

Towards a socio-pragmatic understanding of ePrescribing

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Abstract

ePrescribing in Sweden covers over 65% of all prescriptions. ePrescribing is a highly regulated process with a high demand on availability and security in a complex communication situation with many systems and actors involved. It is an interaction between two markets, healthcare and pharmacy. The purpose of this work is to contribute to the development of models to analyse e-services. Three models are used to analyse ePrescribing: the Generic Exchange Model, the Generic Regulation Model and a socio-pragmatic communication framework. The conclusion of this application is that the models contributed to new essential insights and helped to focus on essential communication aspects. The analysis contributes to a better understanding of ePrescribing in a general, to be useful both for those who are working with developing ePrescription, taking into account the different legislation and history of prescribing in their countries, and for policy makers who may want to turn the process of ePrescribing into a new direction.

Keywords

ePrescribing, ePrescription, information systems, social communication, multi-functionality, e-services

1 Introduction

1.1 Background

Many organisations communicate with structured electronic messages. These messages appear at first sight to be rather simple. So why is communication between organisations considered such a complex undertaking? One answer is that even if every single message seems to be simple, it represents many views and usages. We can use the term multi-functionality (Goldkuhl 2005a) to describe this.

Many researchers have pointed out the limitations of focusing only on the informational or referential aspect of a message in order to understand communication. A more comprehensive approach is to view information exchange as a social act of communication. Different frameworks have been suggested to analyse this communication. The application of speech act theory (within the Language Action Perspective) has been one influential approach (Winograd & Flores 1986; Ljungberg & Holm 1996).

ePrescribing is a complex communication action involving different professions (Physicians, Nurses, Dentists, Veterinaries and Pharmacists), many actors (Prescriber, Patient, Pharmacist, and Authorities) and many different relations (Prescriber – Patient, Pharmacist – Customer, Citizen – Authorities, etc). Furthermore, the outcome of a prescribing activity, the prescription, is not just a piece of information. For example, it is an authorisation to the pharmacist to dispense drugs at the request of the customer.

ePrescribing is technically complex, involving many different systems and system interfaces from an ordination by a physician in the EHR (Electronic Health Record) system, via a prescription sent to the pharmacy, an order from the customer (either through an e-commerce system or at a pharmacy), to the dispensing process and life cycle of the electronic prescription. Today ePrescription in Sweden is no longer only a means of electronic communication. The electronic prescription has become the original artefact whose history is mirrored in the computer system as it was yesterday mirrored on paper.

The development of a new format for ePrescription in Sweden (NEF 2007) has demonstrated a need for handling the real communication complexity. Syntactic and semantic controls, as well as the control of legal prescriptions and business regulations have been implemented to increase the quality of ePrescription with the focus on patient safety and lowering the costs of deficiencies in information quality. Studies have shown the importance of working with improving the quality of information in ePrescribing (Åstrand et al 2007c).

The tremendous growth of ePrescribing in Sweden, where at least 65% of all prescriptions are electronic, together with the growth of new public e-services, points to a need to develop and use models for conceptualisation and guidance in analysing and developing e-services (Goldkuhl & Röstlinger 2007). The experience from ePrescribing in Sweden, with its complexity and its great impact on and dissemination in the healthcare sector, makes it an interesting object of study.

1.2 Purpose and research approach

The main purpose of this work is to contribute to the practical knowledge of ePrescribing. This is done through the development of models that can be used to guide the analysis and development of ePrescribing, which is an important part of the healthcare sector including the pharmacy sector.

Three theoretical models have been selected and applied in the analysis of ePrescribing.

In order to analyse the work practice in its different settings the Generic Exchange Model (GEM) (Goldkuhl & Röstlinger 2007) is used as the basic framework.

As ePrescribing is a highly regulated activity a Generic Regulation Model (GRM) (Goldkuhl 2008) is used. GRM is based on GEM.

The analysis of different facets of communication mediated through or in connection with the use of information systems between the actors in ePrescribing is done within the framework of socio-pragmatic communication (Goldkuhl 2005a).

This work is seen as part of a practical inquiry of ePrescribing to contribute to the general practical knowledge of its process (Goldkuhl 2007). The work is guided by practical theories that have been developed for analysing e-services. The Generic Exchange Model (GEM) is a result of a transformation of the BAT (Business Action Theory) model¹, which is suitable for both public and business settings. This makes the model well suited in the practical inquiry into a process which encompasses both the public health sector and the business sector of pharmaceuticals. The GEM model is used to analyse the general work practice of ePrescrib-

¹ The BAT model is based on the Language Action Perspective and has been used to analyse business interactions (Goldkuhl & Lind 2004).

ing. The analysis intends to give an overview of the work practice as a complement to the analysis of the communicative actions between the actors in ePrescribing.

Another contribution of this study is the experience of applying the three practical theories (GEM, GRM and the socio-pragmatic framework for communication) on ePrescribing.

The main benefits expected from this application are the *conceptualisation* of different phenomena, properties and relations that exist in ePrescribing practices. Although the focus is on ePrescribing we think that most of the analysis result can also be applicable to other forms of prescribing such as using phone, fax or paper as medium.

The basic empirical material consists of relevant parts of the existing documentation from the work with defining the new national ePrescription format (NEF 2007), requirement specifications for developing the Swedish National Pharmacy Register (Åstrand et al 2007b), the Prescription Register and the eCommerce system for ordering on prescriptions at Apoteket AB, laws and decrees regulating the prescribing process (from ordination to dispensing and consumptions of drugs), process and routine descriptions of the dispensing process, together with interviews and personal communications with requirement engineers, developers, pharmacists, prescribers and other experts (e.g. judicial ones) in the field.

2 Analysis of the work practice of ePrescribing

2.1 The Generic Exchange Model

The Generic Exchange Model (Goldkuhl & Röstlinger 2007) has been developed for the specific use of both the government – citizen exchange and for a business setting with an interaction between supplier and customer (Figure 1). The model consists of two levels, the forum or market level which is a place where actors can meet for exposure and search, and the dyadic level where communication between producer/supplier and client/customer takes place.

