

## Appendix E

### Benefits and Limitations of FOSS EHRs

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#### Benefits

FOSS EHR systems can provide a number of advantages for physician practices relative to commercial EHR products.

***Lower Acquisition and Maintenance Costs.*** The software license fees for FOSS EHR systems are very low (even zero, if no commercial add-on modules are purchased). The bulk of the monetary costs, therefore, stem from hardware purchases, installation/support services, and software customization. Most practices (especially smaller ones) will be unable to install and support these systems without professional technical expertise. However, for all of the FOSS EHR projects reviewed, there exist at least several support firms available to install, configure, and maintain the applications on a contract basis. Although the number of these firms remains limited, the cost of an installation, support, and maintenance contract for a FOSS EHR is still significantly lower than the typical fees paid to proprietary EHR vendors for licensing, installation, and support. \* If the number of open-source installations increases, these costs could be reduced further through improved economies of scale. Given the public availability of source code for these projects, the barriers to entry are low for new companies wishing to provide installation and support services for FOSS EHR systems, which will likely prevent the costs of these services from increasing significantly even if the demand for FOSS EHRs increases significantly.

This report does not include specific cost data related to implementation and support, although information related to cost was collected. Given the limited number of support vendors and client sites that shared cost data for each FOSS EHR system, it was determined that these data were not reliable for purposes of comparing the FOSS EHR systems assessed. Nevertheless, collection occurred around 12 data points regarding implementation and support costs, and, in aggregate, these data suggested that the implementation costs range from \$5,000 to \$15,000 for a small practice site. As best as could be determined, this price range is lower than that generally charged by commercial EHR vendors.

***Greater Opportunity for Customizations and Enhancements:*** The public availability and open licensing models of FOSS EHRs enable physician practices with sufficient resources to fund any customizations and feature enhancements that they may need. With closed proprietary EHR products, in contrast, all customizations and enhancements depend on the vendor's development staff. As a result, modifications requested by individual practices are often long-delayed or never performed. The open-source model provides practices with the flexibility to implement such software changes using their own resources.

***Shared Development Costs:*** Under the open-source development model, all practices may benefit from the investments made by other practices to enhance the functionality of the system. For example, if one

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practice pays for the development of a digitized form that it needs to capture a specific type of encounter, all practices that need this feature will benefit when the code is publicly released. This advantage is greatest when the commercial or nonprofit organizations that perform the development work can encourage practices to sponsor solutions that are of general value, rather than highly specific to the practices' local needs.

***Decreased Barriers to Interoperability:*** Supporting data exchange standards or providing full access to application programming interfaces (APIs) is often not in the business interests of proprietary vendors. Publication of their technical architectures often subjects proprietary vendors to increased competition for related software products. In open source EHR projects, however, the source code and underlying data structures are already entirely open, by definition. Hence, these projects (even the commercial ones) include support for APIs, data relays, and web-services to allow their systems to more easily connect to other Health IT solutions. However, open architectures and API specifications do not unto themselves confer interoperability, which is achieved only when the technical specifications of messaging interfaces and APIs are aligned across FOSS projects. Such alignment is something that has yet to occur.

***Less Vulnerability to Vendor Failure or Product Termination:*** Second to cost, fear of vendor lock-in is the most common reason cited by physician practices for selecting an open source solution. There have been a number of well-documented examples of EHR vendor failures, product sunsetting, and forced upgrades. With FOSS EHR systems, these adverse events are of lesser concern because, in the event that a FOSS EHR vendor organization stops supporting an EHR system, the source code remains available and may be adopted by another firm (at least theoretically). This very situation, in fact, occurred with the failure of the Pennington Firm and subsequent adoption of the OpenEMR code base by PossibilityForge, which allowed practices to continue using their Open EMR systems.

## **Limitations**

Although there are clear benefits to using FOSS EHR software and many medical practices have now availed themselves of this option, these practices remain very much in the minority among health care organizations that have adopted clinical information systems. The reasons for this stem both from specific functional limitations among the available FOSS EHR systems and from certain challenges inherent in the FOSS EHR model, in general.

### **Functional Limitations of FOSS EHR Systems**

The detailed assessments of FOSS EHR systems revealed a number of consistent gaps in functionality. These gaps include a lack of focus on coded data, a lack of general decision support capabilities, a lack of open-source-compatible knowledge bases, and a lack of complete e-prescribing and laboratory ordering solutions. The leaders of these FOSS projects indicated that they are in the process of addressing some of these inadequacies, but others are likely to remain in the near future.

***Lack of Coded Clinical Data:*** The FOSS EHR systems reviewed here generally lack in support for coded clinical data, such as laboratory tests, medication codes, and even ICD-9 and CPT-4 billing codes, in certain cases. Some systems provide more coding than others, but on the whole collecting clinical data in a coded form amenable to analysis and decision support is not among the development priorities of the FOSS EHR projects. This is likely the case because support for coded data entry can add significant complexity to an EHR application (relative to free-text entry) and can slow the clinician workflow. Nevertheless, decision support enabled by structured and coded data is one of the touted

benefits of FOSS EHR projects, so it is surprising that the most prominent systems in use today do not support it well. Lack of focus on standard coding today will make the later implementation of complex decision support, integration into health data exchanges, and use of clinical data analysis tools more challenging.

