● 专论：国外医学信息技术 ●

〔**编者按**〕 医学信息技术的研究、创新与应用在医学信息学领域一直具有重要的地位。医学信息技术是指利用计算机和信息技术进行医学信息采集、传输、管理和应用，从而为医学临床决策提供支持。其内容可涵盖所有与医学数据和知识应用相关的数据结构、算法、数据库系统、网络技术，以及以患者为中心的各类医疗信息系统，如医院信息系统、临床信息系统、医学影像存储与传输系统等。我国医学信息技术发展较之发达国家起步较晚，在理论与实践层面仍存在不少问题。他山之石，可以攻玉，多汲取其它国家医学信息技术发展的成功经验和失败教训能够帮助我们少走弯路，从而提高我国医疗信息化投资的效率。本期专论以"国外医学信息技术"为主题，内容包括信息和通讯技术在卫生机构中成功应用的关键因素、医院和区域卫生信息化发展，介绍国外医学信息技术领域的研究与实践，以期对我国医学信息技术发展提供借鉴。

Critical Factors for the Successful Introduction of Information and Communication Technologies into Health Care Organisations

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〔**Abstract**〕　　The paper discusses critical factors for the successful introduction of information and communication technologies (ICT) into health care organisations. The proven evidence around the world suggests that introducing health ICT is a mutual transformation process that actively involves people, organisation and technology. The key people factors include personal attributes of the change agent, user ownership and positive user attitudes. The organisational facilitators are adequate funding, strong leadership and project management, integration of IT with work practices, managing change and end user expectations, and end user training and support. User friendly and useful systems can be achieved by involving both management and frontline health care workers in requirements analysis, system selection or prototyping, development and implementation.

信息和通讯技术在卫生机构中成功应用之关键因素

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〔**摘要**〕　　讨论促进或阻碍信息和通讯技术在卫生机构中推广应用的关键因素。世界各国的经验表明，卫生信息技术的引进是一个需要人员、机构和技术相互沟通、适应、转变的过程。关键的人文因素包括：系统引进者的个人素质、系统使用者对技术的认同和态度；机构因素包括：财务投入、项目领导和管理的能力、系统使用的流程与卫生工作流程的吻合度、对技术引进过程中出现的变化情况的处理和对使用者的期望度的引导、用户培训和支持。只有将管理人员和医务人员都调动起来，参加到需求分析、系统选择和模型建立、开发及应用的全过程中才能建立起友好和高效的系统。

〔**关键词**〕　　评价；卫生保健；信息和通讯技术；卫生信息系统；实施；因素；成功

1　Introduction

Increasing consumer demand across a range of health care and treatment contexts has，and will continue to cause，managerial and clinical attention to the safety，quality and efficiency of health care services. Within the health system in the developed countries government support is being given to the introduction of funding and quality management systems underpinned by information and communication technology（ICT）.

While ICT has proven potential for improving health care quality，safety and efficiency，introducing ICT solutions into health care organisations for clinical purposes can be surprisingly difficult. Technical impediments have often been compounded by social and managerial factors[1]. The outcome of ICT implementation，whether success or failure，is usually not due to any single set of factors but rather a series of actions that generate a chain of responses[1]. Consequently，health ICT solutions are often seen as costly，difficult to use，disruptive to clinician communications and workflow. Berg[2] notes that the more comprehensive and complex the technology，the more difficult it is to achieve success.

To our knowledge，there are few detailed，systematic studies in China on the introduction of ICT solutions into health care organisations. There is a knowledge gap on

how to introduce health ICT solutions for improving communication processes，patient safety and efficiency，on what works and what does not work and why. The lessons learned from health ICT introduction around the world are canvassed in this paper in the hope that our findings will inform academics，hospital general managers and ICT managers in China to the complex social technical challenges that many other countries have already experienced. These experiences may help Chinese health care organisations to devise targeted，relevant and actionable management strategies to overcome the challenges.

To effectively organize the content，the critical factors for successful introduction of health ICT discussed in this paper are grouped into three categories：people，organisation，and technology.

2　People

Lorenzi and Riley[3] suggest that the major challenge to information system（IS）success is more often behavioral rather than technical. They believe that people with low psychological ownership and those who vigorously resist implementation can cause even a "technically best" system to fail. The personal issues that need to be considered include key actors' personal attributes，team members' expertise and management support，users' attitudes，expectations，skills and knowl-

edge[4]，communication skills，computing skills and system – related functional expertise[5]. These critical factors are discussed in the following sections.

2. 1　Personal attributes of the change agent

A study on the implementation of Electronic Medical Record System in a large Swedish teaching hospital found that previous experience and familiarity with the introduction of a similar system at another site enabled the project manager to successfully plan and organize the project[6]. Miller[8] suggests that the adoption of an Oncology Information System（OIS）in the Department of Radiation Oncology requires that a position be established within the department where the change agent can influence the implementation decision making；has a complete understanding of the processes involved and replaced；has full knowledge of the software's capabilities；has the time to investigate and customize the software to meet the local requirements；and possessing a personality that can encourage a group to meet a goal[8].

