

- psychopharmacology and managed care. *Am J Psychother.* 1998 Winter;52:54-63.
6. Cerullo MA. Cosmetic psychopharmacology and the President's Council on Bioethics. *Perspect Biol Med.* 2006 Autumn;49:515-523.
 7. Rangel EK. Cosmetic psychopharmacology and the goals of medicine. *Virtual Mentor.* 2007 Jun;9:428-32.
 8. Svenaeus F. The ethics of self-change: becoming oneself by way of antidepressants or psychotherapy? *Med Health Care and Philos.* 2009 Feb;12:169-178.
 9. Stein DJ. Cosmetic psychopharmacology of anxiety: bioethical considerations. *Curr Psychiatry Rep.* 2005 Aug;7:237-238.
 10. Rothman DJ. Shiny, happy people: the problem with "cosmetic psychopharmacology." *New Repub.* 1994 Feb;210:34-38.
 11. Fournier JC, DeRubeis RJ, Hollon SD, Dimidjian S, Amsterdam JD, Shelton RC, *et al.* Antidepressant drug effects and depression severity: a patient-level meta-analysis. *JAMA.* 2010 Jan;303:47-53.
 12. Gibbons RD, Hur K, Brown CH, Davis JM, Mann JJ. Benefits from antidepressants: synthesis of 6-week patient-level outcomes from double-blind placebo-controlled randomized trials of fluoxetine and venlafaxine. *Arch Gen Psychiatry.* 2012 Jun;69(6):572-579.
 13. Kirsch I, Deacon BJ, Huedo-Medina TB, Scoboria A, Moore TJ, Johnson BT. Initial severity and antidepressant benefits: a meta-analysis of data submitted to the Food and Drug Administration. *PLoS Medicine.* 2008 Feb;5(45).
 14. Posternak MA, Zimmerman M. Therapeutic effect of follow-up assessments on antidepressant and placebo response rates in antidepressant efficacy trials: Meta-analysis. *Br J Psychiatry.* 2007 Apr;190:287-292.
 15. Turner EH, Matthews AM, Linardatos E, Tell RA, Rosenthal R. Selective publication of antidepressant trials and its influence on apparent efficacy. *N Engl J Med.* 2008 Jan;358:252-260.
 16. Rapaport MH, Nierenberg AA, Howland R, Dording C, Schettler PJ, Mischoulon D. The treatment of minor depression with St John's Wort or citalopram: failure to show benefit over placebo. *J Psychiatr Res.* 2011 Jul;45:931-941.
 17. Barbui C, Cipriani A, Patel V, Ayuso-Mateos JL, van Ommeren M. Efficacy of antidepressants and benzodiazepines in minor depression: systematic review and meta-analysis. *Br J Psychiatry.* 2011 Jan;198(1):11-16.
 18. Thase ME. The small specific effects of antidepressants in clinical trials: what do they mean to psychiatrists? *Curr Psychiatry Rep.* 2011 Dec;13(6):476-482.
 19. Ioannidis JPA. Effectiveness of antidepressants: an evidence myth constructed from a thousand randomized trials? *Philos Ethics Humanit Med.* 2008 May;3(14).
 20. Rao AR and Monroe KB. The effect of price, brand name, and store name on buyers' perceptions or product quality: an integrative review. *J Marketing Res.* 1989 Aug;26(3):351-357.
 21. Waber RL, Shiv B, Carmon Z, Ariely D. Commercial features of placebo and therapeutic efficacy. *JAMA.* 2008 Mar;299:1016-1017.

The benefits of open source electronic medical record (EMR) systems: OSCAR McMaster as a case study

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As medicine continues to be revolutionized by computer technology, open source software (OSS) is playing an important role in making available innovative, cost-effective solutions for the medical community. Source code is the set of instructions that make up a computer program. "Open source" refers broadly to any program built from source code that is openly published and licensed. Such software can be adapted or used in its original form and is licensed for use for any purpose, including for-profit enterprise. It is typically available free of charge and maintained by a community of contributors who volunteer their time to create and improve it. Everyone benefits from open source as it continues to underpin the majority of the internet's web servers.¹ Much of the world's commercial software

products are built using open source languages, including Facebook² and many of Google's products, such as the Android operating system.³ In addition to its use in private industry, open source also provides a platform for programmers to produce free software, thereby enabling the creation of alternatives to commercial products for various applications. In medicine, one exciting example of this phenomenon is the electronic medical record (EMR) system.

