleware, and componentware.[4] Common models and architectures are also suggested.[15] Standardization is also a foundation for integration. In healthcare, Health Level Seven (HL7) is frequently used for exchanging XML-based clinical documents.[16] Another international initiative is the openEHR standard[17] that aims to structure and unify clinical knowledge by consensus (through the definition of so-called archetypes), which then can be applied as clinical data integration components.[18]

However, healthcare is still a late adopter of integrated systems.[19] The key problems appear to be related to the practical issues of integrating the vast number of systems.[20] Transferring data is not sufficient to make integration useful. For instance, the user has to be able to understand the data or to reuse the data across different contexts, and some data need reference values to make sense. Along these lines, Schmidt & Bannon (1992) argue that it is one thing to enter, access, and manipulate the same set of information, but further work is then needed to agree on the interpretations of the meaning of this information.

Unfortunately, the practical work and data work necessary to make this happen is often neglected. This suggests that a detailed socio-technical approach is necessary for understanding and managing integration in health care.[21–23]

The theoretical framework of information infrastructure has been used to study the design, implementation, and use of large-scale information systems.[8,9,22] These systems are never seen as stand-alone entities, but are interdependent with other information systems and organizational elements.[9,22] A basic principle of an information infrastructure—and a key point in this paper—is that it is never built from scratch; rather, it evolves from the installed base, a network of existing interdependent information systems. An emergent installed base may become very large and complex, making it difficult to replace or change. Therefore, newer versions must be adjusted or changed carefully to maintain backward compatibility with previous versions.[6] This is a process of ongoing negotiation and compromise for achieving stability or alignment,[24] making it crucial to acknowledge the socio-technical details.

Zooming in on local medical practices might highlight the nuances and complexities that are difficult to see from a bird's eye perspective. In this regard, Atkinson[25] points out the complexity of medical work, its richness, and messy character. Similarly, zooming in on clinical users' work related to maintaining and securing data integrations across systems may pinpoint what data integrations in healthcare really consists of and how users maintain them. Such a focus is closely related to the notion of articulation work.[10–12] Articulation work is "work that gets things back 'on track' in the face of the unexpected, and modifies action to accommodate unanticipated contingencies. The important thing about articulation work is that it is invisible to rationalized models of work." [11] In health care, the cooperative work involves several participants and limitless numbers of various tasks. Hence, articulation work becomes complex and demanding,[10] and ignoring it may mean that the system is not used or that it furthers inequities.[26] One mechanism to reduce the complexity (and hence articulation work) is to standardize work practices. However, Gerson & Star [27] emphasize that it is not possible to anticipate and provide for every event that might arise in a series of tasks. No standard can thus be complete, and a supporting system thus requires articulation to deal with the unanticipated contingencies that arise.

IT systems in hospitals support cooperative work. Schmith & Simone[28] argue that cooperative work interleaves distributed tasks; articulation work manages the consequences of the distributed nature of the work. Hence, IT systems in hospitals need coordination and articulation work to function. Articulation work is often invisible.[11] Star & Strauss[11] emphasize the notion that invisible work is often linked to the social status of the work and the workers. Work in this category is often done by parents, secretaries, and housekeepers. A hospital has several groups of employees, and the hierarchy of the professions in health care is strongly pronounced. Physicians, for instance, have a high social status, and it is likely to imagine that articulation work put on this profession would make invisible work more visible. Despite the work being a part of the background and invisible by virtue of routine, it may, because of the workers` social status, be pushed in a direction of being recognized and acknowledged.

Method

The study was conducted in the Northern Norway Regional Health Authority. The data were collected from January 2015 to April 2018 in a project that prepared for an implementation of a new EMMS. Methodologically, the study utilizes an interpretive research approach, and the main method for data collection involves semi-structured interviews and participant observations.