2. 2　User ownership and positive user attitudes

In any workplace the number of parties who have a stake in and influence on the health information system implementation is huge[2]. Coombs et al. [9] find that both user ownership and positive user attitudes are critical factors for the success of information system（IS）introduction into health care organisations. In fact，a positive user attitude is seen as an important predictor of system usage as it may influence user acceptance of the system，which may ultimately impact on user behavior[10]. User satisfaction with implementation strategies，processes and the introduced system are all indicators of system success.

3　Organisation

The most problematic aspects of system implementation and operation has been found to be organisational

factors. Successful implementation of ICT requires both good technical and good organisational skills[3]. The organisational issues that contribute to successful IS system implementation relate to change management and include time，motivation and context，integration，funding，meeting information needs and providing value to users，training and support，collaboration and trust，project management，and evaluation and learning[11]. Yellowless[11] suggests that both bottom up and top down management are required for successful implementation of change. Five broad organisational issues that must be addressed to promote successful ICT implementation are financing，interoperability，standardization and connectivity of clinical information systems，help with redesign of workflow，technical support and training and help with change management[12].

An essential aspect of implementation is staff motivation and overcoming resistance to change or lack of confidence in using the new technology. Organisational strategies known to cause staff resistance to uptake of new technology include lack of user involvement，poor communication，lack of attention to people and organisational issues and poor project planning[13].

3. 1　Funding

Management commitment to a project is central to its success. Baron et al. [12] suggest that financing is an essential component of information system implementation. These costs include hardware，network，software，staff training time and resources，trainers and system documentation，ongoing support services and materials to assist people to develop proficiency in using the system. Crosson et al. [15] also consider that financial incentives may have encouraged more ambulatory care clinics in USA to successfully implement e – prescribing than might otherwise have done so.

3. 2　Project management

When technological change is implemented within

a health service context that has relied on non – technology approaches it is not surprising that some people will find the situation threatening. The implementation of an IS system requires a whole – of – organisation change and thus a detailed plan is required[13]. If all staff members are to adapt to the new system and practice, there needs to be a well prepared plan that all understand and are willing to work to[6]. This requires a collaborative effort. Developers and implementers should work together during the planning stage to ensure the system is introduced in a non – threatening way. Clinicians should also be involved in advising on content and flow as well as modification of the system for their local departmental needs. A realistic timetable can only be determined following an assessment of the capacity of the organisation to change. Once the decision is made, and the implementation strategy designed and fully resourced, the implementation should be driven by top managers and departmental leaders, assisted by competent project teams involving information technology specialists.

Even with a comprehensive plan in place there will be unforeseen issues that need to be addressed at the project management level. Some of these issues have been identified by Ash et al.[14] who believe that there are eight types of unintended adverse consequences of introducing health ICT solutions: work flow, communication, dependence on technology, system demands, emotions, more work or new work, changes in the power structure and new kinds of errors.

Most of these problems stem from insufficient planning in the first instance as well as subsequent difficulties with resourcing or mis – calculation of the time that will be needed for ICT implementation. Common mistakes include using an implementation strategy or pattern which was successful in another organisation instead of using an approach designed for the new context. There is no evidence that an implementation plan that was successful in one organisation would be similarly successful in another because in each situation there are differences in organisational capacity as well as technical and resource deficiencies. As well, end users' expectations of ease of use, flexibility and the range of services that will result from the ICT will be different and therefore can affect uptake.

Funding is essential not only for the initial set up of the IS system, but also ongoing hardware and software maintenance and training support. Because technology is developing rapidly it is likely that system demands will constantly increase, making more work and new work inevitable; therefore adequate resources must be available on an ongoing basis and allow for technology upgrades and system development[14].

3. 3　Leadership

Some people will embrace change while others will be less keen until they have a better understanding or feel more confident. Such reactions can be interpreted as reluctance. However effective leadership can sharply reduce the resistance to change to achieve a more successful implementation[3]. Wyatt[16] believes that one of the most important factors determining success of the implementation is project ownership by senior managers, and clinicians[16]. Ideally, in a health care environment, a clinician should champion the implementation and ensure that other users are involved from the very beginning so that they share ownership of the project.

3. 4　Integration

Multidimensional integration is important for the success of health ICT systems. Well – integrated ICT systems make it possible for health care users to log onto the system once, access all the relevant information about their patients from anywhere at any time. This will significantly improve efficiency and usability of the system[17]. The ICT system should support health care users in maximizing their expertise and effectiveness rather than impede their professional activities.

