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Review Paper

Clinicians at Work: Sharing Care in the Information Age

1. Introduction

Early Medical Science

The most famous physician from the Netherlands is probably Herman Boerhaave, who lived from 1668 to 1738. Boerhaave, who lectured at the University of Leiden, was a botanist, a physician and professor of chemistry. He excelled in all these areas and managed to publish classical works, such as *Institutiones Medicae* (Medical Principles, 1708), *Aphorismi de Cognoscendis et Curandis Morbis* (Aphorisms on the Recognition and Treatment of Diseases, 1709) and *Elementa Chemiae* (Elements of Chemistry, 1724).

From Switzerland came Albrecht von Haller (1708-1777), who was a student of Boerhaave. Von Haller was a compassionate, emotional man, and became professor in health sciences, anatomy, botany, and surgery. He wrote many great works, among which the *Elementa Physiologicae*, a book on physiology which remained a standard for a long time.

Another example of broad scientific knowledge and learning is Rudolf Virchow, who lived from 1820 to 1902. He was a pioneer in such diverse fields as pathology, anthropology, archeology, and medical history. That he

could also be a narrow-minded dogmatist, however, was proven by the way he destroyed Philipp Ignaz Semmelweis, an obstetrician from Vienna. Semmelweis discovered that puerperal fever could be prevented if physicians washed their hands before examining pregnant women. Virchow publicly (and we now know unjustly) ridiculed this standpoint, which cost Semmelweis his job and reputation.

Nowadays, such broadly oriented scholars are very rare. The amount of knowledge has grown to such large proportions that it is no longer possible to master several medical specializations to a level such as that of Boerhaave in his age.

Changes in Health-Care Delivery

Another aspect that has changed, is the way health-care delivery operates, which is caused by the *socialization* of physicians. Fifty years ago, being a family physician was a 24-hours-a-day job. Without communication tools, fast means of transportation, and a backup service, the physician had to rely on his own capability and good health to deliver the service to the needy population. Nowadays, many physicians want to be able to work part-time, have the weekend off, and a vacation every now and then. This raised the need for sharing pa-

tient care with other health-care providers.

Another element in health care which increases the need for shared care is the regulation of workload for hospital-based physicians. Especially physicians with long waiting lists have expressed the need to improve the quality of the referrals to their clinics by better cooperation with referring physicians.

Hospital-based care is expensive when compared to primary care. There is a tendency, triggered by political and financial forces, to substitute expensive care delivered in the hospitals by care delivered by primary-care physicians. In these latter settings, general practitioners keep patients under their care, and only when serious problems occur, the patient is sent to the hospital. This approach has proven to be effective, both from a medical and economical point of view [1]. Moreover, most patients prefer the close-to-home care delivered by the general practitioner.

The developments described above have led to situations in which patients receive care from several care providers, each with their own expertise and knowledge. Increasingly, physicians cooperate and communicate with other care providers, even within the same specialty. In order for

shared care to be delivered in a coherent manner, precautions have to be undertaken to prevent the process from disintegrating.

2. Shared Care Initiatives

The concept of shared care is gradually emerging. But what is shared care aiming at? Orton [2] describes the aims of shared care as:

- earlier and safer discharge of patients from hospital;
- more frail and elderly people are supported in their own homes;
- provision of better coordinated and more flexible community care;
- efficient use of acute hospital services;
- greater responsiveness to the needs of patients.

The shared-care concept is developing rapidly. For a number of diseases and their treatment, shared-care plans have been formulated and implemented. Issues in the implementation of the shared-care approach include patient- or parent-held patient records, communication between primary and secondary care, and the use of hospital facilities by primary care physicians. We describe a number of these projects in the remainder of this section.

Internal Medicine

In 1993, Sheldon et al. [3] found that of 203 HIV-positive men only 19% had their general practitioner involved in HIV-related care, but that 51% showed interest in receiving shared care between clinic and general practitioner. That a shared-care approach is not acceptable under all circumstances for patients is shown by the study performed by Grun and Murray [4]. These researchers found that only a minority of HIV-positive but asymptomatic persons were willing to join a shared-care program.

Helliwell and O'Hara [5] describe the development of a shared-care pro-

tolocol for the management of rheumatoid arthritis. The evaluation showed that the protocol was followed in 65% of the cases, and that most of the monitoring activities were done by general practitioners. Communication problems between general practitioners, consultants and patients were one of the reasons why the protocol failed.

