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Developing a Novel, Open Source EMR-Integrated Appointment Scheduling System for the Developing World

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Background and Purpose: Electronic medical record (EMR) systems streamline access to medical information and are important for strengthening continuity of care. EMRs do not, however, typically manage workflow associated with scheduling and monitoring patient visits. Integrating existing stand-alone scheduling systems with information stored in EMRs is error-prone and inefficient. Furthermore, functional criteria important to developing world health centers may not be addressed by systems designed for use in the developed world. An integrated system tailored to the needs of developing world health centers is necessary to efficiently use medical and clerical resources, improve quality of care, and decrease the burden of seeking healthcare for patients. This abstract discusses how these design requirements were developed into an appointment scheduling module for OpenMRS, an open source EMR. Software implementation at the Refugee Clinic in Tel Aviv is used as case study to demonstrate the module's value. The Refugee Clinic is staffed by volunteers and provides care to immigrants from Eritrea and Sudan; it can be considered a special case of a developing world health center.

Methods: Design requirements of an appointment scheduling module were established by a multidisciplinary, international team of health center staff, OpenMRS implementers, and computer programmers. An iterative development process that incorporated feedback was employed to be sure design criteria were met and that the final product was appropriate for use in health centers worldwide. The module was installed at the Tel Aviv Refugee Clinic. Three months after implementation, a user study was undertaken to assess staff understanding of the module and solicit feedback for improvement.

Results: An appointment scheduling module was developed and is available as an open source add-on to OpenMRS at modules.openmrs.org. Key software features include: scheduling patient appointments based on provider availability; operating a block or sequential scheduling system; "squeezing" a patient into a full timeslot; converting a patient appointment into a patient visit; managing a patient queue; gathering statistical data; and maintaining confidentiality. A user study revealed that the module was well understood, easy to use, and had a large and positive impact on resource utilization and efficiency. Concerns about error recovery and missing features were identified and addressed by subsequent software modifications. The module is being actively used, with 4,296 appointments scheduled at the Refugee Clinic in eight months. In the 90 days after public release, the software was downloaded 150 times, and positive feedback has been received from implementation sites in five countries.

Conclusions: We have developed a novel, open source appointment scheduling system that is fully integrated with OpenMRS. Our module links a patient's medical history with past and future appointments for improved follow-up. The scheduling algorithm developed is especially applicable to the workflows of the developing world, as validated during eight months of use at the Tel Aviv Refugee Clinic. There, a user study and feedback indicate that the module has improved resource utilization,

efficiency, and scheduling frustration amongst patients and staff. Additionally, previously unknown statistics, such as average appointment duration, are being generated and used to inform decision-making.

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