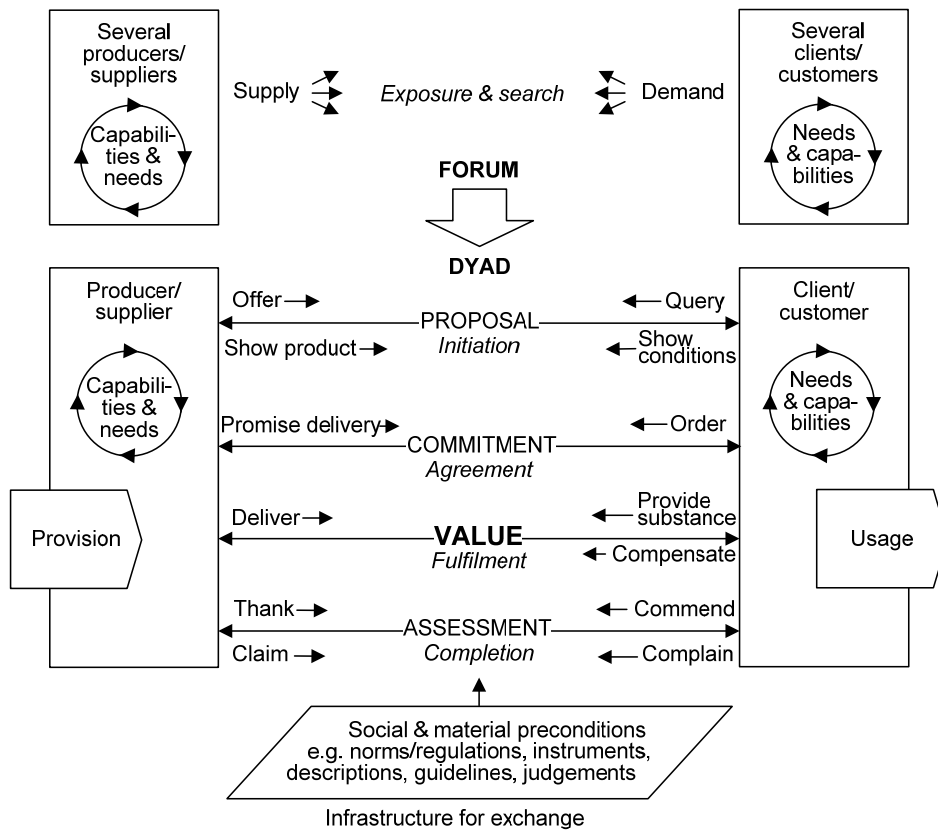


Figure 1 The Generic Exchange Model (GEM)

The dyadic interaction consists of four generic *phases*: initiation, agreement, fulfilment and completion. To these phases are connected corresponding types of exchange *objects*: proposal, commitment, value and assessment. The actors perform different actions in each phase. Another important concept in the model is the infrastructure for exchange, which consists of social and material preconditions, such as norms and regulations, instruments, guidelines, descriptions, etc.

The GEM model has emerged from the BAT model (Goldkuhl, 1996; Goldkuhl & Lind, 2004) which describes business interaction between a supplier and a customer. BAT is a model within the language-action tradition (Winograd & Flores, 1986). BAT has been compared to other similar models in Goldkuhl (1996), Verharen (1997) and Petersson & Lind (2005).

2.2 The Generic Regulation Model

The Generic Regulation Model came out of experiences in using GEM for developing e-services in the public sector (Goldkuhl 2008). E-services in this sector are usually highly regulated. The Generic Regulation Model, which is a specialisation of the GEM model, highlights regulatory aspects between public agencies and citizens. Regulation is seen as a regulation between different practices. One practice is considered the regulating practice which is regulating the other practice.

Regulation is also put in the context of application of laws regulating different practices. The regulating practice is concerned with transactions that end with a product in the form of a decision. This decision, an outcome of regulating practice which in turn is regulated by laws,

acts as a specific rule for transactions in the regulated practice. This regulated practice is also governed by specific laws.

2.3 Analysis of Exchange in ePrescribing

What is meant by ePrescribing? The National Council for Prescription Programs in the US makes the following definition:

“two way [electronic] communication between physicians and pharmacies involving new prescriptions, refill authorizations, change requests, cancel prescriptions and prescription fill messages to track patient compliance.”

This definition of ePrescribing goes beyond the definition of an electronic prescription made by the Swedish Medical Agency in their directives on prescriptions:

“electronically transferred ordination of medical drugs ... for individual user issued by a qualified prescriber” (our own translation from Swedish) (LFVS 1997:10)

Another definition which focuses on the exchange of documents is taken from the Swedish National Board of Health and Welfare:

“... [a] document, issued by a prescriber, which means an authorization for a pharmacy to dispense a certain medicinal product, ..., to a certain person.” (our own translation from Swedish, Socialstyrelsens Termbank 2007 – the Swedish National Board of Health and Welfare - Terminology)

The definitions made by the authorities lack a definition of the *activity* of prescribing. The definition focuses on the exchanged objects.

In *ePrescribing – Studies in Pharmaco-informatics* (Åstrand 2007) a process perspective is presented which also involves the citizen/patient. In this view ePrescribing

“may be seen as an essential part of the continuous workflow in healthcare and pharmacy. In the same way, patients need to have updated and correct information on their drug therapy, both current and past. ... Furthermore, the patient demand for fast and reliable healthcare services and modern patients’ claims for empowerment also need to fit into a good definition.”

This perspective on ePrescribing, which is the focus here, is not limited to issuing the prescription document but also involves dispensing by the pharmacy and the consumption of the drug by the patient. We need to take into account the difference between Prescribed, Dispensed and Consumed drugs (Åstrand 2007).

These initial definitions are important to consider when we apply the generic model to ePrescribing. We need to consider both the whole cycle from initiation in the interaction between the prescriber and the patient through dispensing and consuming the drug and finally the completion phase with its relation both to the pharmacy and the prescriber.

This approach is useful to understand the complexity of ePrescribing and helps us to highlight important issues such as quality, safety and effectiveness, i.e. in the end contribute to a better drug utilisation to the benefit for different stakeholder. Information technology plays an important role in contributing to this goal.

There are basically two exchange situations: the healthcare - patient exchange and the pharmacy – customer exchange. The latter can be seen as part of the healthcare - patient exchange if we consider the process perspective mentioned above. However, the process interaction is rather loosely coupled, as the exchange takes place in different forums/marketplaces.

After the application of the GEM model we will illustrate the regulatory aspects with the use of the GRM model.