Moody et al. [6] asked 634 general practitioners what they considered to be valuable service from the regional gastro-intestinal unit, for patients with chronic disorders. A large majority of the respondents expressed a desire for: (1) news bulletins, (2) treatment protocols, (3) a telephone hotline with a senior consultant, and (4) a shared-care setting with the hospital unit.

Diabetes is an example of a disorder that can greatly benefit from shared care [7,8]. However, on the other hand, Pringle et al. [9] demonstrated that glycemic control in diabetic patients not only depends on factors such as gender, treatment group and years passed since the diagnosis, but also on the organization and the process of care. Shared care did not pay off in this particular experiment. A study by Hoskins et al. [10] resulted in a different outcome. A comparison between follow-up systems involving general-practitioner care, shared care, and clinical care showed that shared care resulted in better attendance rates and had comparable or better patient outcome. The authors conclude that, with the support of and communication with well-equipped diabetes clinics, general practitioners can provide patients with high-quality care.

Also obese persons can benefit from the shared-care approach. Richman et al. [11] designed a shared-care weight-loss program in which both the hospital and general practitioners participated. This program was compared prospectively with an existing hospital-based program. The

shared-care program turned out to be the most effective of the two.

Surgery

FitzGibbon and Keon [12] investigated shared care between a specialized cardiac surgery department and non-specialized hospitals. Patients referred to the cardiac surgery department were, after operation, transferred for postoperative care to the referring hospital. This procedure increased the availability of surgical treatment, while postoperative care remained unchanged, facilitated by the close relationship between the hospitals involved.

Obstetrics

A possible tool for supporting shared care is the use of patient-held records. Forbes et al. [13] questioned 148 women receiving shared care from both primary and secondary care providers during pregnancy. These women used a patient-held record for data storage and communication between the care providers. The researchers compared the results with those of a group of 52 women receiving only clinical care. The shared-care group was more satisfied with the care they received. The authors report, however, that patient-held records have certain limitations, one of them being that the patient is not always carrying it when visiting the care provider.

Although most of the studies cited here paint a favorable picture of shared care in comparison to other forms of care, there are also studies which show that shared care is not new. Turnbull et al. [14] showed that midwife care alone outperforms shared care provided by general practitioners, consultants and midwives. The women in the midwife-managed group received less medical procedures, such as an episiotomy or an induction of labor. Furthermore, they were more satisfied with the care they received than the

women in the shared-care group. These findings are supported by research undertaken by Tucker et al. [15]. These authors argue that in women with low risks of pregnancy complications, involvement of secondary care consultants offers no clinical benefit.

Urology

Benign prostatic hyperplasia is a very common disorder among elderly men. In the UK, urologists alone cannot possibly provide care for all these patients [16]. A feasibility study by Morris et al. [17] indicated that management of the disease can easily be done by community care. When a patient presents himself, an important question is, 'is this a benign or a malign form of hyperplasia?'. Booth et al. [18] describe a study in which general practitioners used the services of an outreach clinic for quick assessment of patients with suspected prostatic obstruction. After investigation by specially trained nurses in the clinic, patients were either referred back to the general practitioner or were seen by a urologist. The general practitioners valued the service of the hospital highly, because it provided them a quick and accessible specialist assessment. The patients were happy with the thorough and reassuring approach.

Oncology

Williams [19] describes the special place of the general practitioner in relation to cancer. One of the tasks of the general practitioner is to provide shared care, which means helping the patient by monitoring the treatment activities and its progress, and supporting the patient and the family in coping with all stages of the disease.

As already described in the paragraph on dealing with obstetrics, patient-held shared-care records function as a central storage system and

communication tool between care providers. Hooker and Williams stress the value of these shared-care records for supporting care for children with cancer. An interesting point in their study is the involvement of all the care providers in the development of the record, and the focus on communication with patient and parents using the cards [20].

3. Role of Information

The need for information for the delivery of good-quality health care is growing rapidly. As in other areas of society, computer technology plays an increasing role in managing this information. Hammond [21], reviewing the development of hospital information systems, indicates that health care has failed to keep pace with the rise in computing power and communications technology, possibly because of the complexity of health care and the large variety of individuals working with the systems. He underlines the importance of these systems for collecting, storing, processing, retrieving, and communicating patient-related data, not only between hospital departments but also between hospitals and other care providers. He concludes that "clinical information is not the property of a single facility but rather part of a global resource which focuses on the patient-centered record". Buffone and Beck support this view: "Patient care typically requires that multiple providers share data and information in a facile and relevant manner" [22].