In total, the authors conducted 19 interviews with nurses, physicians, and project members. Six of the interviewees were physicians who would be responsible for the main part of the data work embedded in the integration described in this paper. The aim was to understand the medication process in detail and to learn the challenges related to the process of making integrations. The duration of the interviews varied from 30 minutes to one hour. We used an interview guide but let the informants choose the direction of the conversation. The interview guide worked as a checklist to ensure that the questions of interest were covered. The focus in the interview guide was medication management and challenges related to integration between the EMMS and other systems used in the hospital. A digital voice recorder was used to record the interviews. Afterwards, the interviews were transcribed. The analysis used a hermeneutic approach in which the explored phenomenon was understood based on the meanings of its parts and their relationships.[29,30]

The EMMS project

In 2014, the Northern Norway Regional Health Authority signed a contract for a new EMMS, namely the Metavision system from the global vendor iMDsoft. The cost of the procurement, including the implementation and 15 years of use, is estimated at EUR 114 million. The system was procured for several reasons: a) A fundamental problem was the prevalence of paper-based medication charts (leading to a risk of medication errors), b) the lack of efficiency in the overall medication cycle, and c) a lack of functionality for decision support and medication management in patient pathways. The Northern Norway Regional Health Authority decided that the EMMS would cover emergency units, intensive care and anesthesia departments, operating rooms, clinical wards, and outpatient clinics. All medication is to be documented in the EMMS during the hospital stay and when medication is administered during outpatient clinics consultations. The implementation was scheduled to start in the beginning of 2018, but the implementation was postponed to 2019, partly due to challenges of integrating the EMMS with the health region's EPR. The DIPS EPR has been running in all of the hospitals in the northern healthcare region since 2004, and the combination of the EMMS and the EPR is supposed to serve as the backbone for the patients' medication pathway. The medication list is first to be made in the EPR, and the reconciliation of the list will also happen in the EPR. The medication list is then to be transferred to the EMMS for the duration of the patients' hospital stays. When the patient is ready to be discharged, the medication list is to be transferred back to the EPR, where the prescriptions and the discharge letter are managed. Figure 1 shows the planned medication pathway. In the next section, we explain how the integration between the EMMS and the EPR implicates intensive data work for the physicians.

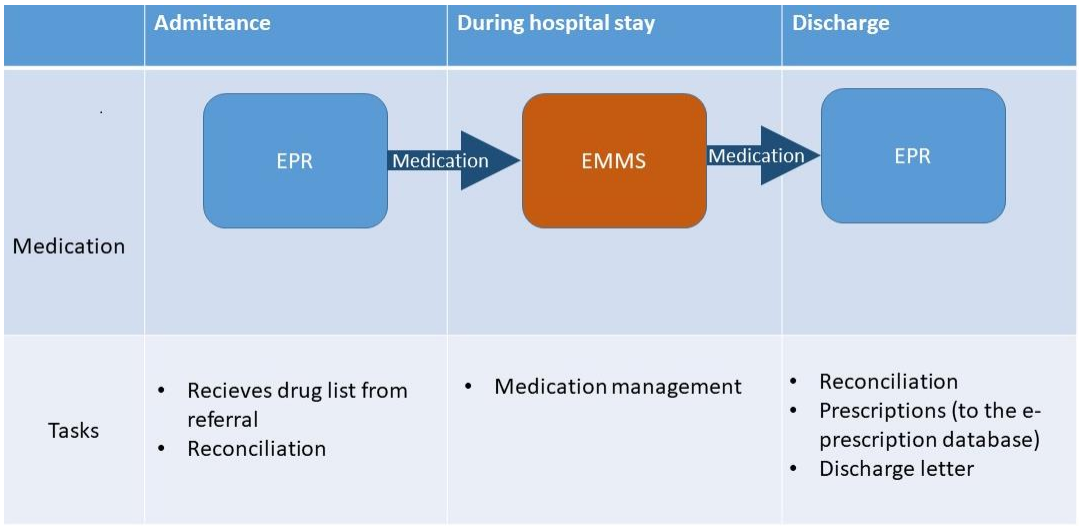

Figure 1. The planned medication pathway in the Northern Norwegian Health Authority

Case

When a patient is admitted to the hospital, the content in the medication list must be quality assured. Medication reconciliation is a way to do it. The method is a process of creating the most accurate list possible of all medications a patient is taking—including 1) drug name, 2) dosage (mcg, mg, g or tablets, capsules, suppositories, etc.), 3) frequency (i.e., twice a day or one morning + one evening), and 4) route (orally, intravenously, etc.)—and comparing that list against the physician's admission, transfer, and/or discharge report, with the goal of providing correct medications to the patient at all transition points within the hospital. This includes asking patients about their medications and checking different information sources. This process results in a medication list that represents documentation of what patients actually used when admitted to the hospital.