In general terms, EMR systems are computer programs that physicians use in the patient care setting to record information about patients and encounters, typically using the SOAP note format (Subjective, Objective, Assessment, and Plan). EMR systems have many features, ranging from appointment scheduling to chronic disease management, but they act primarily as a computerized replacement for paper records.⁴ Because EMR systems are associated with increased efficiency and improved

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patient outcomes, they are well-received by physicians and are increasingly essential to care delivery.⁵ This is exemplified in Canadian primary care adoption rates which have doubled to 54% since 2006.⁵ Such systems represent a significant expenditure of healthcare funds, worth an estimated \$54 billion US globally in 2014.⁶ For many Canadian physicians, EMR systems are an expense worth thousands of dollars per year, and choosing between an open source and a commercially developed EMR system can be a difficult decision.

By nature, open source medical software is designed for open data standards in an effort to achieve interoperability, or seamless interfacing between systems. Consider that commercial EMR vendors have a vested interest in keeping user data locked down in their own proprietary format specific to their EMR software.⁷ This helps them to retain subscribers, as customers are likely to encounter difficulties if they try to switch to a different EMR. Similarly, companies that develop EMR software will often have a monopoly on the provision of technical support, leaving the end user threatened by the possibility that the company might discontinue support or go out of business. They could also impose requirements on how and where patient data is stored, sometimes requiring that it be stored on their networks. With an open source EMR system, technical support is available from competing providers at negotiable rates.

Despite the lack of profit motive for open source programmers, there exists a sophisticated worldwide community of developers of OSS. They are motivated for diverse and often complex reasons, ranging from passion for a particular subject area to a desire to enhance their résumés.⁸ Such individuals are often industry professionals seeking to satisfy a niche software requirement, making them uniquely well-suited as designers. Indeed, physicians themselves contribute to open source EMR systems.

Privacy and security are perhaps the most crucial aspects of a software product designed to record and store medical information. By definition, open source code is openly published. This is tremendously valuable in that it enables total transparency of implementation and enhances security by facilitating the peer review and subsequent validation of the design of a software system.⁹ The only way to verify with certainty how patients' medical information is handled is to refer to the source code. In closed source, the code is compiled into binaries and its inner workings are thereby obscured. Thus clinicians who use an open source EMR system are granted total disclosure regarding its functioning before opting to use it, whereas users of closed source software are not. These users instead enter into a trust relationship with the provider of their software. OSS encourages good practices from the outset, as programmers are influenced by the awareness that their work will be accessible to others and subject to external audit. There is less temptation to rely on discredited practices sometimes seen in closed source, such as security through obscurity, or achieving security by relying on secrecy of design instead of accepted best practices.¹⁰ Beyond the software itself, most of the security of patient data in EMR systems actually depends on network configuration, data storage aspects such as physical storage location and encryption, and

user practices. So while there is no reason to expect that OSS is inherently less secure than closed source software, it is imperative for any EMR system that due diligence is followed. Users must be properly trained, and the services of a competent technical support provider are required to configure and operate the system securely.

The most obvious benefit of open source EMR software is that it is free in the sense that anyone can immediately access it online, download it, and use it without paying anything. There are no licensing fees. Commercial EMR systems available in British Columbia are subject to recurring licensing fees that are typically in the range of \$3,000 Canadian annually.¹¹ While the cost analysis for an EMR system includes far more than just licensing fees, there is evidence that OSS leads to an overall reduction in costs.¹²

The market for EMR systems has traditionally been dominated by commercial products, but there is a free, Canadian-made open source EMR option that is widely used across the country called Open Source Clinical Application Resource


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Because EMR systems are associated with increased efficiency and improved patient outcomes, they are well received by physicians and are becoming an increasingly essential component of care delivery.

(OSCAR) McMaster. The project was spearheaded by a Canadian physician, Dr. David Chan, and developed by the Department of Family Medicine at McMaster University. Since its inception in 2001, OSCAR has grown significantly and now has organized user groups, commercial technical support providers, and support from major institutions such as McMaster University. The OSCAR community is comprised of clinicians and software designers, so physicians who choose OSCAR for their clinic will not be alone. As of 2012, OSCAR EMR has more than 700 clinical users in British Columbia and has been favourably received.¹³

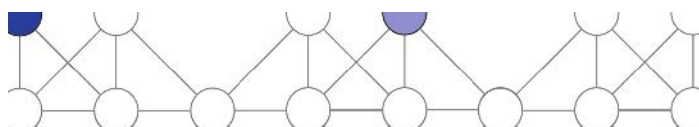
OSCAR is a feature-rich EMR system built on Java and MySQL. It includes a component called MyOSCAR, which functions as a Personal Health Record (PHR) that enables patients to participate more closely in their medical care. OSCAR stores patient data such that it may be migrated to a different system if desired, and it allows the clinician to make decisions about how the data is stored and managed. Furthermore, OSCAR has support for provincial billing and laboratory services, allowing for efficient exchange of information. Because it is web-based it can be used on any platform capable of supporting a web server or modern web browser. This means patient records can be created or accessed on virtually any platform, including Apple OS X, Microsoft Windows, Linux (an open source operating system), or even a smartphone. In 2012, OSCAR received certification from Canada Health Infoway, indicating that it meets or exceeds standards for privacy, security, and interoperability.¹⁴