2.4 ePrescribing: Healthcare – Patient exchange in the Healthcare forum

The forum/market place for the patient is usually the regional healthcare providers - publicly or privately owned. It is possible for the patient to choose between several different prescribers offering their services to the citizens.

The product offered in this forum has a generic meaning: something is produced with the intent to be used by someone. This means that what is produced can be a service and, in the context of ePrescribing, it can also be a kind of permit or decision in the form of a *prescription*. Other outcomes could be a *doctor's certificate*, *treatment*, *advice* or a *referral* to some other actor in the healthcare sector.

At the dyadic level we have an interaction between a producer and a client. In this context the producer is the prescriber and the client is the patient. These actors have their capabilities and needs which influence the communication.

The interaction starts with an initiation phase. Actions by the customer can be an earlier request for an appointment with a doctor, a presentation or description of a health-related problem. The response by the doctor in this phase could be an investigation, a diagnosis and a presentation of some alternative treatment. A proposal for medical treatment could be made to the client, represented in the model as an exchange object of the *Proposal* type.

The next phase is called the agreement phase. In this phase the prescriber and the patient agree on the prescription of a medical drug to alleviate, cure or prevent a disease or a health-related problem. The prescriber promises to issue a prescription to the patient. The prescriber also promises, on behalf of the public healthcare, to pay the reimbursement for the prescribed medical if that is applicable to the disease. The exchange object is a *Commitment* from both parties.

The next phase is called the fulfilment. The exchange object is of the *Value* type. On the part of the prescriber it is an ePrescription which is a "... document, issued by a prescriber, which means an authorization for a pharmacy to dispense a certain medicinal product, ..." (see above). The prescriber gives instructions of use to the patient.

The exchange object from the patient is either the patient fee or, in case of the renewal of the prescription by phone, a corresponding patient fee, which is paid later when the drug is dispensed. To be noted is the fact that the compensation for the delivered prescription is not directly linked to the prescription, but is a payment of the appointment. In a way the issuing of a prescription is for free except in the case of renewal by phone.

The completion phase may consist of different types of evaluation actions. This phase could be viewed in two ways. First, it can be viewed as a completion of the appointment and in this context an assessment of the immediate outcome. Another approach is to view the completion as an assessment of the **intent** behind the prescription. This second approach highlights one of the difficulties that exist, involving a risk for discontinuity in the prescribing process. The prescriber often has no knowledge, apart from the information given directly by the patient, of what is dispensed to and consumed by the patient.

Ideally, the completion phase consists of a "prescription fill message to track the patient's compliance" (see above) and information from the patient about the outcome for the patient of

consuming the drug. Part of this feedback can be achieved by using information in the Swedish National Pharmacy Register (Åstrand et al 2007b), which contains dispensed prescribed drugs at pharmacies. This information can influence the decision of the prescriber.

The connection between the different exchanges in ePrescribing, i.e. the Prescriber – Patient exchange and the Pharmacy – Customer exchange, can be described as linked communication loops.

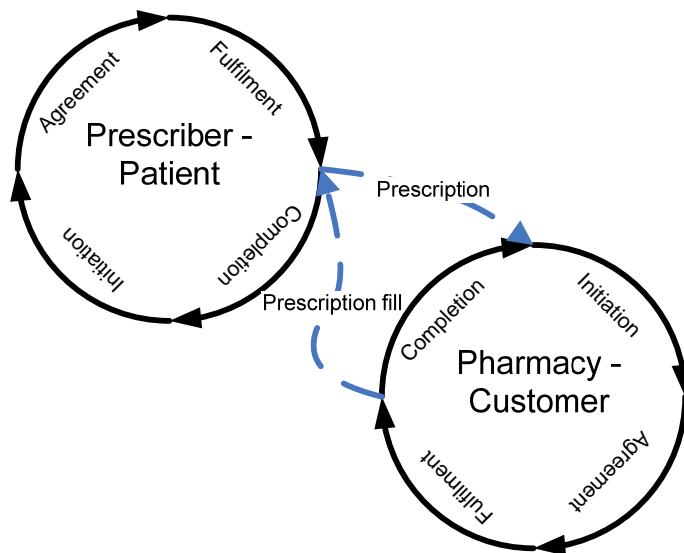


Figure 2 Linked communication loops in ePrescribing

The link to the pharmacy market is the prescription. **It is the specific prescription, together with the regulation of the exchange infrastructure, which regulates the whole pharmacy market (see below on the GRM).**

The infrastructure for exchange involves all the legislation around the prescription document, the policy for reimbursement, the price-setting of drugs for the wholesale market and the end customer market, what drugs are reimbursed, the legislation on generic substitution, etc.

The prescription entering the pharmacy market regulates on the transactional level all the events on this market. That is why this document has such an importance and prescription a long history.

“For hundred years, the written prescription had been the method of choice for physicians to communicate decisions on drug therapy and for pharmacists to dispense medication.” (Åstrand 2007).

An important interdependence that exists between the two forums/markets is the economic transaction involved in the reimbursement process. This relation is not described here, as the focus is on the pharmaceutical/medical aspects of the communication.

2.5 ePrescribing: Pharmacy – Customer exchange in the pharmacy market

The pharmacy market in Sweden today (2007) has one government-owned operator, Apoteket AB. Customers can of course choose which local pharmacy to go to and if they wish make an order on their prescription via an ecommerce site (hosted by Apoteket AB) and get the drugs

sent home without visiting a local pharmacy. With ePrescription it is possible to go to any pharmacy in Sweden to get it dispensed.

On the dyadic level the initiation phase usually starts with the customer asking to buy medical drugs on an ePrescription. The pharmacist accesses the referred Prescription and asks about the amount, checking for generic substitution and availability and making a proposal which includes drugs and pricing, including the reimbursement. The pharmacist also checks the legality of the prescription and makes a pharmacological control of the dosage, checking possible drug interactions etc. This phase ends up in a *Proposal* type of exchange to the customer.

In the next phase the customer accepts this proposal and commits him or herself to pay for the dispensed drugs. The pharmacist prepares the order for dispensing.

The fulfilment phase consists of delivering the drugs to the customer and the payment of the drugs by the customer. The pharmacist makes a technical control of the drugs which are handed out and gives instructions of use to the customer. The dispensed drugs are registered for the official statistics and for reporting back to the healthcare sector what generic substitution has been made, which forms the basis for sending an invoice to the healthcare sector for the reimbursement. This event is also entered into the National Pharmacy Register, which can be used later by the prescriber, pharmacist and the patient as a historical record of dispensed drugs.