The EMMS project group (including representatives from the EMMS vendor) and the EPR vendor discussed whether reconciliation should run in the EPR or in the EMMS. In one way, the EMMS was preferred because it is a task closely related to medication management. However, the EMMS project decided that this process should run in the EPR because the EPR, unlike the EMMS, already had good functionality for the task and because a reconciled medication list represented a historical document that had to be time stamped, signed, and stored in the patient's EPR.

When a physician has completed the reconciliation for a specific patient in the EPR, she needs to continue working with the same medication list in the EMMS, as it represents the starting point for any medication management during the patient stay. To achieve this, the EMMS project required integration such that a reconciled medication list can be transferred from the EPR to the EMMS.

However, making this integration work efficiently turned out to be challenging because the two systems have different ways of organizing medication information. While the EMMS had its own internal way of organizing medication information, the EPR organized the same information in accordance with the national digital drug register FEST. FEST is developed by the Norwegian Medicines Agency and is the sole digital register available for drugs in Norway. General practitioners, nursing homes, pharmacies, and hospitals all

use this register. In Norway, the prescribers in primary care use brand names, but not names of the active substances of the drugs. The medication management in the EPR is related to making prescriptions that are transferred to the e-prescription database, and hence the EPR likewise uses brand names. The e-prescription database is owned by another actor; The Norwegian Directorate of Health.

The Southern and Eastern Norway Regional Health Authority use the same EMMS as the Northern Norway Regional Health Authority, and both regions have similar issues with customizing the FEST register to the EMMS. One problem is that the FEST register collects its data from another register named Farmalogg. Farmalogg is a subsidiary of the Norwegian Pharmacy Association. The pharmaceutical industry has to provide data to Farmalogg for each drug that should be used in Norway, but the rules on how this data should be organized are not strict. For instance, the same active substance could be spelled differently in one brand name compared to another (i.e., the English spelling or the Norwegian spelling), or the dose could be denoted as 1 mg/ml à 2 ml or as 2mg/2ml. This means that the information in FEST is not based on structured data, but on free text fields. Entries are copied from FEST as unstructured data to the EPR and the EMMS in the hospitals and to systems in the primary care. This induce a problem since the EMMS needs structured data. Hence, pharmacists have to manually customize the drugs for the EMMS database. In spite of this, the FEST database has good functionality for handling prescriptions for the general practitioners and the pharmacies. An expression of this is that the database recently has been sold to Iceland for being used for similar purposes.

The challenges related to integration when transferring the drug list from the EPR to the EMMS can be spelled out in the following ways: First, in accordance with the FEST register, drugs in the EPR are denoted by their brand name while the EMMS uses the international non-proprietary name of the active substance(s). For the latter, it means that each international non-proprietary name (active substance) could match more than one brand name. This is a problem when a medication list is transferred between the EPR and the EMMS because there is no one-to-one relationship between the brand name and the international non-proprietary name (see the example in figure 2). This came as a surprise to the EMMS project members. One of the members said the following:

> I was surprised that the relationship between international non-proprietary name and brand name lacked uniqueness, i.e., when patient had been admitted to the hospital and had a medication list that contained some brand products, the lists could not be translated uniquely to an international non-proprietary name without a human touch. Everybody was very disappointed by this.

Accordingly, the brand name in the EPR must be translated to the international non-proprietary name in the EMMS, as each international non-proprietary name (active substance) could match more than one brand name. For most drugs, the integration will suggest a mapping, but the physician using the EMMS must check whether this mapping looks correct and approve the translation before the process is complete. The crucial reason for checking it is that the drug list in the EPR is not based on structured data, but on free text fields. Consequently, the brand name of a drug in a text field form needs to be translated to the international non-proprietary name in a structured form. This requires tight quality assurance to ensure that everything is correct. For some drugs, no mapping will be

available. This could be because the active substance is spelled differently. For drugs that contain more than one active substance, the order in which the active substance is presented might be different (i.e., paracetamol + codeine versus codeine + paracetamol). The physician then has to find the drug in the EMMS` database and choose the combination of correct international non-proprietary names.

