Case Report ■

Electronic Messaging Between Primary and Secondary Care:

A Four-year Case Report

PETER W. MOORMAN, MD, PHD, PETER J. BRANGER, MD, PHD, WOUTER J. VAN DER KAM, MD, JOHAN VAN DER LEI, MD, PHD

Abstract **Objective:** To observe how electronic messaging between a hospital consultant and general practitioners (GPs) in 15 practices about patients suffering from diabetes evolved over a 3-year period after an initial 1-year study.

Design: Case report. Electronic messages between a hospital consultant and GPs were counted. The authors determined whether a message sent by the consultant was integrated into the receiving GP's electronic medical record system. After the observation period, the GPs answered a questionnaire.

Measurements. The number of electronic messages and the percentage of messages integrated into the electronic medical record.

Results. The volume of messages was maintained during the 3 years after the original study. In the original study, the percentage of the messages integrated by the GPs increased during the year. After that study, however, seven GPs stopped integrating data from messages. The extent to which received messages were integrated varied widely among practices.

Conclusion. The authors conclude that extrapolation of the results of the original study would have led to incorrect conclusions. Although the volume of messages remained stable after the original study, GPs changed their method of handling messages. Initially, all GPs used the opportunity to copy data from the messages into their own records. At the end of the observation period (that is, the 3 years after completion of the original study), more than 50 percent of GPs had ceased copying data from the messages into their own records. The majority of GPs, however, wanted to expand the use of electronic messaging.

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In the Netherlands, the general practitioner (GP) acts as a gatekeeper between primary and secondary care. The GP may refer a patient to a secondary care hospital consultant. When the GP refers a patient, a referral letter, describing a summary of current complaints, medications, and past illnesses, is given to the patient, who hands it to the consultant. The consultant reports his or her findings back to the GP by means of progress reports and discharge letters.

Researchers report that paper-based communication is insufficient in quality,[1–3] inefficient, error-prone,[4,5] and often too slow.[6–9] In the early 1990s, researchers started using electronic messaging to replace traditional paper-based communication. Many publications have suggested positive effects of electronic messaging.[10]

Studies that assess the introduction and effects of technology in care face the problem of bias.[11] Bias can, for example, be due to the mere awareness of being observed (the Hawthorne effect), enthusiastic early acceptance, active compliance with the supposed wishes of the researcher, or special attention

Affiliations of the authors: Erasmus University Rotterdam, The Netherlands (PWM, JvdL, PJB, WJvdK); Deloitte & Touche Bakkenist, Diemen, The Netherlands (PJB); Isala Klinieken, Zwolle, The Netherlands (WJvdK).

Correspondence and reprints: Peter W. Moorman, MD, PhD, Department of Medical Informatics, Room Ee2110, Medical Faculty, Erasmus University Rotterdam, P.O. Box 1738, 3000 Rotterdam, The Netherlands; e-mail: <moorman@mi.fgg.eur.nl>.

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received. Unfortunately, researchers rarely report on how projects evolve after their original study.

For a period of 12 months, Branger et al.[12] studied the introduction of electronic messaging between a hospital consultant and GPs concerning the care of diabetic patients. The study concluded that electronic messaging leads to more messages from the consultant to the GP, more diabetes-related data in the GP information systems, and improved patient outcome (i.e., a significant decrease in hemoglobin A_{1C} levels was found).

In this paper we present a case report describing how electronic messaging evolved during the 3 years following our original study.

Methods

Setting

The original study[12] took place in the Dutch Apeldoorn region. This region has a population of about 180,000 inhabitants, one general hospital (in two locations), and 65 GPs. In the original study, 20 GPs in 15 different practices and a hospital consultant communicated electronically about their diabetic patients. The GPs and the consultant documented their patient data in the electronic medical record (EMR) of their (identical) information systems. A software module enabled the transmission and receipt of electronic messages. A detailed description of the setting is provided in the original study.