Finally, the completion phase could either consist of a complaint or comment by the customer on the dispensed drug at a later visit to the pharmacy, but also be materialised in a planned counselling event with a pharmacist on the total drug use of the customer.

The infrastructure for exchange is heavily regulated by the authorities, who make regular inspections of the pharmacies. At the pharmacies the whole infrastructure of the exchange regulation of prescribing is crystallized, as the pharmacy is the final gatekeeper working both for the fulfilment of the prescriber's intention with the medical treatment, the authorities' intention for patient safety and the cost effectiveness of the drug use. This makes the dispensing process very complex and involves a lot of control measures.

Prescriptions contain sensitive information about individuals, which means that information security and integrity is an important issue. The risk of fraud in this area is also present, which demands constant vigilance by the pharmacists.

2.6 Model of exchange in ePrescribing – a regulatory perspective

We describe the two interacting work practices in prescribing in Figure 3. The first is the healthcare practice with the prescriber – patient interaction (described in section 2.4 above). The second interactive practice is the drug provision one with the pharmacy – patient/customer interaction (described in section 2.5 above). The prescription has the role of regulating the pharmacy – patient exchange. It gives the patient the authorisation to buy the prescribed drug from a pharmacy and at the same time it gives the pharmacy the authorisation and obligation to sell the prescribed drug to the particular customer/patient. Without this prescription the exchange would not occur.

In terms of the GRM the healthcare practice is the regulating practice and the drug provision practice is the regulated practice. The prescription is the *specific rule* that regulates the transactions in the regulated practice. Both practices are regulated by several laws (for example LVFS 1997:10).

In Figure 3 we have not described all actions in the exchanges. The two exchanges have been “boiled down” to request – product exchanges. More comprehensive GEM analyses have been presented in sections 2.4 and 2.5 above.

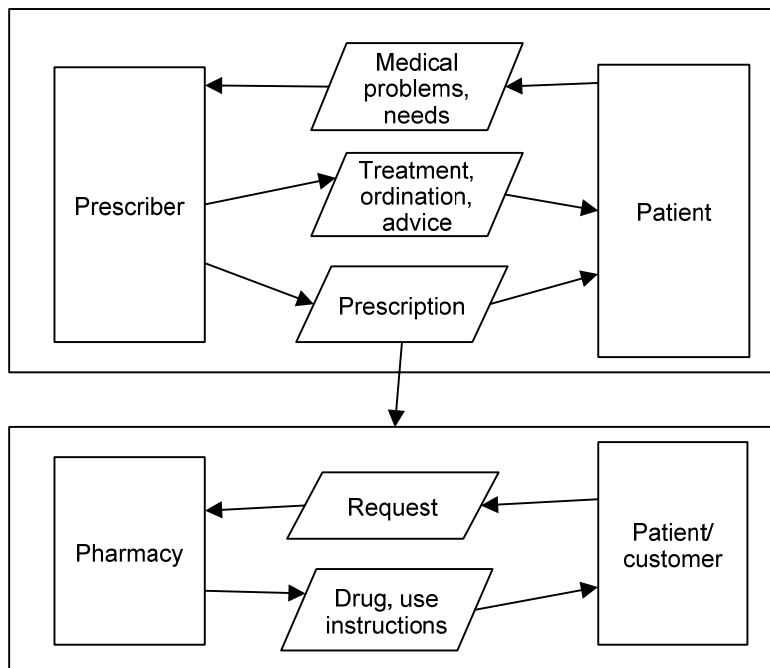


Figure 3 Prescription as a link between healthcare and pharmacy exchange practices

Figure 3 is a generic model that can be used to illustrate both paper prescription and e-prescription. In the former the patient receives the paper prescription from the prescriber and he/she must bring it and show it as a kind of certificate to the pharmacy when requesting the drug. In the case of ePrescription, the prescription is electronically transferred to the pharmacy, and it is then used as a basis when the patient requests the drug. In both cases, the particular ordination of the prescriber is expressed in the use instructions accompanying the prescribed medicinal drug to the patient (both on the prescription, whether handed out to the patient or electronically stored at the pharmacy, and on the dispensed package of the drug).

We have now studied ePrescription in its different work practice contexts. It is time to move on to a more detailed analysis of ePrescription. This will be conducted in the next section, in the shape of a socio-pragmatic communication analysis.

3 Socio-pragmatic communication analysis of ePrescribing

The diversity of the communication situations gives rise to a need for several frameworks for analysis. Hence, in this study we will complement the work practice and exchange analysis of ePrescribing (section 2 above) with a more detailed analysis framework. This will demonstrate how different models focus on and highlight different aspects of the communication. A model is useful just because it focuses on certain aspects and not on others.

The scope of this analysis will be slightly different. It will focus more on ePrescription as a message for communication. IT artefacts are seen as a communication instrument mediating messages. There is a need to understand both the communication that is undertaken via the IT artefact and communication in a broader context of IS use.

Goldkuhl (2005a) has developed what is called a socio-pragmatic communication framework. It emphasises communication as a social action and interaction and conceptualises different communication functions. This framework has its roots in speech act theory (Searle 1969; Habermas, 1984) and the language action perspective (Winograd & Flores 1986). It obtains, however, theoretical inspiration from several other sources as well: from semiotics (Bühler 1934; Jakobson 1960), functional linguistics (Halliday 1994), and conversation analysis (Sacks 1992). For the background and contents of the model we refer to Goldkuhl (2005a). An application of the framework can be found in Larsson et al (2006). The socio-pragmatic communication framework is theoretically harmonious with the GEM model, since both of them build on the same theoretical basis, socio-instrumental pragmatism (Goldkuhl 2005b).

3.1 Analysis framework: A socio-pragmatic conceptualisation of communication

The framework consists of nine facets of communication, called communicative functions, described below.