***Lack of Rules Engines and GPL-Compatible Knowledge Bases:*** None of the FOSS EHR projects t assessed here in detail have a core rules engine for decision support. Simple decision support has been implemented in the context of data-entry forms, but this is usually confined to edit check logic that helps users fully and correctly complete forms. Although edit checks are beneficial and may even promote quality of care in certain cases, they cannot provide the quality-improvement and patient-safety benefits of full decision-support capabilities, such as drug-drug interaction checking or guideline-based reminders.

The greatest barrier to more sophisticated decision support capabilities is the absence of knowledge bases that are compatible with the open source license models used by FOSS EHR projects (i.e., GPL). Although a number of commercial knowledge bases exist, especially for drug-interaction checking, these resources are all proprietary and cannot be leveraged by FOSS EHR products without special fee-based licensing.

***Lack of Support for e-Prescribing and Electronic Lab Ordering:*** Currently, none of the projects reviewed in detail in this report offer e-prescribing or electronic laboratory ordering. Although all of the projects indicated that they are in the process of implementing solutions in these areas, they are being slowed by negotiations regarding NDAs and/or the appropriate treatment of proprietary assets within open-source projects. In the case of e-prescribing, most of the projects are awaiting approval of their implementation proposals by the SureScripts network. In the case of laboratory ordering, the large reference labs (i.e., Quest and LabCorp) are moving slowly towards offering lab-ordering connectivity to smaller practices that use FOSS EHR systems (although the same barriers may exist for small practices using proprietary EHR systems)

### **General Challenges of the FOSS EHR Model**

Beyond specific functional limitations, there remain significant general challenges in making the open source model work well for EHRs. It is likely that the following issues will need to be addressed before FOSS EHR systems are widely adopted among ambulatory physician practices.

***Physician Trust:*** FOSS still hasn't fully proven itself as a viable model in the health care market, and there is hesitancy on the part of many practices to implement the available solutions. One cause for these reservations is the lack of a large and well-capitalized project that builds, maintains, installs, and services a FOSS EHR solution. The FOSS EHR marketplace needs a vendor like RedHat, but all of the existing organizations are much smaller and less mature. Even with the opportunity to transfer open-source code to a new vendor in the case that a FOSS EHR organization fails, most physician practices are unwilling to risk the disruption of such a transition.

***Duplication of Effort:*** There is significant software development effort duplicated across the various FOSS EHR projects. Among the three major FOSS EHR projects available today (ClearHealth, FreeMed, and OpenEMR), each is built on the same LAMP architecture and all are open source. Yet, each one has a completely different database structure, different user interface, different APIs, and

incompatible add-on modules. There is no good reason for this state of affairs, and it exists to the detriment of physician practices using these systems because good solutions developed for one system do not work for the others, and interoperability among the systems is impeded. This duplication of effort wastes resources that would be better spent on addressing the gaps in functionality that exist for all of these systems.

***Paucity of Vendor Support:*** One of the most common arguments in favor of open source development is the ability of practice sites to fire the vendor if they are unhappy with the quality of service. This is only possible, however, if vendor alternatives exist. In fact, this study found a maximum of only three firms for any given FOSS EHR solution.

The paucity of support firms is, of course, a dilemma of cause-and-effect. The demand for FOSS EHR systems by physician practices is relatively low, which limits the number of firms providing support for FOSS EHR products. In turn, the small number of support options increases the risk and limits the adoption of FOSS EHR solutions by practice sites.

The lack of technical compatibility among FOSS EHR systems compounds this problem. The multiple overlapping projects divide the pool of support vendors as firms develop expertise in one project over another. The limited resources of the smaller support firms make such specialization necessary. If the FOSS EHR projects were to consolidate, practice sites might benefit from a larger pool of qualified support firms.

***Proprietary Libraries, Databases, and NDAs:*** It is very difficult for a FOSS EHR system to connect to proprietary resources in a way that is compatible with the GPL open source model. This challenge applies to resources such as electronic lab systems, e-prescribing networks, and decision support databases. The owners of these resources have non-disclosure requirements and licensing models that make it difficult, if not impossible, for FOSS EHR projects to leverage the resources while remaining faithful to the openness of the GPL licensing model.

In some cases, a FOSS EHR project will forego the functionality provided by these resources until a comparable open-source solution can be found. In other cases, a project will implement the proprietary service and release the solution under a less open license than the standard GPL. Doing so allows the third parties to keep their code proprietary while allowing distribution of their assets as part of an open-source system.