The original study ended in April 1995. The consultant and GPs continued communicating electronically using the same software.

Messages

Electronic messages[13] were communicated in the so-called EDIFACT standard.[14] A message consists of both administrative data (e.g., patient name and address) and medical data. When sending a message, the physician can include medical data items from their EMR. In the electronic record, medical data are divided into five categories—Current Medical History (anamnesis), Measurements (e.g., weight, blood pressure, and laboratory test results), Diagnoses, Medication, and Unclassified (i.e., data that cannot or have not been assigned to another category). Medical data in the categories Measurements, Diagnoses, and Medication are coded. Medical data in the categories Current Medical History and Unclassified are predominantly free text.

To send a message, the physician evokes the communication module from the patient encounter screen in the EMR. The physician first has to specify the start and end date of the reporting period. In case of prior messaging, the module suggests the date of the last communicated message concerning the patient as start of the period. The module then presents all data in the EMR from the selected period; the physician may subsequently remove data from that list.

After the physician has determined the medical data that has to be sent, the module automatically transforms the data into EDIFACT format. In the message, each individual measurement, diagnosis, and medication is stored as a separate data item. The data that were recorded in free text (current medical history and unclassified) are stored in data items of up to 70 characters of text.

Integration

On receipt of a message, the communication module permits the receiver to indicate which clinical data items in the message are to be integrated into the medical record system. We use the word "integrated" to indicate that (parts of) a message can automatically be copied into the EMR of the receiving party. Thus, data from the message are automatically stored in and become part of the data in the receivers' system. When, for example, a message item containing a glucose measurement is integrated into the receiving system, the glucose value is inserted into the table containing laboratory results and can be displayed on a graph with the glucose values already present. When a receiver decides not to integrate a message, the message is either kept in the received format, printed, or deleted.

Outcome Measures and Analysis

We automatically received an anonymous copy of every message sent between April 1994 and April 1998. Whenever the receiver integrated the message, or parts of it, into their system, we received a second anonymous copy containing the integrated data items. All copies of messages were sent automatically, without intervention by the physicians.

We counted the number of sent and received messages for each physician. In each electronic message we counted the total number of items in that message and the number of items in each category. For each message received by the general practitioner, we evaluated whether any items in the message had been copied into the EMR; if one or more items had been copied, we categorized that message as integrated. For each practice, we calculated the message integration by dividing the number of integrated

Table 1 ■

Annual Volume of Messages from Consultant to 15 General Practices (GPs) and from GPs to Consultant

Practice	No. of Messages							
	From Consultant to GP				From GP to Consultant			
	Original Study Year	Year 1	Year 2	Year 3	Original Study Year	Year 1	Year 2	Year 3
1	47	59	63	62	44	48	60	76
2	14	24	25	26	5	5	0	0
3	22	28	39	44	12	5	4	6
4	33	32	23	24	3	1	1	1
5	48	38	46	37	11	0	0	0
6	11	14	23	18	0	10	6	0
7	28	24	15	21	30	10	6	3
8	24	45	53	58	2	10	7	0
9	10	17	19	16	6	0	0	0
10	24	37	45	36	8	4	18	9
11	47	45	52	45	6	5	7	2
12	64	90	90	96	9	40	48	52
13	22	28	27	32	10	2	14	7
14	32	41	58	34	4	3	20	19
15	26	22	32	25	4	4	9	0

messages by the total number of messages received in that period. For each integrated message, we counted, for each data category, the percentage of items that had been copied into the EMR. For the integrated messages, we calculated, for each practice and each category, the data integration by dividing the number of copied items by the total number of items in those messages.

To assess opinions of the GPs on electronic messaging, we sent a questionnaire to all 15 general practices. In the questionnaire we asked the GPs whether they wanted to continue sending and receiving messages electronically. We also asked them to indicate their agreement to 11 theses, using a six-point scale ranging from "totally disagree" (1) to "totally agree" (6).