Function	Explanation
Trans-situationally compliant	The message is in accordance with general institutions and norms and specific trans-situational grounds, which may be brought into the situation as the social background to the communication
Situationally responsive	The message may be a response to a prior message in the communication situation and situational features
Expressive	The message is the expression of the locutor's subjectivity (intentions, desires, skills, emotions, values, understandings, commitments etc).
Referential	The message says something about something in the world; objects and processes talked about
Accountable	The message needs to be comprehensible, i.e. it must to some degree be self-contained and include sufficient self-references and arguments to explain its role in the communication process
Directed	The message is directed towards one or more addressees. There may also be secondary recipients (an audience)
Relational	The message establishes certain action relations (expectations, commitments, states) between locutor and addressee and sometimes on a socially broader level
Projected	The message may be an initiative to further actions
Mediational ²	The message is expressed in some medium (channel, carrier) and thus utilises the particular features of this medium

Table 1 The nine communication facets in the socio-pragmatic communication framework (from Goldkuhl 2005a).

3.2 Analysis of the ePrescription Communication

In this section we will make some general remarks before we analyse the two different communication situations in ePrescribing: patient – prescriber and customer – pharmacy.

In the analysis of the communication the first decision to make is to clarify who are the locutor and the addressee. The framework assumes a dyadic communication, but it is possible to define secondary addressees if needed.

One result in the analysis using GEM was that the prescription and its infrastructure for exchange regulate the whole pharmacy market (on prescribed drugs). The implication of this is that while the communication at the forum/market level of the healthcare sector mainly takes

² By mediational is here **not** meant the act of mediating but the form in which the communication is taking place.

place between the prescriber and the patient, it is obvious that the pharmacy market is also an addressee of the communication acts, since it is a part in regulating the pharmacies' authorisations to sell drugs to customers.

The pharmacy market will be represented by a pharmacy actor in the model. Even if the communication between the customer/citizen and the pharmacy exerts an influence on the healthcare sector, this influence is effective **after** the communication has taken place. This does not contradict the view of ePrescribing as a process that also encompasses the dispensing and consumption of drugs, a view we have taken in the preceding analysis. In this analysis prescription and dispensing are separated as two different speech acts. They are linked into one overall process via the application of GEM (see the previous section 2).

In the dispensing process step at the pharmacy based on the prescription the locutor is the customer³ and the pharmacy is the addressee.

The two different communication situations focus on two important messages, prescription and prescription order. In the models and analysis we have assigned the locutor as the main initiator of the communication. If we look closer at the conversation that actually takes place in these communication situations, we obviously have in some cases an interaction where the addressee takes an initiative in response to acts made by the original locutor. This is particularly the case with the exchange around a prescription order, where the pharmacist creates speech acts in the fulfilment of the order process. As these acts are a direct response to the initial speech acts by the original locutor, we have kept this actor as the locutor in the model, even if in these speech acts the addressee acts as a locutor in those cases. This approach makes it easier to follow the analysis.

3.3 Analysis of the Prescriber – Patient Communication

Below a picture (Figure 4) is presented to illustrate an application of the framework on the Prescriber – Patient Communication, where the creation of the Prescription is the basic communication act.

³ Note that the role of the patient has changed from patient to customer in relation to the pharmacy.

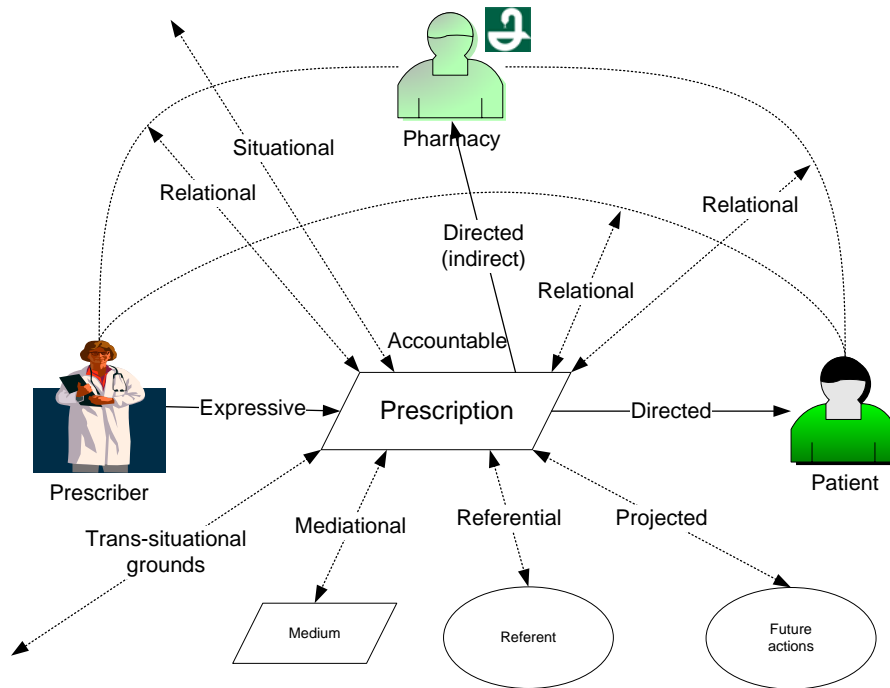


Figure 4 Nine facets of communication – applied to the Prescriber – Patient communication (based on Goldkuhl 2005a).

3.3.1 Directed facet

The **Directed** facet is the focal point in the analysis of who is the addressee of the communication.

In the ePrescription message the *Designated message receiver* is a *Healthcare Agent* that could either be a relaying or a dispensing agent, according to ENV 13607 (ENV 13607 2000), on which NEF is based. In the implementation of ePrescription in Sweden only the role of dispensing agent is used.

The conclusion from the analysis in section 3.2 is that we have two addressees in the action of issuing a prescription: patient and pharmacy, where the pharmacy is not directly involved in the communication situation.

3.3.2 Mediational facet

The **Mediational** facet influences what is **seen** as the addressee, i.e. it focuses on the physical addressee. With an electronically mediated prescription, for example, the physical addressee is the National Corporation of Pharmacies (Apoteket AB). With paper as the medium for the prescription the doctor hands out the prescription to the patient, who brings it to the pharmacy.

A prescription could either be electronically mediated, issued by phone, sent by fax or printed out as a paper prescription handed out to the patient. With ePrescription and paper prescription the same prescription rules apply, but with phone or fax prescription there are some limitations (for example the duration the prescription is valid).

3.3.3 *Situationally responsive facet*

The communication between the prescriber and the patient can take place in different contexts. One situation is when the prescriber physically meets the patient for consultation either at a hospital or at a care centre. It could also be a question of the renewal of a prescription at the request of the patient via telephone or email. In this case the prescription is a matter of a response to an earlier message. The patient may have a medication history which can be accessible in various ways, either via the patient directly, an EHR-system or through access to the Swedish National Pharmacy Register (Åstrand et al 2007b). These aspects are covered by the **Situationally responsive** facet.