In the Netherlands, the general practitioner forms the *interface* between primary and secondary care. Typically, patients first consult their general practitioner. If considered necessary, the general practitioner refers the patient to a specialist who reports the results of the assessment (and possibly therapy) back to the general

practitioner. For this reason the Dutch general practitioner is considered to be the central physician in the patient's medical history and the ideal person to coordinate shared care. This is especially true for patients with chronic illnesses. Hasler even goes so far as to stipulate the care for patients with chronic diseases as "the very stuff of general practice" [23]. This coordinating task puts high demands on the information-processing capacity of the general practitioner and the efficiency of communication with other care providers. A large number of studies have demonstrated that communication between physicians about co-treated patients is prone to be delayed, incomplete, or erroneous [24-27].

Especially for patients with chronic diseases, well-coordinated care is essential. Many of these patients are treated concurrently by different physicians. An example of a chronic disorder, requiring lifelong medical attention, is diabetes mellitus. Evidence exists that diabetes mellitus will become a more serious public health problem in the years to come. For the Netherlands, it has been estimated that the number of diabetes patients will increase from 191,000 (1.35% of the population) in 1980 to 355,000 (2.2% of the population) in 2005; this increase is partly due to the aging of the population, but also the result of an increasing incidence [28]. Furthermore, general practitioners are often confronted with comorbidity of their diabetes patients. Schellevis et al. [29] found that 40% of the diabetic patients aged over 65 suffered from one or more other diseases, such as ischemic heart disease or hypertension; these patients are likely to be involved in more than one surveillance scheme, which may lead to improperly coordinated, and possibly inefficient care. Recent studies point in that direction, indicating that distributed care may lead to inefficient care [30-32].

4. Models of Shared Care

With the formation of teams of co-operating health-care providers the physician as a soloist is coming to an end [33]. Care teams could consist not only of physicians and nurses, but also, for example, of social workers. Such a team could improve the quality and efficacy of care [34]. In the same series as [33] and [34], Orton [35] gives a clear description of shared care. In a shared-care setting consultants and general practitioners provide a package of tasks to a patient, which was originally supplied by hospital clinicians only.

Technology is regarded as one of the possibilities to support teamwork and shared care. Especially computer-based patient records linked together using a computer network can bridge the information gap between care providers, social workers, public-health researchers, policy makers, and financial institutions [33]. In a recent paper, Hickman et al. [36] describe a taxonomy of current shared-care models. They discern:

1. A basic model, in which consultants and general practitioners exchange letters on a regular basis;
2. A model centered around specialist clinics in the community;
3. Liaison clinics;
4. Shared-care record cards;
5. Computer-based shared care;
6. Electronic mail.

The authors believe that this taxonomy can be used to classify a broad variety of shared-care initiatives. This classification can then be used by health-care workers to develop ideas and projects involving shared care.

In an excellent review paper Hampson, Roberts and Morgan describe the state of the art in shared-care research [37]. The authors studied 230 papers on the subject and divided the field in three, task-oriented, main areas of research, each with a number of subgroups (Table 1). In their discussion the authors dedicate a section to the possible contribution of information and communication technology to the further development of shared care. A centralized computer-based patient record could be a solu-

tion, but many hurdles have to be overcome to make the introduction. In the meantime, every effort should be made to improve communication between care providers.

5. Workflow Management

While looking for a cost-effective way of operating, many companies outside health care have reorganized themselves in loosely linked divisions, which are commonly known as *virtual enterprises*. They consist of geographically distributed companies, each with its own competence, responsibilities and management. Maintaining a high-quality, cost-effective output from a virtual enterprise requires that the different processes form a coherent and integrated whole. In order to do so, virtual enterprises use automated workflow-management techniques to manage the process.

Health care consists of large numbers of care providers, some working as a soloist or in small group practices, others working in larger organizations

Main group	Subgroup	Issues tackled
Communication	Discharge letters from hospital to general practice	Content and format of letters, delay in receiving these letters
	General practitioners referral letters	Content and format of letters, delay in receiving these letters
	Discharge planning	Restructuring the process, optimizing communication
	Pharmacist communication	Optimizing cooperation and communication between pharmacists and physicians
Prescribing	Accuracy of medication records	Accuracy of medical records, patient-held records
	Hospital dispense policies	Building protocols for discharge medication policies
	Shared prescribing and costs	Building regional formularies, generic prescribing,
Sharing disease management	Diabetes, obstetric care, mental health, geriatric care, HIV, and others	Protocols for communication, cooperation, division of tasks and responsibilities

Table 1: Areas in Shared Care Research

When care for a particular patient needs it, some of these independent actors work together in order to try to improve the patient's well-being. After finalizing the treatment, the temporary team dissolves, but may remain in contact related to other patients. The similarity with the virtual enterprise described above is striking.