Correlation tests were performed using the Spearman correlation coefficient.

Results

Number of Messages

During the original study period (April 1, 1994, to March 31, 1995), the consultant sent 452 messages to the GPs. In the 3 years following the study, yearly message volume from consultant to GP was 544, 610, and 574 messages, respectively. During the original study period, the 15 general practices sent 154 messages to the consultant. In the 3 years following the study, the yearly message volume from GPs to the consultant was 147, 200, and 175 messages, respectively.

Table 1 shows the message volumes between consultant and the general practices during the study period and the subsequent 3 years.

Table 2 ■

Annual Integration (%) of Messages by the 15 General Practices

Practice	Original Study Year	Year 1	Year 2	Year 3
1	91	97	100	95
2	100	83	0	0
3	18	7	0	0
4	30	38	87	75
5	69	0	0	0
6	73	50	61	0
7	96	96	100	100
8	67	89	89	62
9	50	18	5	0
10	71	51	0	0
11	94	69	19	2
12	95	88	98	99
13	100	96	100	94
14	34	73	84	100
15	96	86	53	0

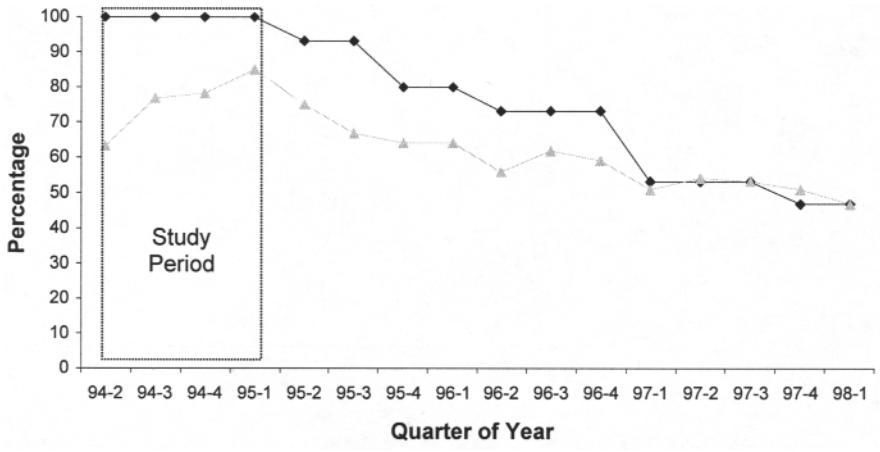

Figure 1 The percentage of the 15 general practices that continue to integrate received messages (*diamonds*) and message integration by all 15 practices (*triangles*), for the original study year and the subsequent three years, per quarter of year.

Message Integration

During the original study year, the GPs integrated 339 of the 452 (75.0 percent) of the messages they received from the consultant; during the following 3 years, this percentage decreased to 67.5 percent in the first year after the study, 57.5 percent in the second, and 51.1 percent in the third. Table 2 shows the percentage of messages integrated by each general practice during the original study period and the subsequent 3 years. Notice that some practices stopped integrating messages; Practice 5, for example, continued to receive messages in the years following the original study (Table 1) but did not integrate them (Table 2).

Figure 1 shows, for 3-month periods, the percentage of received messages that were integrated by the 15 general practices in each period. Figure 1 also shows the percentage of practices that continue to integrate messages.

Data Integration

Integrated messages contained, on average, 17.7 data items, of which GPs integrated 10.5 (59.3 percent). Integrated messages contained, on average, 3.6 current history items, 8.3 measurement items, 1.7 diagnosis items, 3.0 medication items, and 1.2 unclassified items. The GPs integrated, on average, 2.5 (68 percent) current history items, 4.3 (52 percent) measurement items, 1.1 (66 percent) diagnosis items, 1.9 (64 percent) medication items, and 0.8 (69 percent) unclassified items.