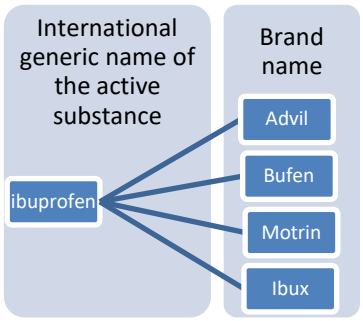

Fig 2. The relationship between an international non-proprietary name and brand names

Second, it is a challenge to translate the units (for instance one tablet) in the drug list from the EPR to the amount (for instance 500 mg) in the EMMS. Since the medication in the EPR is not structured, no link exists between one tablet and 500 mg. The consequence is that the physicians have to manually type the dosing in the EMMS. As mentioned above, the EPR's medication management is related to making prescriptions that are transferred to the e-prescription database, and for patients managing their own medication at home, the number of units is easy to comply to. Patients do not relate to how many mg to use each day, but on how many tablets to take, while in the EMMS, the dosage is based on the amount, for instance, 500 mg. The amount is the essential information for the health care professionals at the hospitals. Whether this is administrated as one unit at 500 mg or two units at 250 mg is not important, but depends on what is available when the nurses administer the drugs.

The third issue concerns the frequency at which the drug should be administered. The EPR denotes frequency as morning, midday, night, and so on, while the EMMS is based on a timeline and the frequency has to be related to an exact time (i.e., 7 a.m. or 8 p.m.). For the patients at home, it is easier to apply to morning and night instead of being tied to specific times. While the EMMS is based on a timeline, the frequency of the drug administration has to be linked to an exact time for the system to be able to alert the clinicians when to give the medication and to document whether the medication was given at the right time. Another issue in regard to time is that different hospitals and different wards at the same hospital have varied times for morning medication. For instance, some wards administer medication at 7 a.m. in the morning, while others define the morning medication time to be at 8 a.m. This implies that the translation of morning, midday, and night is not straightforward, and again the physicians have to manually type the time the medication should be administered to complete the integration.

The fourth challenge is the route that the drug should be given. It is essential to know whether the drug should be given orally, intravenously, as an inhalation, or in some other way. As with the previously discussed issues, this has to be manually typed for each drug.

How to solve the integration issue was discussed on several occasions between the vendor and the EMMS project group. One main debate was all the additional and time-consuming data work the physicians had to perform in the system to complete the integration. The physicians included in the project made it clear that all the extra clicks they had to do in the solution were totally unacceptable. They would not approve of the additional work and argued forcefully for their view. This made it difficult to move forward in the project without acknowledging their objections. Thus, the EMMS vendor had to perform some changes to improve the solution. For instance, the first proposal included additional clicks to approve each drug, each dose, each frequency, and each route included in the drug list. This feature was due to a technical insufficient solution and was removed in the next proposal from the vendor. Other issues were not related to the technical solution and hence could not be improved by the vendor (e.g., the lack of correlation between "morning" and "7 a.m.").

Concluding discussion

Traditionally, the integration of information systems is considered to be a task to identify the data elements that need to be integrated across two or several systems and then to develop the implementation. This approach is too simplistic, reflecting a view that integrations are a clear-cut technical task.[4,5,7,13] Clearly, this does not take into account the implicated organizational work that is associated with integrations.

In our case, this was reflected in how the integration needed to be manually maintained through routinely data work by the physicians to ensure a correct mapping between free-text (EPR) and structured data (EMMS), between units and amounts, between different frequency levels and lastly consider different routes the medication should be given. Overall, it is the responsibility of the physician working with the EMMS or the EPR to check whether the integrated data is correct, to make the necessary modifications, and then to sign off that everything is in order. This has to be done both when the patient is admitted to the hospital and as part of the discharge process, which implicates a substantial amount of articulation work.[10,11] Accordingly, the integration is a socio-technical engagement and requires effort to keep things running. This suggests that many integration projects actually create more work for the users than what they relieve and may therefore be a cause of failures in many projects.

Furthermore, we see in this case an example of a key point from the information infrastructure literature.[8,9,22] New technology is never built from scratch; it always builds on and extends the installed base. Historical decisions and existing systems both nationally and regionally have impacts on the daily work of local actors. The integrations in this case have connections to the EPR and the FEST register, which have further dependencies on Farmalogg, on the e-prescription database and on systems used by pharmacies and general practitioners in primary care. The fact that prescriptions in Norway are based on brand names, that the FEST register originally was made for primary health care, and that the FEST register is based on Farmalogg are examples of historical traditions and decisions that serve as premises to how the local integration between the EPR and the EMMS in the region could be solved. Additionally, the medication picture includes several stakeholders; that is, the vendors of the different EPR and EMMS systems, the Norwegian Medicines Agency who is responsible for the FEST register, the Norwegian Directorate of Health who