Automated workflow-management techniques aim to integrate flows of information, tasks and (financial) resources into one efficient process. E-mail, electronic data interchange and distributed data processing are elements supporting the tasks of health-care providers. Workflow management can facilitate health-care delivery by efficiently streamlining the flow of data between the many health-care providers, the patient, the hospitals and other parties, such as insurance companies [38]. On admission of a trauma patient to the hospital, an automated workflow-management system may, for example:

- search the network for relevant previous information;
- transmit an eligibility request to the insurance company;
- urge the physician to perform certain actions; or
- inform the general practitioner about the admission,

Using a workflow-management system, every admission to a hospital automatically generates a number of interactions with other (remote) computer systems, but also with persons working in the hospital, in a general practice, or in a pharmacy [39].

An early example of a workflow-based approach is described by Hempel [40]. In his study, physicians and nurses used a flow sheet and outpatient medical records to support diabetes care. The results of the study showed that, using a diabetes flow sheet, the quality of the documentation, and the compliance of care pro-

viders to recommended medical procedures increased significantly.

Based on experience in other sectors, many software industries and consultancies are now focusing on the implementation of automated workflow-management systems in health care. In the USA, an example of such an initiative is the Healthcare Open Systems and Trials (HOST) program, which aims to accelerate the adoption of computer-based patient records, foster and encourage the development of open architecture, integrated health-care information systems, and promote movement toward community-wide networks for health-care information. One of the main areas of research of HOST is the development and implementation of workflow management in health care.

6. Building and Implementing Clinical Guidelines

Developing clinical guidelines is one of the issues in health care that attracts a constant flow of both positive and negative attention, financial resources, and research activities. The reasons for developing clinical guidelines stem from emotional, medical, managerial, and economical viewpoints, in that they can help with [41]:

- reducing errors and uncertainty;
- reducing practice variation;
- reducing inappropriate care;
- reducing costs of health care;
- improving insight in the delivered care; and
- improving the predictability of the total medical consumption.

For example in the USA, the UK and the Netherlands, physician organizations are constantly defining, refining, and updating clinical guidelines [42]. The implementation of these guidelines, however, is not to be taken lightly. Tierney et al. [41] implemented clinical guidelines for the management

of left-ventricular systolic dysfunction, published by the Agency for Health Care Policy and Research (AHCPR). These authors conclude that the guidelines are an 'excellent, evidence-based review of the current state of the art', but that the guidelines lack explicit definitions and specificity.

Another interesting study, performed by Safran et al. [43], started from a different point of view. The researchers set out to develop a set of guidelines, using a panel of experts. The guidelines were implemented in a computer-based patient record system. One group of physicians received alerts and reminders interactively, while another group of physicians did not. Both groups, however, used the same computer-based patient record. The results showed that the physicians receiving alerts and reminders adapted to the guidelines in a faster way and more fully than physicians who did not receive these messages. The key to success in this project seems to be the availability of locally designed and, therefore, easily accepted guidelines, and a clear-cut translation of these guidelines in computer-based messaging procedures.

Fridsma et al. [44] argue that general guidelines are often difficult to implement because of local circumstances that are not taken into account in these general guidelines. The authors studied the possibility of transforming general guidelines into site-specific versions. They conclude that these specific guidelines are less difficult to implement, without being in conflict with the general guidelines.

In the Netherlands, the Dutch Organization of General Practitioners has developed clinical guidelines for a large number of diseases, including the management of diabetes, asthma, and hypertension [42]. Grol [45] investigated the level of dissemination of the stan-

dards among general practitioners. He found that the large majority of the general practitioners knew the standards well, and agreed with the procedures used to create the standards. The disadvantage was that most of the general practitioners did not want the standards to become obligatory. They feared, for example, abuse of the standards in malpractice procedures by unsatisfied patients. Furthermore, keeping the guidelines up-to-date and bringing them into the office of the general practitioner will be the challenge of the next decade.