Table 3 shows for each practice, the data integration per data category. Practice 1, for example, integrated

Table 3 ■

Data Integration per Data Category for Each of the 15 General Practices

Practice	No. of Integrated Messages	Current History (%)	Measurements (%)	Medication (%)	Diagnoses (%)	Unclassified (%)
1	222	55.3	93.0	88.2	64.5	41.6
2	34	97.1	71.2	95.6	95.3	95.6
3	6	57.9	79.2	56.3	60.0	87.5
4	60	99.0	99.1	99.4	99.1	98.7
5	33	38.0	42.6	35.4	78.4	41.7
6	29	72.7	23.4	41.4	43.3	79.4
7	86	83.4	63.5	80.7	73.6	86.8
8	139	21.8	6.1	25.1	29.0	39.7
9	9	100	97.1	100	97.8	94.1
10	36	36.9	28.0	24.3	30.6	22.7
11	86	45.3	47.1	62.8	51.5	47.6
12	323	83.3	39.1	47.5	67.8	1.4
13	106	95.7	79.2	86.7	89.1	98.5
14	124	90.9	60.9	87.2	88.1	94.6
15	61	37.1	19.0	41.7	33.3	52.6

Table 4 ■

Ten Measurements Most Often Included in 1,354 Messages Integrated by 15 General Practices, Their Occurrence, and the Percentage Integrated into the EMRs of the Receiving Practices

Measurement	No. of Occurrences in Messages	Integration (%)
Weight	1,493	60.5
Blood pressure	1,348	53.0
Hemoglobin A_{1c} level	496	71.8
Glucose level	461	59.2
Cholesterol level	403	60.3
Triglycerides level	272	61.0
Creatinine level	262	55.3
Urea level	245	48.2
LDH level	243	35.8
ALAT level	227	40.0

ABBREVIATIONS: EMR indicates electronic medical record, LDH, lactate dehydrogenase; ALAT, alanine aminotransferase.

data from 222 messages; 55.3 percent of current history items were integrated, and 93.0 percent of the measurement items.

The measurement items of the integrated messages involved 76 different measurements. For the ten measurements sent most frequently, Table 4 shows how often each was sent by the consultant and the percentage subsequently integrated by the GPs into the EMRs. The measurement sent most often by the consultant to the GPs was patient weight, which was sent 1,493 times; 60.5 percent of these items were integrated by the GPs into their EMR.

Questionnaire

Twelve of the 15 general practices (80 percent) responded to our questionnaire. Of the three nonrespondents, two had stopped practicing. Of the 12 responding practices, 9 (75 percent) indicated the desire to continue receiving electronic messages from the consultant, and 6 (50 percent) wanted to continue sending messages to the consultant.

Table 5 shows the GPs' responses to the theses in the questionnaire. The percentage of messages integrated into the EMR was negatively correlated with the agreement scores for the thesis that electronic messaging reduces the ease of reviewing the record (Spearman's rho, -0.69; $P < 0.05$). The number of received messages correlated positively with the agreement scores for the thesis that electronic messaging should be extended to other patient groups (Spearman's rho, 0.59; $P < 0.05$). Physicians who wanted to extend electronic messaging to other patient groups thought that electronic messaging saved time (Spearman rho, 0.78; $P < 0.01$).

Discussion

Researchers who focus on the effects of new technologies in health care are often limited to relatively short study periods—as, for example, with an assessment of impact. When designing a study, investigators select a study period sufficiently long to allow the technology to be evaluated. To predict future effects, they have to rely on the extrapolation of study results. Discontinuation of the study period, however, results in a new setting, even when the technology remains available and unchanged. For example, financial or other incentives may be withdrawn,