3.3.4 *Expressive facet*

The **Expressive** facet expresses the intention of the prescriber in terms of an “ordination”, for example in the EHR system. The prescriber has the intention to prevent, cure or relieve a condition or a disease through medical treatment. The patient may also have preferences for a certain medication or treatment.

Adequate drugs are selected for this treatment with the creation of the correct strength, form, dosage and an instruction of use. This ordination is an expression of the prescriber’s professional medical knowledge. Intention and knowledge are thus transcribed into a prescription.

3.3.5 *Relational facet*

The issuing of a prescription is part of the **Relational** facet, because it establishes an action relation between the patient, the prescriber and the dispensing agent, i.e. a pharmacy. From a speech act point of view (Searle 1969) this can be considered as a **declaration** of an authorisation, while at the same time the contents of the prescription are a **directive** to take a certain amount of the drug or drugs at a certain interval for certain situations or conditions. The prescriber also makes a **commissive** action in promising that the regional healthcare organisation will pay the reimbursement for the drug. The prescriber is responsible for the contents of these directives in the prescription. Whether or not the addressee will comply with this directive is not given. The patients may never use the ePrescription (Ekedahl & Månsson 2004).

3.3.6 *Trans-situationally compliant*

To make it a **valid** prescription it must be addressed to the patient (as the subject of care) in the form of a document or standardised message according to the norms and rules of a prescription, which declare the authorisation of the patient to order a drug prescribed in a prescription. The issuing of a prescription must be **Trans-situationally compliant**.

What constitutes a legal prescription is defined in a set of prescription rules issued by the Swedish Medical Product Agency. How these rules are to be applied on electronic prescriptions is then interpreted by the National Corporation of Pharmacies together with the prescribers’ healthcare organisation in the county councils. Some of these rules are implemented in the validation of incoming prescriptions to the National Corporation of Pharmacies (NEF 2007).

If a prescription fails to comply with the defined rules, the National Corporation of Pharmacies will reject it. If there are errors in the ePrescription, which makes it impossible for the pharmacy to dispense the prescription, a message is transferred back to the prescriber’s systems with an error code and a text that explains the reason for rejection (or acceptance with amendments).

Another context is the rules concerning the reimbursement of payment for the drug delivered to the patient, which influence the contents of the prescription. A customer may not receive a reimbursement for more than a maximum of 3 months' drug consumption.

Another regulation is the so-called rule of generic substitution. The prescribed drug must also be an approved drug with a certain product identification from approved sources (product databases). There are also rules for what drugs require a certain qualification to prescribe and what drugs need a prescription at all etc.

The conclusion of this facet is that the prescription has a very complex contextual setting, which is one contributing factor to the complexity of the ePrescribing process. This is not only valid for a certain element in the prescribing process, but also for the interdependence of the different elements.

3.3.7 *Projected facet*

According to Goldkuhl (2005a), the **Projected** facet covers some of Searle's speech act functions (Searle 1969). One of these speech act functions is the class directive, which we have dealt with earlier in connection with the relation facet. According to Searle, a directive speech act aims at influencing the addressee to take a specific action. In this context it is obvious that a prescription is an admonishment to the patient to take medication for a certain condition or disease in a certain way, for a prescribed treatment period and of a certain dosage.

The prescriber can also demand that the drugs should be dispensed several times without further consultation with the prescriber, i.e. a number of iterations can be prescribed. The prescriber can also demand that the prescription should be dispensed on a certain date at the latest.

3.3.8 *Referential facet*

The **referential** part of the communication is traditionally the major focus in the description of the communication process, particularly when the communication is electronically mediated. Most of the effort of analysing the domain is almost exclusively focused on the referential domain. This facet is a very important part of the communication, because it is the visible result of the intentions and contextual constraints in the communication.

When starting to work with a new format for ePrescription in Sweden, it became evident that in order to semantically define the contents of an ePrescription it was necessary to understand the whole process and context in which a prescription was created and used. From this insight came the understanding that it was necessary to codify the legislative rules (at least those rules that were computationally possible to define with the present information resources at hand).

It was also necessary to develop test procedures of the EHR systems to ensure that they transmitted the same semantic view of the prescription. The aim was not only to implement the rules for validating the prescription when it arrives at the National Corporation of Pharmacies; these rules had to be *implemented in the process* up to the interaction with the prescriber in the 16 different EHR systems that issued prescriptions (2007).

This activity of defining and implementing a new format in ePrescription was an effort to achieve a semantic inter-operability between the systems of the healthcare sector and those of the pharmacy.

The message gives reference to different objects in the world. For ePrescription these involve, for example, a number of references to objects that can only be decoded using a database. One important reference is the prescribed medicinal product. This reference and its corresponding description are very important in issuing a prescription. Other references, which are only comprehensible with the use of databases, are the authorisation code of the prescriber and a code for the prescriber workplace. These references also add up to the complexity of the ePrescription process.

3.3.9 Accountable facet

The use of the **Accountable** facet refers to the degree of comprehensibility of the speech acts to the addressees. First, it is important that the patient understand the purpose of the prescription and is able to understand the instructions about how to take the medical drug. This is specially noted in the prescription rules by the authorities:

“23 § ... instructions regarding dosage, use, purpose and treatment period shall be written so that the patient or the animal carer can use the medical drug in a correct manner. ... “ (LVFS 1997:10)

Secondly, the accountability of the message is important for the pharmacist who is going to dispense the drug in the prescription.

Even if the ePrescription format as such contributes to making the prescription more readable and more complete there are special issues about completeness and correctness with ePrescription, due to the EHR-system’s lack of compliance with the regulations for ePrescriptions.

3.4 Analysis of the Customer – Pharmacist Communication

Below a picture (Figure 5) is presented to illustrate an application of the framework on the Customer – Pharmacy Communication, where the order based on the Prescription is the basic communication act.