Workflow systems rely heavily on widely accepted guidelines in which, for example, the involved persons and organizations, the tasks and procedures to be performed, and the division of these tasks are described. Another important aspect of guidelines is that they should supply a form of decision support, helping an individual physician to choose between several competing options. Constructing and implementing these guidelines is an art in itself, a long tedious process which may take many years. At present, it appears that there is still a long way to go.

7. Implementing the Interface between Primary and Secondary Care

While the care providers are trying to tear down the walls that have separated them for so many years, the medical informatics societies are busy developing the tools that should facilitate shared care. In this review we also look at some of the trials and tribulations that are related to the delivery of what is sometimes referred to as *seamless care*.

Integrated Patient Records

As discussed in section 2, the effectiveness of distributed care depends on a well-structured communication system. Developments of computer-based

patient records have resulted in a large number of operational systems in both primary care [46] and the hospital [21]. Data exchange between these computer systems is also becoming operational, often based on standardized textual messages using, for example, HL-7 or the EDIFACT syntax in Europe [47]. Research has indicated that this approach eliminates transcription errors, reduces administrative workload and increases the general practitioner's knowledge about the total care that patients are receiving [48]. The disadvantage of this method is that it leads to duplication of data and thus to possible inconsistencies. Therefore, the interest for integrated or shared records, or multidisciplinary records, is rising rapidly.

In Europe, several EU-supported projects aim to develop and implement computer-based integrated care records. The EPIC project [49], for example, focused on the development of an information system capable of providing the support necessary to facilitate integrated care to vulnerable patients treated at home. Based on a *business analysis* of the community care, the information model was created and implemented.

Rigby et al. [50] describe any medical record as a capturing of three processes, namely:

- the patient's physical and health state;
- the activities, thoughts and uncertainties of the care provider(s);
- the plans and intentions to support the patient.

They discern a part of the record which is shared by all the involved health-care professionals (e.g., the problem list, or allergies), and a part which is profession-specific or only known in a particular patient-clinician relation. The benefits of such an integrated record are many, including:

- a focus on interdisciplinary communication,

- effective care planning,
- better understanding of resource usage, and
- reduction in administrative workload.

Integrated records and telemedicine are also used in rural communities where health-care services are few and remote [51]. Linking physicians electronically may provide better service to the patients, offer remote processing of data, and can assist the delivery of shared care.

Many paper-based integrated records have been developed and the use of them in patient care has been evaluated. Essex et al. [52] developed a shared-care record for the treatment of psychiatric patients. The evaluation demonstrated the acceptability of the records to patients, increased their autonomy, and improved communication between the involved care providers. The acceptability to the care providers, however, left much to be desired. Arguments presented by the care providers against the shared care approach included:

- psychiatrists, doubting whether the general practitioner was able to look after schizophrenic patients, also fearing that shared care was a challenge to their authority;
- general practitioners, unwilling to accept responsibility for long-term care.

There were also organizational barriers; for example, general practitioners were not allowed to make direct referrals to community psychiatric nurses. The study clearly indicates that technological solutions will not be accepted when the organizational structure is missing.

Defining the Need for Information

When designing an integrated health-care record, an essential question is which data to include in it. Defining *minimum data sets* is an exercise which has been done before, but most

of the time related to the care given within one particular setting, for example a hospital or a general practice. Computer systems are then used to urge clinicians to fill in any gaps found in the data relating to a particular patient [53].

In a shared-care situation, however, the task of defining the required data set becomes even more difficult.

In order to enable shared care, Moran et al. [54] designed a community database, based on the requirements of the health-care professionals. This database differs fundamentally from a regular medical database: instead of diagnoses and medications, the community database contains information about the professional and the physical resources necessary to keep the patient at home and out of the hospital. The authors report difficulties in attuning the data stemming from the different care providers.

8. Discussion

When the interface between primary and secondary care is being re-invented, the question arises what the effects are, from a medical, economical, and organizational point of view. This question is often hard to answer and not much information is available on this subject. Evaluation of the effects of a certain intervention, however, may provide valuable clues for further developments. The implications are many; we will discuss a few of them, without attempting to give a complete overview.

Cost Justification

As indicated earlier, the use of shared care may implicate considerable shifts in financial resources [52]. When primary-care physicians are able to provide high-quality care at low costs, this may be in conflict with a hospital policy: dehospitalization is not in their best interest [55]. Furthermore,

insurance companies using managed-care systems, are mainly targeting at risk selection and profits: these structures require high administrative overheads. In this respect, Light [55] uses the term Master of Business Administration-managed care, as opposed to clinically-managed care.