owns the e-prescription database, the Norwegian Pharmacy Association who organize Farmalogg, and the pharmacies and the general practitioners who use those systems. The bonds and dependencies between the systems and stakeholders imply that changes in one system or register could affect the other components in the picture. And due to the good functionality that the systems and registers have for handling prescriptions for the general practitioners and the pharmacy, it is reasonable to believe that some of those stakeholders are satisfied with the current conditions and may be reluctant to make changes. The existing practices and systems play a crucial role in how the integration in this project is solved. The network in the medication pathway of existing interdependent systems is large and complex, making it difficult to replace or change, exactly as the information infrastructure literature suggests.[8,9,22] In our case, this is demonstrated in the effort of establishing the integrations where challenges occur as a consequence of historical decisions and already existing systems. Concretely, this spelled out in the different denotation of dosage of the drugs in the EPR and the EMMS. Accordingly, to be able to use data across different systems, an agreement on the interpretation of the meaning of the very same data is needed.[10] The EPR denotes the dosage in tablets because the data is based on FEST, a register that historically was made for serving prescriptions in primary health care while the EMMS denotes the dosage in amount (usually mg) because that is what the clinicians at the hospitals needs.

This implies that when studying articulation work, it is not sufficient to look at the local setting, but in addition, the bigger picture, including the existing interdependent information systems, requires attention.

The necessity illustrated in this case, to manually type the dosage, the frequency and the route for each drug in the list prior to using the drug list transferred from one system to another is articulation work. It is routine, and the tasks carried out have "no value" themselves[11]. The work is just something that must be done before the "real work" can start. This articulation work has the potential to become part of the background work and hence to become invisible in the environment. Usually, this kind of silent work is associated with the low social status of the work or the workers or marginalized user groups, as Star & Strauss [11] point out. In contrast, the clinicians in our case have a high social status as physicians, and this influences the extent of the articulation that unintentionally can be put in place. As we have elaborated in our case, the physicians did not consent to the extra work that was related to transferring the drug list from the EPR to the EMMS. This indicates that the work will be more visible and hence become declared as important work. Which work is defined as visible or invisible is not clear, and the visibility may change based on who performs the tasks. If this work was to be performed by secretaries or nurses, it might be kept quiet.[11] Moreover, even if the workers put into words the supplementary data work, their opinion could be ignored and it might be expected that the work must be done without further acknowledgement or discussions. However, in our case the objections from the physicians —who have a high social status— persuaded the vendor of the EMMS to make improvements in the system. The work was recognized and acknowledged as important. In articulation work (which is typically invisible in rationalized models of work), visibility is a benefit when introducing new ICT systems. It is easier to navigate the expectations of the users, and the need for additional data work appears in the light for everyone to see.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Gibbons P, Artz N, Burke-Beebe S, et al. Coming to terms: Scoping Interoperability for Health Care. *Heal Lev Seven EHR Interoperability Work Gr*. 2007:1-31. http://www.hln.com/assets/pdf/Coming-to-Terms-February-2007.pdf.
2. Viangteeravat T, Anyanwu MN, Nagisetty VR, Kuscu E, Sakauye ME, Wu D. Clinical data integration of distributed data sources using Health Level Seven (HL7) v3-RIM mapping. *J Clin Bioinforma*. 2011;1(1):32. doi:10.1186/2043-9113-1-32.
3. Ellingsen G, Monteiro E, Røed K. Integration as interdependent workaround. *Int J Med Inform*. October 2012:1-9. doi:10.1016/j.ijmedinf.2012.09.004.
4. Singletary L a. Applications integration: is it always desirable? *37th Annu Hawaii Int Conf Syst Sci 2004 Proc*. 2004;0(C):1-9. doi:10.1109/HICSS.2004.1265632.
5. Giuse DA, Kuhn KA. Health information systems challenges: The Heidelberg conference and the future. *Int J Med Inform*. 2003;69(2-3):105-114. doi:10.1016/S1386-5056(02)00182-X.
6. Bowker GC, Star SL. *Sorting Things Out: Classification and Its Consequences*. MIT press; 1999.
7. Berg M. Implementing information systems in health care organizations: Myths and challenges. *Int J Med Inform*. 2001;64(2-3):143-156. doi:10.1016/S1386-5056(01)00200-3.
8. Hanseth O, Lyytinen K. Design theory for dynamic complexity in information infrastructures: the case of building internet. *J Inf Technol*. 2010;25(1):1-19. doi:10.1057/jit.2009.19.
9. Star S, Ruhleder K. Steps Toward Design an Ecology and Access of Infrastructure : for Large Spaces Information. *Inf Syst Res*. 1996;7(1):111-134. doi:10.1287/isre.7.1.111.
10. Schmidt K, Bannon L. Taking CSCW Seriously : Supporting Articulation Work *. 1992;1(1):1-33.
11. Star SL, Strauss A. Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. *Comput Support Coop Work*. 1999;8(1-2):9-30. doi:10.1023/A:1008651105359.
12. Suchman L. Supporting Articulation Work. In: *Computerization and Controversy: Value Conflicts and Social Choice*. Academic Press, San Diego; 1996:407-423.
13. Ellingsen G, Monteiro E. The slight surprise of integration. *Des ubiquitous Inf Environ socio-technical issues challenges*. 2005:261-274.

