

# Complex integrations in health care

Camilla Bjørnstad<sup>1</sup>, Bente Christensen<sup>2</sup> and Gunnar Ellingsen<sup>3</sup>

<sup>1</sup> Norwegian Centre for E-health Research, e-mail:

*camilla.bjornstad@ehealthresearch.no*, <sup>2</sup> UiT, The Arctic University of Norway, Tromsø and North Norway Regional Health Authority, <sup>3</sup> UiT, The Arctic University of Norway, Tromsø

**Abstract.** Integrations in health care are hard to manage in practice due to their complex organizational realities. To categorise the integrations as syntactic, semantic or pragmatic may help to better plan the process in developing them, and deciding how to manage them in a good way and hence obtain well-functioning integrations.

## Introduction

Integration of information systems in hospitals is considered a foundation for efficient treatment and care as well as for functional cross-departmental patient pathways. Key systems involved are amongst many others: Electronic Patient Records (EPRs) and Electronic Medication Management Systems (EMMS). Unfortunately, healthcare is still a late adopter of integrated systems. Overall, a key problem appears to be related to the practical issues of integrating the vast number of systems where the technical problems become messed up with complex organizational realities. A key lesson learned from these – and other socio technical - studies is that one needs a thorough understanding of the practices involved when implementing new technology (Fitzpatrick and Ellingsen 2012). A principal aim of our paper is therefore to contribute to a socio-technical understanding of integration in health care. Particularly the paper aims to develop a framework that describes integrations and hence recognize and contributes to

resolve challenges when constructing integrations. Theoretically, we draw on the concept of information infrastructures (Bowker and Star 1999). We extend this perspective to Carlile's (2004) integrative framework for managing knowledge across boundaries to narrow down on specific and different integration challenges. Based on this perspective, we categorize integrations into syntactic integrations where information is transferred between systems, semantic integrations where information has to be translated between the systems, and pragmatic integrations where information has a transformative effect on the organization. Based on an interpretive research method (Walsham 1995), we have studied the formative stages of a large-scale EMMS project in the Northern Norway Regional Health Authority that was initiated in 2012.

## The EMMS project and the anticipated use scenario

In January 2012, the Northern Norway Regional Health Authority decided to start a bid for tender process for a common EMMS for the health region. The cost of the procurement, the implementation and 15 years of use is estimated at EUR 114 million. The EMMS needs to be tightly integrated with other key systems in clinical practice, most notably the Electronic Patient Record (EPR) from the vendor DIPS ASA. One of the overall aim of the EMMS project was that all information, documentation and decision support regarding medications should be gathered in one system to ensure complete overview for the clinicians. The original plan was that patient information at admittance like name, birth date and address should be registered in DIPS EPR, but an integration should ensure that this information could be used in the EMMS as well. Furthermore, the process of deciding what medication the patient is using including a reconciliation of the medication list, should happen in the EMMS.

## Analysis

At the *syntactic* level, there is a common understanding of the differences and dependencies between data that are crossing the boundaries between two systems (Carlile 2004). This makes the integration a simple transfer of data from one system to another. In our case, patient information, like name, birth date and address are examples of data that easily could be transferred and used from the EPR to the EMMS and thereby can be classified as a syntactic integration. The same goes for the integration between the EMMS and the lab system. The results from lab tests are interpreted the same way in the two systems and transferring the answers are sufficient to make a well-functioning integration.

At the *semantic* level of integration, the differences and dependencies between data that is crossing the boundaries are somehow unclear or the meanings of the

data are ambiguous (Carlile 2004). This leads to different interpretations. To develop a successful semantic integration, it is crucial to establish shared meanings and find a meaningful way to share and manage data that are crossing the borders between systems. At this level, is it not adequate to transfer data from A to B, the data have to be translated to give meaning. An example from our case, is when the clinicians using the EMMS request the medication-in-use list for a specific patient from DIPS EPR. In the EPR the drugs 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. For instance, ibuprofen is the non-proprietary name of the active substance, while some of the different brand names are Advil, Ibux, Bufen, Ibumax and Motrin. This came as a surprise for the EMMS project members. One of the members said: “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 international non-proprietary name without a human touch. Everybody was very disappointed by this”. The effect of this is that there must be a translation between the brand name in the EPR and the international non-proprietary name in the EMMS. Therefore, the physician must carefully examine each translation of medication between the systems. The integration will suggest a mapping, but the physician using the EMMS must check whether this mapping looks correct and potentially make changes before the process is considered complete. When this is done, the medication list is ready for use in the EMMS.