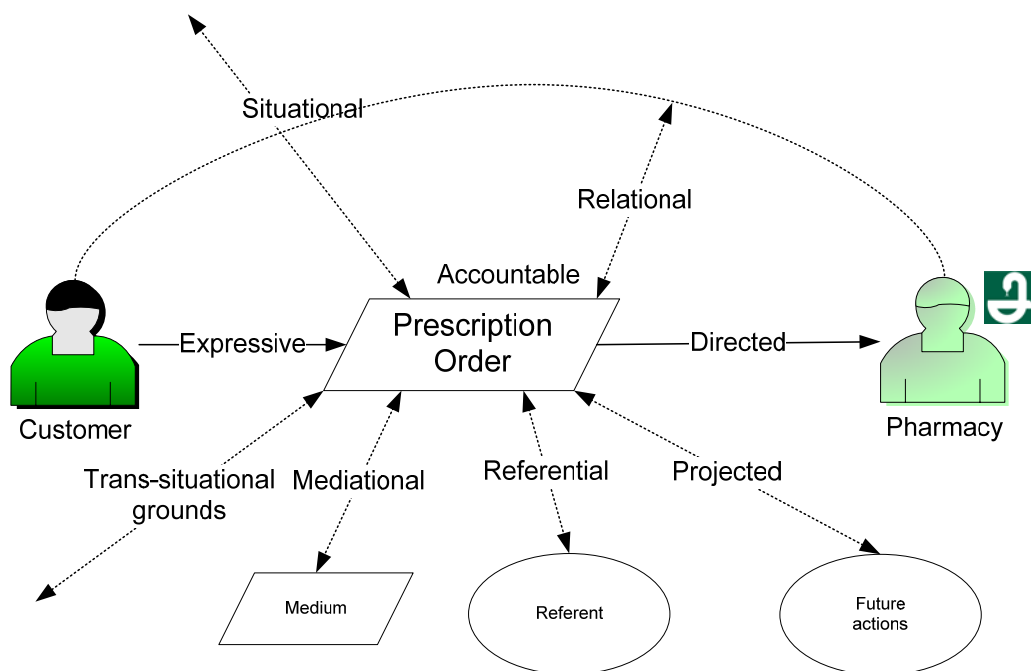


Figure 5 Nine facets of communication – applied to Customer – Pharmacist communication, adapted to ePrescription (based on Goldkuhl 2005a).

3.4.1 *Directed facet*

The conclusion from the analysis in section 3.2 is that we have one addressee in the action of a prescription order: the pharmacy. The prescriber is the original locutor of the prescription. In the communication between the customer and the pharmacist the prescriber is only involved later in the process and is therefore not considered as an addressee. For the prescription-based order the customer/patient is the locutor.

3.4.2 *Situational responsive and mediational facet*

The situational context in which communication occurs between the Customer and the pharmacy can vary. Most of the variation is linked to the **Mediational** facet, which can be Internet-mediated communication via an e-commerce system for prescription, telephone-mediated communication or, as is the most common today, through the medium of physical appearance at a local pharmacy.

What is the main communication act in this communication? Here, an analogy with the paper world could help to clarify the analysis. The customer brings to the pharmacy a paper prescription, which is handed over to the pharmacist. The customer either says nothing or makes an explicit request to deliver a drug on the prescription. This could be seen as a speech act of the **directive** class, which is usually named an order in a classical business setting. The speech act is the real meaning of the act, whether outspoken or not. The message that is transferred is an order based on a prescription, a prescription order – i.e. a request to dispense a drug.

The prescription only plays the role as an authorisation (which specific rules are specified in the prescription) as the basis for a pharmacy to dispense a drug to the patient.

3.4.3 *Expressive facet*

The **expressive** facet expresses the intentions of the customer. A prescription order expresses the customer's intention that the prescription is to be filled. It is also necessary to add additional information such as delivery mode, delivery address, etc.

If we first consider the situation where the customer arrives at a local pharmacy, the intention of the customer is usually to order the dispensing of one or several prescriptions. It could be the first occasion of dispensing the prescription, or iteration. The order is directed towards the pharmacist.

3.4.4 *Relational facet*

The order request by the customer creates a number of action relations with the addressee. The order request is a **directive**.

The pharmacist's response to this request results in a number of actions. The pharmacist makes a promise to deliver a certain drug at a certain price, which is a **commissive**. This promise to deliver a drug at a certain price is based on regulations on the whole pharmacy market regarding pricing, generic substitutions (the cheapest **available** generic drug), reimbursement rules (the drug must be valid for reimbursement and the reimbursed amount must be calculated according to the earlier history of the customer prescription fills and the assessment by the pharmacist of the amount of drug consumption that is valid for reimbursement).

The customer can choose not to accept the generic substitution and pay the full price for the difference to the prescribed drug. The prescriber could also have directed in the prescription not to accept any generic substitution.

The actual prescription contents regulate the application of the rules on the specific dispensing case.

The pharmacist can also create a **directive**, if the pharmacist has found that, for example, a drug in one prescription has a potentially serious interaction with another drug in another prescription, perhaps issued by another prescriber (Åstrand et al 2006a). This **directive** could aim at urging the customer not to take a certain drug together with another drug or to instruct the customer to avoid a certain interaction or to avoid the risk of duplicate drugs.

3.4.5 Accountable facet

The order by the customer may sometimes be clarified in an interaction between the pharmacist and the customer. It could concern the amount of drugs to be dispensed, and particularly with electronic prescriptions, the need for the pharmacist to clarify together with the customer which prescriptions are to be filled. This is done in a face-to-face situation through clarifying questions, such as asking which prescriber has prescribed the drug at what time before selecting the prescription that should be filled. If the medium is an e-commerce system for prescription orders, there is usually no need for clarifications.

In response to the prescription order the pharmacist contributes to the accountability in making the directive of the prescription more comprehensible by additional information and explanation. If there is a paper prescription handed to the pharmacist, an interpretation of the prescription is made when transcribing the prescription for dispensing. Whether it is handwritten or if the prescription does not contain package identification (i.e. the prescription is on the product level) the product information is translated into package information (ePrescription is currently always on the package level while a paper prescription is usually on the product level).

Clarification by the pharmacist of the instructions of use and dosage also occurs both for paper and ePrescriptions. These clarifications (for example corrections and clarification of non-standardised abbreviations) can be made on the prescription original (whether on paper or electronically) and on the label on the package when delivering the drug. The pharmacist also gives oral instructions when delivering the drugs, for example how to handle an inhaler.