This discussion at least makes it clear that formal evaluation of changes to the organization of care is necessary. This does not only apply to, for example, the introduction of a new drug or a new surgical procedure, but also applies to the implementation of information technology. To our knowledge, few of such evaluation studies have been published. We describe two experiments.

Overhage et al. describe the design and implementation of an electronic communication network to be used for patient care and research [56]. They also identified a number of previous evaluation studies, focusing on the effects of information technology on health-care delivery. The authors conducted an evaluation study focusing on the physician's use of electronically accessible full-text medical references, the impact on testing in the emergency department, and the effect on cost and quality of prescription writing.

Payton et al. [57] compared the annual costs of treatment of a patient with Alzheimer's disease when treated at home (\$12,572) and the costs of institution-based care (\$42,050). The authors implemented a communication network, to be used by home-based caregivers, providing functions such as peer support, professional advice, education, and counselling. The annual costs of this network were \$1,797 per patient. After pointing out a number of limitations to the study, for example its small size, the authors conclude that the network is cost-effective by facilitating the replacement of expensive institution-based

services by home-based services.

Gatekeepers

Another important question arising from the shared care discussion is: who is in charge? Shared care needs a coordinator. Franks et al. [58] underline the value of a gatekeeper, especially in environments where patients are at risk of overtreatment. In the USA, this risk is apparent and is due to five factors: the fee-for-service system; the fears of malpractice claims; the continuing development of new medical technology; the aggressive medical culture, based on an intolerance to uncertainty; and the oversupply of specialists. Franks et al. report that people tend to view gatekeeping as the medically limited bureaucratic function of opening and closing the gate to high-cost medical services. This view does injustice to the gatekeeper, and Franks et al. try to reinstate the gatekeeper as the patient's advocate, guarding the patient against unnecessary medical interventions. The authors also argue that the primary-care physician is the best choice for the patient's benefit.

Light [55] supports this view. He underlines the role of computer systems in supporting the general practitioner with making the right choice for treatment in the primary-care setting, or referral to secondary care. Light suggests that computer-based decision-support systems perform the same tasks as medical administrators, at a fraction of the cost. Again, formal evaluation studies are needed to either support or reject this view.

In spite of all the innovations in health-care technology, evidence exists that the attitude of both physicians and patients influence to a large extent the outcomes of any medical treatment [58]. The introduction of information and communication technology in health care always requires organizational changes and will, therefore,

always meet with considerable resistance. Implementing computer-based shared care is a beautiful example of a promising but difficult organizational enterprise that deserves our full attention.

