Electronic clinical practice guidelines: current status and future prospects in Hong Kong

Clinical decision support (CDS) systems are software programs that are designed to help in clinical decision-making by matching characteristics of individual patients to a computerised knowledge base, thereby customising assessments and treatment recommendations. A useful CDS system should enhance the medical workflow by providing relevant information, organising data in a useful way, and performing analysis in response to new data.[1,2] The objective of a CDS system is—by its integration into a clinical information system—to improve the quality of medical care and the clinical outcome by providing 'just-in-time' information and advice at the point of care. Clinical decision support systems may thus help in various aspects of patient management by providing diagnostic[3] and therapeutic or management support. Functions include the creation of alerts to inappropriate prescriptions and to abnormal biochemical laboratory, radiology, or pathology results, and provision of electronic clinical practice guidelines (eCPGs) that give patient-specific evidence-based recommendations.

Clinical practice guidelines

Clinicians are faced with overwhelming amounts of rapidly changing medical information. Hence, the use of CPGs derived from evidence-based clinical trials can reduce inappropriate variations in practice and foster best practice, thus improving the quality of health care and controlling costs. Clinical practice guidelines are widely distributed and easily accessible online; yet, adherence to CPGs remains suboptimal, perhaps because of information overload and heavy clinical workload.[4,5] A meta-analysis of randomised controlled trials of physician reminders has shown that eCPGs are effective when recommendations are patient-specific, are delivered at the point of care, and require an acknowledgement.[5]

Designing electronic clinical practice guidelines

Textual or narrative forms of CPG are available for many clinical conditions. To computerise CPGs, several variables warrant consideration.

Clinical setting

Wide variations in work practices mean that eCPGs are applied differently in different settings: implementing eCPGs in the out-patient clinic is likely to be very different to implementing eCPGs in the in-patient setting. For example, a trial of computer reminders to implement preventive care guidelines among hospitalised patients failed to increase the actual provision of preventive care, because physicians considered the out-patient rather than in-patient setting to be the appropriate place for the delivery of preventive care.[6]

Target group

Targeting the right clinicians is also very important. For instance, providing computerised heart failure CPGs to a cardiologist may result merely in substantial obtrusion in the workflow because of frequent eCPG reminder prompts with information already well known to the cardiologist. In contrast, junior doctors and non-specialists may find eCPGs more useful and may be more receptive to their implementation.

Format

Clinical practice guidelines may be in the form of algorithm, flowchart, checklist, or reminder. The algorithm and flowchart are capable of representing more complex guidelines, while the checklist and reminder are more suitable for simple guidelines.

Active or passive systems

In an 'active' system, eCPGs are automatically invoked in response to input clinical data or electronic orders. In a 'passive' system, eCPGs will be triggered only on request—for example, by providing a link to a website containing eCPGs such as the United States National Guideline Clearinghouse (www.guidelines.gov) or the United Kingdom National Institute for Clinical Excellence (www.nice.org.uk).

Computerisation of clinical practice guidelines

Computerising evidence-based management algorithms is an attractive approach to generating and using eCPGs. The successful use of eCPGs requires formal structured representation and unambiguous interpretation.[7] Most CPGs, however, are written in unstructured narrative form. In an effort to computerise a guideline for the treatment of heart failure, several obstacles were observed.[8] Firstly, the definition of heart failure relied on an echocardiographic criterion (the ejection fraction), which was not routinely used in the study institute. Secondly, some definitions were not clear-cut. For example, systolic dysfunction was defined as an "ejection fraction of <35%-40%"; a computer would not have been able to deal with an ejection fraction of, say, 38%. Thirdly, the algorithm branch points were not precise enough—for example, physicians were advised to modify therapy if symptoms deteriorated or if side-effects occurred, but it was not specified what constituted a side-effect or deterioration in symptoms. Fourthly, co-morbid medical illness and concurrent medications were not catered for by the system. Successful computerisation of algorithm-type CPGs requires further research.[9]

In contrast, eCPGs in the form of reminders have been successful. Multiple randomised controlled trials have confirmed that computerised reminders increase the delivery of preventive care in the out-patient setting.[5,10,11] A randomised controlled trial implementing four rule-based computer reminders for preventive care showed significant increase in the delivery of preventive care.[12] These systems use Arden Syntax,[7,13,14] which is designed to model the knowledge required to make medical decisions and is most suited for the generation of single-decision alerts and reminders.

Future challenges

In the future, structured authoring (tools that allow non-programmers to create eCPG),[6] structured data entry,[15] and unambiguous specification of decisions and actions are required.[6] To this end, expansion of the National Guideline Clearinghouse guideline classification system has been proposed.[16] Ongoing research includes structured authoring or representation of CPG for computer-based implementation.[17] Different representation models (eg Arden Syntax, PROforma, GLIF, PRODIGY, EON, DILEMMA, Asbru, and GUIDE) are being tested, and there is consensus about the importance of a common model.[7,18,19] Moreover, there is a growing interest in the integration of eCPGs into electronic patient records. Finally, the legal liability of a system that makes (or erroneously does not make) clinical recommendations needs further exploration.[4]

Considerations for Hong Kong

The Hong Kong Hospital Authority manages 43 public hospitals with over 28 000 beds. The Hospital Authority has built a clinical information infrastructure, the Clinical Management System, which supports direct clinician access for data entry, appointment bookings, electronic ordering of medication, laboratory and radiology tests, and electronic retrieval of test results.[20] The Clinical Management System has been implemented in the in-patient and out-patient settings in all Hospital Authority–managed hospitals and hence provides the basis for incorporation of an eCPG system, which could target common, chronic illnesses, such as diabetes mellitus, hypertension, and ischaemic heart disease.