3.5 Managing change

The introduction of ICT solutions into health care organisations is a complex and disruptive process, which may initially increase healthcare workers' workload[5]. While such projects are usually initiated by administrators wishing to establish a health information and monitoring system, perceptions by clinicians that there are few benefits for them or patients will be a major hurdle to overcome. Crosson et al. [15] believe that planning for managing the effects of ICT introduction on clinical workflow is important for encouraging the widespread adoption and effective use of an e – prescribing system by US ambulatory care clinicians.

Berg[18] describes introducing an IT solution into an existing work environment as a process of "convergence of tool and practice"; at one hand the IT system must be customized to accommodate the activities of the health workers; on the other hand the workers must also change their practices to accommodate the use of the system. Therefore, regular reviews and modifications to systems and timetables are required to respond to user needs in a timely manner[6]. For instance, in a US hospital, a facilitator for continuous qualify improvement was set up to document system problems and receive prompt feedback, thus allowing users to communicate problems to administrators on a timely manner[5].

3.6 Managing expectations through effective communication

Communication and coordination are crucial to the success of health information system implementation. Crosson et al. [15] surveyed 16 physicians and 31 staff members working in 12 ambulatory clinics in USA that had scheduled to implement e – prescribing system. They find that communication is important for managing end users' expectations. In that case e – prescribing systems were successfully introduced because clinician expectations of the system were that prescription work-

flow would be improved rather than a focus on reducing turn – around time to improve financial returns. On the contrary, where end – users had little preparation or had high expectations that the system would save time, function perfectly and not disrupt existing work practices, the e – prescribing system was not completely implemented or implementation discontinued or the system never installed.

An observational study conducted in the Veterans health care system in USA[5] recommends that strategies to increase usage of computerized clinical reminders include assigning responsibility for each clinical reminder to nurses or doctors; improving visibility of positive results from system usage, creating a feedback mechanism about the use of the system, and limiting the overall number of clinical reminders.

A system introduced into a large aged and community care facility in Sydney, Australia[6] first assessed workflow issues associated with clinical documentation as well as local management. The implementation goal was based on the expectation that continuity of records would be maintained during the transfer from a paper – based system to the IT system and also that the IT system would include all aspects of information needed for compliance with government regulations. This realistic expectation enabled the success of the project.

3.7 Training and support

A key component of success is the provision of adequate training and support[17]. Help that is continuously available and easy to obtain encourages system usage. McDonald et al. [7] found that some people are enthusiastic adopters of technology while others are not. This difference creates a change in status and power among workers. More senior workers who showed initial reticence did change following training and coaching tailored to their individual needs and learning pace so long as it was provided in a way that ensured privacy and dignity.

Encouragement and participation by advanced users can help to increase normal users' confidence in using

the new system if this is done in a supportive environment. System vendor representatives also play an essential role in training and support. Ongoing education and training encourages enthusiastic participation and commitment from clinicians and others and it was found that an onsite support/resource person or project manager facilitates implementation more effectively than visiting trainers[7].

Training materials need to respond to the needs of the end users in terms of essential IT system information, the complexity of language, and mode of information transfer. Limitations around technical documentation may lead to operational deficiency of IT systems.

4　Technology

In addition to fully satisfying the functional and non-functional requirements of health care organizations and workers, successful introduction of a health IT system is likely if the system is intuitive, user friendly, already well developed for clinical work and allowing flexibility for further development[6]. To ensure user acceptance, the IT system needs to fit with the workflow of clinicians[19], fit with the needs of the users and be well integrated into clinical work processes and be easily accessible[20].

The behavior of a health information system is usually complex and the more complex and novel the technology, the higher the possibility that the project will fail. Where users are not used to IT technology, usability becomes a critical factor that determines ongoing acceptance of a system[5] Technology factors that affect professional performance or output, such as slow computer speed or not enough or inconveniently placed workstations, lead to user di-satisfaction with the system.

As professionals in health care settings become more skilled at using ICT there is greater pressure on health informatics researchers to engineer health information systems and to deploy them effectively in complex settings and to adapt them to a range of user populations[21, 22]. User friendliness of a system can be achieved by involving users in system prototyping and development and integrating systems into the health care practice context. Further, as healthcare environments move to greater dependency on ICT there is a need to have comprehensive risk management strategies in place for downtime and data security.

5　Conclusion

The experiences of introducing ICT solutions into health care organisations in the developed countries suggest that this process is one of mutual transformation that actively involves people, organisation and technology. The key people factors include personal attributes of the change agent, user ownership and positive user attitudes. The organisational facilitators are adequate funding support for both system introduction and maintenance; strong leadership and effective change management; effective communication; effective training and ongoing support and seamless integration of the ICT solution into health care practices. The introduction of the change process needs to balance the need to promote the organisational change with consideration of people's capacity for adopting such change. User friendly and useful systems can be achieved by involving both management and frontline health care workers in requirements analysis, system selection or prototyping, development and implementation.

The above experiences will be useful to academics, managers of health care organisations and health information systems in China in their undertaking of the planning and introduction of health ICT solutions.

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