References

- Constantino M, Hoskins PL, Fowler PM, et al. Interaction between diabetic patients, their general practitioners and a hospital diabetic clinic. *Med J Australia* 1991;155:515-8.
- Orton P. Primary care tomorrow: Shared care. *Lancet* 1994;344:1413-5.
- Sheldon J, Murray E, Johnson A, Haines A. The involvement of general practitioners in the care of patients with human immunodeficiency virus infection: current practice and future implications. *Fam Pract* 1993;10:396-9.
- Grun L, Murray E. Acceptability of shared care for asymptomatic HIV-positive patients. *Fam Pract* 1995;12:299-302.
- Helliwell PS, O'Hara M. Shared care between hospital and general practice: an audit of disease-modifying drug monitoring in rheumatoid arthritis. *Br J Rheumatol* 1995;34:673-6.
- Moody GA, Mann R, Gay S, Wicks AC, Mayberry JF. The gastroenterology service: a survey of general practitioners' requirements. *J Roy Soc Med* 1993;86:26-7.
- Sowden AJ, Sheldon TA, Alberti G. Shared care in diabetes. *Br Med J* 1995;310:1199-200.
- Dunning P, Moscattini G, Ward G. Diabetes shared care: a model. *Aust Fam Physician* 1993;22:1601-3, 1605-6, 1608.
- Pringle M, Stewart-Evans C, Coupland C, Williams I, Allison S, Sterland J. Influence on control in diabetes mellitus: patient, doctor, practice or delivery of care? *Br Med J* 1993;306:630-4.
- Hoskins PL, Fowler PM, Constantino M, Forrest J, Yue DK, Turtle JR. Sharing the care of diabetic patients between hospital and general practitioners: does it work? *Diabetic Med* 1993;10:81-6.
- Richman RM, Webster P, Salgo AR, Mira M, Steinbeck KS, Caterson ID. A shared care approach in obesity management: the general practitioner and a hospital based service. *Int J Obes Relat Metab Disord* 1996;20:413-9.
- FitzGibbon GM, Keon WJ. Shared care for open heart surgery: 21 years' experience. *Can J Cardiol* 1996;12:59-64.
- Forbes K, Foster S, Thomas I, Griffin A, Timms H. Sharing antenatal care: client satisfaction and use of the 'patient-held record'. *Aust NZ J Obstet Gyn* 1996;36:11-4.
- Turnbull D, Holmes A, Shields N, et al. Randomised controlled trial of efficacy of midwife-managed care. *Lancet* 1996;348:213-8.
- Tucker JS, Hall MH, Howie PW, Reid ME, Barbour HS, Florey CD, McIlwaine GM. Should obstetricians see women with normal pregnancies? A multicentre randomised controlled trial of routine antenatal care by general practitioners and midwives compared with shared care led by obstetricians. *Br Med J* 1996;312:554-9.
- Kirby RS, Chisholm G, Chapple C, Rudd C, Swallow M, Shore D. Shared care between general practitioners and urologists in the management of benign prostatic hyperplasia: a survey of attitudes among clinicians. *J Roy Soc Med* 1995;88:284-8.
- Morris SB, Pogson C, Shearer RJ. Shared care for benign prostatic hyperplasia: a feasibility study. *Br J Urol* 1995;76:77-80.
- Booth CM, Chaudry AA, Smith K, Griffiths K. The benefits of a shared-care prostate clinic. *Br J Urol* 1996;77:830-5.
- Williams PT. The role of family physicians in the management of cancer patients. *J Cancer Educ* 1994;9:67-72.
- Hooker L, Williams J. Parent-held shared care records: bridging the communication gaps. *Br J Nurs* 1996;5:738-41.
- Hammond, WE. Hospital information systems: A review in perspective. In: Van Bommel JH, McCray AT, eds. *1994 IMIA Yearbook of Medical Informatics*. Stuttgart: Schattauer Verlag, 1994:95-102.
- Buffone GJ, Beck JR. Facilitation of health care delivery through enhanced communications. *Int J Biomed Comput* 1994;34:349-55.
- Hasler J. The very stuff of general practice. *J Roy Coll Gen Pract* 1985;35:121-7.
- Tulloch AJ, Fowler GH, McMullan JJ, Spence JM. Hospital discharge reports: content and design. *Br Med J* 1975;4:443-6.
- Hull FM, Westerman RF. Referral to medical outpatients departments at teaching hospitals in Birmingham and Amsterdam. *Br Med J* 1986;293:311-4.
- Jacobs LGH, Pringle MA. Referral letters and replies from orthopaedic departments: opportunities missed. *Br Med J* 1990;301:470-3.
- Branger PJ, Van der Wouden JC, Duisterhout JS, Van der Lei J. Problems in communication between general practitioners and internal medicine consultants. *Med Inform* 1995;20:45-51.
- Ruwaard D, Hoogenveen RT, Verkleij H, Kromhout D, Casparie AF, Van der Veen EA. Forecasting the number of diabetic patients in The Netherlands in 2005. *Am J Public Health* 1993;83:989-95.
- Schellevis FG, Van der Velden J, Van de Lisdonk E, Van Eijk JTHM, Van Weel C. Comorbidity of chronic diseases in general practice. *J Clin Epidemiol* 1993;46:469-73.
- Branger PJ, Van Oers, RJM, Van der Wouden JC, Van der Lei J. Laboratory services utilization: a survey of repeat investigations in ambulatory care. *Neth J Med* 1995;47:208-13.
- White AJ, Barraclough B. Benefits and problems of routine laboratory investigations in adult psychiatric admissions. *Br J Psychiat* 1989;155:65-72.
- Bareford D, Hayling A. Inappropriate use of laboratory services: long term combined approach to modify request patterns. *Br Med J* 1990;301:1305-7.
- Lee PR. Models of excellence. *Lancet* 1994;344:1484-6.
- Van Weel C. Primary care tomorrow: teamwork. *Lancet* 1994;344:1276-9.
- Orton P. Primary care tomorrow: shared care. *Lancet* 1994;344:1413-5.
- Hickman M, Drummond N, Grimshaw J. A taxonomy of shared care for chronic disease. *J Public Health Med* 1994;16:447-54.
- Hampson PJ, Roberts RI, Morgan DA. Shared care: a review of the literature. *Fam Pract* 1996;13:264-79.
- Vivier BJ, Haimowitz I, Luciano J. *Workflow Requirements for Electronic Commerce in a Distributed Healthcare Enterprise*. Internal document. Niskayuna, NY: One Research Circle, 1996.
- Palaniswami D, Lynch J, Shevchenko I, Mattie A, Reed-Fourquet L. *Web-Based Multi-Paradigm Workflow Automation for Efficient Health-care Delivery*. Internal document. Wallingford, CT: Connecticut Healthcare Research and Education Foundation, 1996.
- Hempel RJ. Physician documentation of diabetes care: Use of a diabetes flow sheet and patient education clinic. *Southern Med J* 1990;83:1426-32.
- Tierney WM, Overhage JM, Takesue BY, Harris LE, Murray MD, Vargo DL, McDonald C. Computerizing guidelines to improve care and patient outcomes: the example of heart failure. *J Am Med Inform Assoc* 1995;2:316-22.
- Grol R. Development of guidelines for general practice care. *Br J Gen Pract* 1993;43:146-51.
- Safran C, Rind DM, Davis RB, et al. Guidelines for management of HIV infection with computer-based patient's record. *Lancet* 1995;346:341-6.
- Fridsma DB, Gennari JH, Musen MA. Making generic guidelines site-specific. In:

- Cimino JJ, ed. *Proceedings 1996 AMIA Annual Fall Symposium*. Philadelphia: Hanley & Belfus, 1996:597-601.
45. Grol R. National standard setting for quality of care in general practice: attitudes of general practitioners and response to a set of standards. *Br J Gen Pract* 1990; 40:361-4.
 46. Van der Lei J, Duisterhout JS, Westerhof HP, Van der Does E, Cromme PVM, Boon WM, Van Bommel JH. The introduction of computer-based patient records in the Netherlands. *Ann Intern Med* 1993; 119:1036-41.
 47. Branger PJ, Van 't Hooft A, Duisterhout JS, Van der Lei J. A standardized message for supporting shared care. In: Ozbolt JG, ed. *Proceedings of the 18th Symposium on Computer Applications in Medical Care*. Philadelphia: Hanley & Belfus, 1994:473-7.
 48. Branger PJ, Van der Wouden JC, Schudel BR, et al. Electronic communication between providers of primary and secondary care. *Br Med J* 1992;305:1068-70.
 49. Boydell L, McAllister B. European prototype for integrated care (EPIC). *Comput Meth Progr Bio* 1994;45:47-9.
 50. Rigby MJ, Roberts R, Williams JG. Objectives and prerequisites to success for integrated patient records. *Comput Meth Progr Bio* 1995;48:121-5.
 51. Jacknowitz L. West Virginia CONSULT: Enhanced information access for health care practitioners in a rural environment. *Ann NY Acad Sci* 1992;670:163-70.
 52. Essex B, Doig R, Renshaw J. Pilot study of records of shared care for people with mental illnesses. *Br Med J* 1990; 300:1442-6.
 53. Young A, Beswick K. Protocols used by UK general practitioners, what is expected of them and what solutions are provided. *Comput Meth Progr Bio* 1995;48:85-90.
 54. Moran WP, Messick C, Guerette P, Anderson R, Bradham D, Wofford JL, Velez R. A practice-based information system for multi-disciplinary care of chronically ill patients: what information do we need? In: Ozbolt JG, ed. *Proceedings 18th Symposium on Computer Applications in Medical Care*. Philadelphia: Hanley & Belfus, 1994:585-9.
 55. Light DW. Managed care: false and real solutions. *Lancet* 1994;344:1197-9.
 56. Overhage JM, Tierney WM, McDonald CJ. Design and implementation of the Indianapolis Network for Patient Care and Research. *Bull Med Libr Assoc* 1995; 83:48-56.
 57. Payton FC, Brennan PF, Silvers JB. Cost justification of a community health information network: The computerlink for AD caregivers. In: Gardner RM, ed. *Proceedings 19th Symposium on Computer Applications in Medical Care*. Philadelphia: Hanley & Belfus, 1995:566-70.
 58. Franks P, Clancy CM, Nutting PA. Gatekeeping revisited - protecting patients from overtreatment. *N Engl J Med* 1992;326:424-9.

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