14. Tun Z, Bird LJ, Goodchild A. Validating Electronic Health Records Using Archetypes and XML. *Blood Press*. 2001.

15. Bernstein K, Bruun-Rasmussen M, Vingtoft S, Andersen SK, N??hr C. Modelling and implementing electronic health records in Denmark. *Int J Med Inform*. 2005;74(2-4):213-220. doi:10.1016/j.ijmedinf.2004.07.007.

16. Pahl C, Zare M, Nilashi M, et al. Role of OpenEHR as an open source solution for the regional modelling of patient data in obstetrics. *J Biomed Inform*. 2015;55:174-187. doi:10.1016/j.jbi.2015.04.004.

17. Christensen B, Ellingsen G. Evaluating Model-Driven Development for large-scale EHRs through the openEHR approach. *Int J Med Inform*. 2016;89:43-54. doi:10.1016/j.ijmedinf.2016.02.004.

18. Martínez-Costa C, Menárguez-Tortosa M, Fernández-Breis JT, Maldonado JA. A model-driven approach for representing clinical archetypes for Semantic Web environments. *J Biomed Inform*. 2009;42(1):150-164. doi:10.1016/j.jbi.2008.05.005.

19. Cross M. Information technology Will Connecting for Health deliver its promises ? *Br Med J*. 2006;332(March):599-601. doi:10.1136/bmj.332.7541.599.

20. Black AD, Car J, Pagliari C, et al. The impact of ehealth on the quality and safety of health care: A systematic overview. *PLoS Med*. 2011;8(1):1-16. doi:10.1371/journal.pmed.1000387.

21. Silsand L, Ellingsen G. Generification by Translation: Designing Generic Systems in Context of the Local. *J Assoc Inf Syst*. 2014;15(April 2014):177-196. http://aisel.aisnet.org/jais/vol15/iss4/3.

22. Aanestad M, Jensen TB. Building nation-wide information infrastructures in healthcare through modular implementation strategies. *J Strateg Inf Syst*. 2011;20(2):161-176. doi:10.1016/j.jsis.2011.03.006.

23. Hanseth O, Lundberg N. Designing work oriented infrastructures. *Comput Support Coop Work*. 2001;10(3):347–372. http://www.springerlink.com/index/N646L462510802X4.pdf. Accessed February 8, 2011.

24. Latour B. *Science in Action*. Cambridge: Harvard University; 1987.

25. Atkinson P. Work among the Haematologists. In: ; 1995.

26. Grudin J. Why Cscw Applications Fail : Problems in the Design and Evaluation of Organizational Interfaces. *Proc 1988 ACM Conf Comput Coop Work CSCW 88*. 1988;4:85-93. doi:10.1145/62266.62273.

27. Gerson EM, Star SL. Analyzing Due Process in the Workplace. *ACM Trans Inf Syst*. 1986;4(3):257-270. doi:10.1145/214427.214431.

28. Schmidt K, Simone C. Coordination Mechanisms : Towards a Conceptual Foundation of CSCW Systems Design *. *J Collab Comput*. 1996:155-200.

29. Klein HK, Myers MD. A Set of Principles for Conducting and Evaluating

Interpretive Field Studies in Information Systems. *MIS Q*. 1999;23(1):67. doi:10.2307/249410.

30. Walsham G. Interpretive case studies in IS research: nature and method. *Eur J Inf Syst*. 1995;4(2):74-81. doi:10.1057/ejis.1995.9.