Of course, opting for an open source EMR system has its drawbacks. Commercial EMR software is typically provided directly from a vendor as part of a streamlined solution that also includes installation and support. Clinicians who choose OSS must find a reputable technical support provider and might need to make more complex decisions about system configuration. Overall, it is probably the more technical option, and the additional autonomy desired by some could be seen as excess decision overhead by others. Furthermore, there are no guarantees. While technical support providers for OSS might guarantee the quality of their support services, they cannot reasonably make guarantees pertaining to the software itself. This is typically not the case with commercial vendors. As such, clinicians must have a high degree of trust in OSS in order to justify choosing it. If they encounter any software-related problems, only the open source community and third-party technical support providers will be available for assistance. Finally, in British Columbia, the Physician Information Technology Office (PITO) offered substantial subsidies totaling \$108 million Canadian for EMR adoption.¹⁵ However, only commercial EMR systems were chosen by PITO to be eligible for funding so clinicians who selected an open source system such as OSCAR would not have received financial assistance.¹⁶

Thinking beyond EMR systems, as technology continues to influence medicine, it is important to be aware of open source. Today's medical students are savvy and demanding users of technology, and the concept of open source is inherently appealing to a generation that is familiar with free software services and willing to adopt the latest technologies. Going forward, OSS will continue to help drive down costs both for those who use it and for those who do not, as commercial software must be sufficiently good to justify its expense if viable free alternatives are available. However, there is still opportunity to enhance collaboration between healthcare providers and open source developers to better meet the needs of patients and to find new applications for open source in medicine. By working together we can help to ensure that open source advances medical practice by driving innovation through the creation of quality, cost-effective software solutions. 

REFERENCES

1. Netcraft Ltd. September 2013 Web Server Survey [Internet]. Bath, Somerset: Netcraft Ltd.; 2013 [updated 2013 Sept 5; cited 2013 Oct 1]. Available from: <http://news.netcraft.com/archives/2013/09/05/september-2013-web-server-survey.html>
2. Protalinski E. Why Facebook hasn't ditched PHP [Internet]. [updated 2013 Feb 27; cited 2013 Oct 1]. Available from: <http://www.zdnet.com/blog/facebook/why-facebook-hasnt-ditched-php/9536>
3. Vaughan-Nichols SJ. Linus Torvalds on Android, the Linux fork [Internet]. [updated 2011 Aug 8; cited 2013 Oct 1]. Available from: <http://www.zdnet.com/blog/open-source/linus-torvalds-on-android-the-linux-fork/9426>
4. Skolnik NS. Electronic Medical Records. New York: Springer; 2011.
5. PricewaterhouseCoopers. The emerging benefits of electronic medical record use in community-based care. Canada Health Infoway. 2013.
6. Research and Markets. Global Healthcare Information Technology. Research and Markets. 2009.
7. Kantor GS, Wilson WD, Midgley A. Open-source software and the primary care EMR. *J. Am. Med Inform Assoc.* 2003; 10(6): 616.
8. Bonaccorsi A, Rossi C. Why open source software can succeed. *Res Policy* 2003; 32(2003): 1243-1258.
9. Fokkink W, Hoepman JH, Pang J. Increased security through open source. *Commun ACM.* 2007; 50(1): 79-83.
10. Scarfone K, Jansen W, Miles T. Guide to General Server Security. National Institute of Standards and Technology. Report number: 800-123, 2008.
11. Physician Information Technology Office. About EMRs: Vendors [Internet]. [Cited 2013 Oct 1]. Available from: <http://www.pito.bc.ca/about-emrs/vendors/>
12. Webster PC. The rise of open-source electronic health records. *Lancet* 2011; 377(9778): 1641-1642.
13. OSCAR Canada Users Society. About OSCAR: User Base [Internet]. Vancouver, British Columbia: OSCAR Canada Users Society; 2013 [cited 2013 Oct 1]. Available from: http://oscarcanada.org/about-oscar/brief-overview/index_html#user-base
14. Canada Health Infoway. OSCAR EMR version 12.1 achieves Canada Health Infoway certification [Internet]. Toronto, Ontario: Canada Health Infoway; 2012 [updated 2012 Dec 6; cited 2013 Oct 1]. Available from: <https://www.infoway-inforoute.ca/index.php/news-media/2012-news-releases/oscar-emr-version-12-1-achieves-canada-health-infoway-certification>
15. Physician Information Technology Office. Funding [Internet]. Vancouver, British Columbia: Physician Information Technology Office; 2013 [cited 2013 Oct 1]. Available from: <http://www.pito.bc.ca/funding/>
16. Figurski M. PITO: Why no open source? *B. C. Med. J.* 2008; 50(3): 122.



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