Table 5 ■

Agreement Scores of the 12 General Practices (GPs) on 11 Theses

Thesis	Mean Score (SD)	GPs in Agreement (%)
Through electronic messaging I save time	4.0 (1.8)	67
Through electronic messaging I receive more reports	5.0 (0.8)	100
Through electronic messaging I receive reports faster	5.3 (0.7)	100
Through electronic messaging I have more information	5.0 (0.7)	100
Through electronic messaging the patients' treatment is improved	3.6 (0.9)	75
Through electronic messaging nothing really changed	2.9 (2.0)	33
Through electronic messaging there is more clarity about each others' actions	4.4 (1.2)	83
Through electronic messaging tasks and responsibilities are more clear	3.1 (1.4)	41
Electronic messaging decreases the ease of reviewing the data in my records	4.7 (1.4)	83
Information and communication technology is nothing but trouble	3.0 (1.4)	31
I would like to extend electronic messaging to other patient groups	5.2 (1.2)	92

NOTE: Agreement was scored on a six-point scale ranging from "disagree" (1) to "agree" (6). The percentage of GPs in agreement is the number of GPs with a score of 4 or higher divided by the total number of respondents.

users of the technology know they are no longer the subjects of a study, and they will have become more familiar with the system. As a result, the users may change behavior. Consequently, the extrapolation may prove to be wrong.

Although the results of evaluations are often published in the literature, the period following the study is rarely documented.

Branger et al.[12] studied the introduction of electronic messaging between a hospital consultant and GPs during a 12-month period. Messaging concerned the care of diabetic patients. In this case report, we documented the subsequent 3-year period.

We observed that, after the study year, the volume of communicated messages was maintained; that is, the consultant and GPs continued sending electronic messages.

Although message volume remained stable, the way GPs handled the messages changed. The GPs could integrate the data into their own medical records; that is, on receipt of a message, a GP could indicate which clinical data items in the message should be incorporated into the medical record of the practice. The consultant's glucose measurements, for example, could be inserted into the medical record and displayed on a graph with glucose values already present there.

During the original study period, message integration by general practitioners increased: 63 percent of messages in the first quarter of the original study period provided one or more data items that were integrated into the GPs' own medical records, compared with 85 percent in the fourth and final quarter of the original study. After the discontinuation of the study, the upward trend changed to a downward trend, and message integration was 47 percent at the end of our 3-year observation period. Extrapolation of the trend observed in the study period, therefore, would have led to an incorrect conclusion.

From this case report it is not possible to pinpoint factors that explain why GPs discontinued integration (e.g., practice size or computer experience) or indicate whether more GPs would have continued if, for example, the design or interface of the module had been better. We know, however, that the upward trend during the study period was followed by a downward trend. All physicians integrated data at some point during the initial study. Since the software was identical for all physicians and remained unchanged after the study period, the question remains why some physicians continued to integrate data while others did not. One possible explanation is that including additional data in one's own medical record results in more data and subsequently less ease of review; in the questionnaire, 83 percent of the GPs agreed that electronic communication decreased the ease with which their own medical record could be reviewed.

When integrating messages, some GPs integrated almost the complete content of messages, whereas others integrated only a minor part. Large differences among GPs also existed with respect to integration of the various data categories. Even important data for diabetes care, such as hemoglobin A_{1c} levels, were integrated only in 72 percent of cases. A common pattern of dealing with information received from the consultant seems to be absent among the GPs.

The observed decrease in the integration of messages into the GPs' own records should not be interpreted as a negative attitude toward electronic messaging. The majority of the GPs wanted to continue receiving electronic messages and wanted to include other patient groups. Physicians who felt they saved time were especially interested in expanding the scope of electronic messaging.

We conclude that extrapolation of the results of the original study by Branger et al. would have led to incorrect conclusions. Although the volume of messages remained stable, GPs changed the method of handling the messages. Initially, all GPs used the opportunity to copy data from the messages into their own record. At the end of our observation period (that is, 3 years after completion of the original study), more than 50 percent had ceased copying data from messages into their own records. Although the method of handling incoming messages changed, the majority of the physicians wanted to expand the use of electronic communication.

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