Use of computerised reminders for diabetes mellitus

To study the feasibility and cost-effectiveness of incorporating eCPGs into the Clinical Management System, we are conducting a clinical trial to study the effectiveness of providing computerised reminders. The system, which is based on locally customised guidelines,[21] will advise on criteria for the referral of patients to a specialist diabetic clinic and will remind doctors to perform regular ophthalmology and biochemical tests, such as assessment of glycated haemoglobin (Hb_{A1c}) levels. The hypothesis is that eCPGs in the form of computer reminders will improve the standard of care and increase appropriate referrals and screening for patients with diabetes mellitus in general out-patient clinics.

When patients present to general out-patient clinics, the system will first check their eligibility for the use of the diabetes guidelines by looking for a diagnosis of diabetes mellitus or, as a proxy, a previous Hb_{A1c} result. For eligible patients, the system will then check the patient records to see whether there are any indicated tests, treatments, or activities. Doctors at the clinic will be allocated randomly to the intervention or control groups, and only doctors in the intervention group will receive the computer alerts.

Conclusion

The use of eCPGs could improve the quality of health care by providing standard and evidence-based medical care, and by avoiding unnecessary investigations or delayed referrals. Thus, eCPGs may benefit patients, clinicians, and the health care system. While active research is ongoing in informatics technology, the practical choice in Hong Kong is to adopt automated computer-generated reminders according to evidenced-based or expert consensus. Finally, although eCPG systems may be useful partners to clinical medicine, they should neither—and are not likely to—replace human expertise, nor should they have the final say.

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References

1. Teich JM, Wrinn MM. Clinical decision support systems come of age. MD Comput 2000;17:43-6.
2. Cheung NT, Wong KC, Chan JT, Leung CB, Lui SF. Quantifying the operational benefits of a Core Clinical Information System. Proceedings of the 4th Hong Kong (Asia-Pacific) Medical Informatics Conference; 1997 September; Hong Kong. Hong Kong: Hong Kong Society for Medical Informatics; 1997:147-52.
3. Berner ES, Webster GD, Shugerman AA, et al. Performance of four computer-based diagnostic systems. N Engl J Med 1994;330:1792-6.
4. Owens DK. Use of medical informatics to implement and develop clinical practice guidelines. West J Med 1998;168:166-75.
5. Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. JAMA 1998;280:1339-46.
6. Greenes RA, Boxwala A, Sloan WN, Ohno-Machado L, Deibel SR. A framework and tools for authoring, editing, documenting, sharing, searching, navigating, and executing computer-based clinical

guidelines. Proc AMIA Symp 1999:261-5.
7. Greenes RA, Peleg M, Boxwala A, Tu S, Patel V, Shortliffe EH. Sharable computer-based clinical practice guidelines: rationale, obstacles, approaches, and prospects. Medinfo 2001;10:201-5.
8. Tierney WM, Overhage JM, Takesue BY, et al. Computerizing guidelines to improve care and patient outcomes: the example of heart failure. J Am Med Inform Assoc 1995;2:316-22.
9. Zielstorff RD. Online practice guidelines: issues, obstacles, and future prospects. J Am Med Inform Assoc 1998;5:227-36.
10. Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventive care in the ambulatory setting. J Am Med Inform Assoc 1996;3:399-409.
11. McDonald CJ. Protocol-based computer reminders, the quality of care and the non-perfectibility of man. N Engl J Med 1976;295:1351-5.
12. Dexter PR, Perkins S, Overhage JM, Maharry K, Kohler RB, McDonald CJ. A computerized reminder system to increase the use of preventive care for hospitalized patients. N Engl J Med 2001;345:965-70.
13. Overhage JM, Mamlin B, Warvel J, Warvel J, Tierney W, McDonald CJ. A tool for provider interaction during patient care: G-CARE. Proc Annu Symp Comput Appl Med Care 1995:178-82.
14. Overhage JM, Tierney WM, McDonald CJ. Computer reminders to implement preventive care guidelines for hospitalized patients. Arch Intern Med 1996;156:1551-6.
15. Cheung NT, Fung V, Chow YY, Tung Y. Structured data entry of clinical information for documentation and data collection. Medinfo 2001;10:609-13.
16. Bernstam E, Ash N, Peleg M, et al. Guideline classification to assist modeling, authoring, implementation and retrieval. Proc AMIA Symp 2000:66-70.
17. Wang D, Peleg M, Tu SW, Shortliffe EH, Greenes RA. Representation of clinical practice guidelines for computer-based implementations. Medinfo 2001;10:285-90.
18. Dart T, Xu Y, Chatellier G, Degoulet P. Computerization of guidelines: towards a “guideline markup language”. Medinfo 2001;10:186-90.
19. Sim I Gorman P, Greenes RA, et al. J Am Med Inform Assoc 2001;8: 527-34.
20. Cheung NT, Fung KW, Wong KC, et al. Medical informatics—the state of the art in the Hospital Authority. Int J Med Inf 2001;62: 113-9.
21. A statement for health care professionals on type 2 diabetes mellitus in Hong Kong. Diabetes Division, Hong Kong Society for Endocrinology, Metabolism, and Reproduction. Hong Kong Med J 2000;6:105-7.