Interview with pharmacist give at hand that a majority of new prescriptions (whether on paper or ePrescriptions) and have to be corrected when it regards dosage instructions. In an observational study made at a mail-order pharmacy in Sweden 38% of all incoming ePrescriptions were corrected regarding dosage instructions without a need to contact the prescriber (Törn-gren & Palo 2006).

This indicates that the prescriber do not see the patient as the addressee of the prescription but relies on the pharmacist to correct the dosage instruction to make it readable and comprehensible for the patient.

3.4.6 Trans-situationally compliant

The regulations regarding dispensing prescribed medical drugs are quite complex. There are legal rules describing what responsibility and rights the pharmacists have in the dispensing process. The pharmacist is responsible for checking that the prescription is valid according to the rules issued by the Swedish MPA (Medical Product Agency) and that the prescriber has

the authorisation to prescribe the drug. There are also rules about the substitution of generic drugs that the pharmacist must follow, as well as rules about subvention, the correct workplace code, etc.

The pharmacological control is also a very important part of the dispensing process. This means, for example, making a technical check of the medication. This involves checking that there is no risk of interaction among the drugs dispensed, that a correct dosage is used, that the dosage instruction is comprehensible to the patient, that there is no risk of duplicate drug use, that the drug prescribed is adequate for the indication in the prescription, etc. At the time of writing there does not exist any means of systematic reporting back the finding by the pharmacist to the prescriber, except contacting the prescriber directly by phone.

If errors are found in the prescription, it is possible for the pharmacist to correct it within the norms and rules which are **Trans-situationally compliant**. The pharmacist also approves the dispensing with a signature (electronically on the prescription dispensing record and by pencil on the drug package dispensed to the customer).

3.4.7 *Referential*

Apart from the information already referred to in the prescription, additional information and status are added. A paper prescription meant adding all the history and life-cycle of the prescription to the paper through hand-written signatures and comments by the pharmacist, together with labels glued on, defining all the dispensing on the prescription. With an electronically stored and maintained prescription all this is managed in the prescription database including history and status changes, which regulate what is allowed to do with the prescription. To manage the life-cycle electronically, new referential information has to be gathered and managed.

The process becomes more complex, since it has to manage the whole life cycle of the prescription with its many rules regulating subventions, and the validity of the prescription (when the whole prescription is completely dispensed, when is the next date for dispensing with subvention, when the validity date has been passed, etc.).

3.4.8 *Projected facet*

The projected facet includes all the advice and instructions which the pharmacist delivers to the customer in order to increase adherence and patient safety. These communication actions are classified as **directives** and take place when delivering the drug to the customer.

This facet expresses the desire of the pharmacist that the customer should adhere to the directive in the prescription issued by the prescriber.

4 Discussion and future work

One purpose of this work was to contribute to the development of models which can be used to guide the analysis and development of e-services. Three models were selected and applied in the analysis of ePrescribing.

A contribution of this study was obtaining experience of applying the three practical theories (GEM, GRM and the socio-pragmatic framework for communication) on ePrescribing. The main benefits expected from this application were a *conceptualisation* of important phenomena in ePrescribing.

Another contribution was to develop a general practical theory of ePrescribing.

Does the usage of the analysis framework contribute to a better understanding in the sense of creating new insights, clarifying ambiguities and/or highlighting different perspective in the domain, adding up to a more coherent description situating the different elements in a context?

Does the frameworks used provide with the necessary concepts contributing to form a general practical theory of ePrescribing?

We think that the analysis presented in this paper *demonstrates* the ability of the models to both function as *guidance* in the analysis and *contribution* of important concepts to describe central phenomena in ePrescribing in the form of a general practical theory of ePrescribing.

It has helped to highlight things that where not obvious and has provided new insights that have not been explicitly stated before.

One such insight was the strong regulative role the prescription has for the pharmacy market. Another insight is the strong interdependence between the health care sector and the pharmacy market regarding prescribed drugs.

Today the ePrescribing process is to a high degree a one way process, with little feedback to the healthcare practice on what is going on in the drug provisioning practice. This one way character put a high responsibility on the pharmacist for the patient safety and effective drug utilisation. Another consequence is poor information quality of prescriptions, where pharmacist frequently corrects prescriptions before they can distribute drugs to the customer.

The notion of accountability and identification of the addresses for the prescription message where very important concepts in highlighting this last aspect. It is obvious that information quality issues do not solve themselves with introducing ePrescriptions. The understanding of the strong interdependence between the health care practice and the drug provisioning practice and how they influence each other, can contribute to improve drug utilisation and insights into how information technology can be used as an instrument for this.

The models have made different contributions with important concepts for analysing different phenomena and their relationships.

The GEM model contributed largely to highlight the interdependence of the different practices, particularly with its concept of a forum/market level distinct from the dyadic communication one.

It was important to view the different communication settings as part of the same process, spanning over different market/forum levels, from the act of prescription to the consumption of medical drugs by the patient. Viewing ePrescribing this way makes it possible to better understand the multi-functionality of the ePrescription message and its role in different phases of the communication.

The notion of exchange phases points towards the need to make a decision about the scope of the process. This guided the analysis of the link between the different forum/market levels with questions like: what do we complete in the completion phase, what kind of the assessments are made?, etc.

The GRM model contributed with the overall insight that ePrescribing encompasses both regulating and regulated practices and to show the specific regulative role of the prescription on the pharmacy market.

The socio-pragmatic framework contributed particularly to analyse the multiple functions of the ePrescription message in ePrescribing.

The three models complemented each other.

The GEM and GRM model's main focus is to get an overall understanding of the exchange (phases, objects, activities) between parties and how this exchange is regulated.

The socio-pragmatic framework contributes with guidance on the different social acts which are linked to the communication, i.e. the multi-functionality of the message.

The models also overlap each other, particularly when it comes to analysing the context of the communication. There is no clear separation of the kind of phenomena that are captured in the models. Instead, they give guidance in viewing different aspects of the same phenomenon.

We think that the usage of the three models in the domain of ePrescribing contributes to the empirical grounding of these theories and their usefulness in analysing and modelling such a complex domain as ePrescribing.

How the models are related to each other in the analysis work needs to be further elaborated. A general conclusion of this work is that making this kind of analysis sheds light on those social acts that are hidden behind the systems and documents in the process. To understand these social acts and the multi-functionality of the messages and documents is very important, not only for stakeholders and developers, but for policy makers as well.

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