The *pragmatic* level of integration arises when the actors and stakeholders have different interests that have to be resolved. The different interests impede the ability to share and manage the data that is crossing the borders between systems. The decision on how an integration is to be managed could lead to negative consequences for some stakeholders or actors when interests are in conflict. Hence a pragmatic integration is not just a matter of translating different meanings, but of negotiating interests and making trade-offs between stakeholders, potentially transforming a practice. This developing of common meanings is consequently a political process of defining common interests. Carlile defines this as transforming knowledge (Carlile 2004).

The Northern Norway Regional Health Authority has decided that the EMMS should be the master for medication data during the patient hospital stay. An overview and information about the medication - including drug name, dosage, frequency, route, and missed doses - will only exist in the EMMS during the stay. Currently the EPR has no access to this data prior to the discharge. The reason for

this has been to clarify roles and responsibilities between the systems. However, this is problematic as there are several instances where EMMS data may be very useful to also have in the EPR during the patient stay. "For instance, a good visualization of the patients' trajectory- his status, what is done and what is to be done in the EPR – would help us to optimize in house resources and plan for discharge early on, hence reduce length of stay. Actually, the visualization in itself would be a kind of decision support" (physician in workshop).

This plan in the EPR represent the overall plan for the patient. Data on vital parameters coming from bedside devices and the EMMS is needed in the treatment plan (i.e. operation theater), because it provides information critical to deciding on actions, for instance deviations from the plan, but also in documenting actions and effects of actions. If a rising temperature indicates that an infection is progressing, steps need to be taken. In contrast, in configuring the EMMS, personnel working in the operational theater want to register procedures in the EMMS instead of the EPR, so that procedures can be connected to the recorded actions during the continual monitoring of the patient during surgery. To be able to combine and aggregate data of this kind is important to them for quality assurance, and for documenting effects. This shows that the two systems have overlapping functionality and the boundaries between them are disputed. Different stakeholders have different opinions, potentially leading to rising tension between various user groups on what to do when and where.

## Concluding discussion

Integrations are not solely a technical task. An organisational and socio-technical approach is necessary for managing integrations in health care. In this paper, we have used Carliles framework that describe boundaries and processes when managing knowledge across boundaries, on integrations. The categories syntactic, semantic and pragmatic is used to highlight the social and organisational issues regarding integrations.

A framework that categorise integrations as syntactic, semantic or pragmatic may help to better plan the process in developing them, and deciding how to manage them in a good way.

In syntactic integrations, the data can simply be transferred between the systems. It is a common understanding of the data, and the integration is mainly a technical task. There is few socio or organisational challenges related to the integration.

Semantic integrations need translation, the data may be interpreted differently in the different systems. In managing such integrations, processes that create shared meanings (Dougherty 1992) or mechanisms to reconcile discrepancies in meaning (Nonaka and Takeuchi 1995) are important to obtain well-functioning

integrations. The data has to be translated to make the integrations work. This requires additional work, and social and organisational factors play an important role to make such integrations work. Compared to syntactic integrations, semantic integrations are more complex to manage.

Pragmatic integrations are highly complex, because actors and stakeholders involved have conflicting interests in how the integrations should be managed. And when an integration is categorized as pragmatic, translation is not sufficient. Translation do not deal with different interests. Such integrations requires a political approach with negotiation and the ability to find common interests among the stakeholders and actors involved. The data in the integration has to undergo a transformation before transferring between systems. Some stakeholders have strong voices and will not necessarily agree on the decisions made. This may lead to rematches that cause additional challenges in managing the integrations. What is required is a process in which actors and stakeholders negotiate and are willing to change their meanings and interests (Carlile 2004). By learning about other actors` interests and understanding the consequences of different integrations, their interests and meanings should transform to solutions that are for the best for the totality of the work practices.

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