A common example of this situation is the use of CPT codes within FOSS EHR systems. These codes are a necessary part of most medical practice's business, but the FOSS EHR supplier cannot count on these codes being available because they must be licensed from the American Medical Association. Since the application cannot count on a certain set of data being available, core system functionality cannot be developed that relies on these data.

As another example, Quest Diagnostics requires EHR vendors to sign a non-disclosure agreement (NDA) prior to viewing its specifications for interfacing to Quest's laboratory information systems. No exceptions are made for FOSS EHR systems. The terms of the NDA prevent a FOSS EHR system from publishing any source code that reveals the interfacing specifications. In certain cases, this impediment can be overcome with the use of a compiled binary library that performs the operations covered by the

NDA, although technically these libraries cannot be included with the other GPL-licensed code (i.e., they are incompatible with the GPL license).

***Increased Costs for Early Adopters:*** All of the FOSS EHR projects reviewed above started as practice management systems with basic patient registration and scheduling features only. As practices began to use these systems, they identified deficiencies in the applications and requested feature enhancements. However, because most FOSS EHR projects have little investment capital (owing to their non-proprietary nature), physician practices had to explicitly fund these product enhancements. These early adopters, therefore, had to pay for the development of important features that were already present in proprietary commercial systems.

For example, the Primary Care Coalition of Montgomery County, M.D., paid a significant amount to ClearHealth to add clinical functionality to its EHR product, perhaps as much as it would have cost to implement a commercial EHR product that already had these features. Although PCC was willing and able to undertake this investment, many other early adopters of FOSS EHRs may not be, and this early adopter penalty may create a barrier for wider EHR adoption given the remaining gap in functionality between FOSS EHR systems and state-of-the-art EHRs.

Some commercial FOSS EHR projects can reduce the early adopter penalty if they are part of a larger firm with the resources to fund the development of critical features. However, even these firms need to realize a return on investment from their FOSS EHR projects fairly quickly, usually through revenue from sponsored development projects. Therefore, the firms are not likely to implement all of the functionality that the typical physician practice may need, just enough to generate interest in their system among prospective clients.

### **Potential Roles for CHCF**

Given the remaining gaps in functionality and general challenges inherent in the market for FOSS EHRs, there are a number of actions that could be taken to enhance the appeal and increase the use of open source EHR systems among ambulatory practices.

***Awareness Raising:*** There may be limited awareness among small practices that a FOSS EHR system can provide them with much of the functionality of a proprietary system at a fraction of the cost. It may be beneficial to simply publicize the availability of FOSS EHR systems and their relevant benefits and limitations among physician practices. For example, all of the systems this study reviewed in detail provide comprehensive practice management capabilities and varying degrees of integrated support for clinical data management (usually basic). This level of functionality may be adequate for many practices interested in implementing EHR solutions, and it could provide a foundation for greater clinical functionality in the future. Additionally, the hosted options offered by certain of the projects would be a suitable introduction to EHRs for very small practices. Finally, most of the FOSS EHR projects enable practices to engage in extensive remote test drives of their systems, which may be more appealing to practicing physicians than attending a trade show or receiving a sales call from a commercial vendor.

***Knowledge Base Development:*** All of the FOSS EHR projects would benefit from a sustainable, open-source-compatible library of decision-support logic, particularly for drug-interaction checking. Although a number of proprietary drug knowledge bases exist, such as Cerner-Multum, FirstDatabank, and Medispan, obvious barriers exist to incorporating these proprietary resources into pure open source

systems. As the closest approximation, the EHR vendor E-MDs makes a copy of its drug knowledge base available under a pseudo-open-source license. However, E-MDs retains copyright to this work and requires that license fees be paid if it is used as part of any commercial offering (including an open source system).

This gap could be addressed through the creation and sponsorship of a community-developed and open source drug-interaction database. One model to consider is that of Wikipedia, in which the drugs and interactions could be edited and amended by registered pharmacists through a wiki-style interface. Ideally, the data structures, programmatic interface, and distribution mechanisms of this knowledge base would be independent of any specific open source EHR. Although this endeavor would entail careful consideration of quality-assurance and legal liability issues, its significant benefits may be worth pursuing.

***Facilitating Cooperation Amongst FOSS EHR Projects:*** As mentioned above, the FOSS EHR market is unnecessarily fragmented. Development effort is wasted on re-inventing the wheel, and scarce resources are spread too thinly over the multiple FOSS EHR projects. To foster cooperation and coordination among these projects, FOSS EHR project leaders and implementers could be convened to specifically discuss greater coordination and the potential synergies thereof.

While it is unrealistic to expect project leaders to abandon their current development silos, they may be come to agreement on ways to allow their systems to better work together. For example, simple agreement on standard data formats for interoperability would be a worthwhile achievement. A greater innovation would be agreement on certain programmatic interfaces that allow custom software modules to work within multiple systems. Common support for such interfaces would allow forms, modules, or reports developed for one FOSS EHR system to be used within others. Technically achieving this level of interoperability would certainly be challenging, but potentially very worthwhile.

Finally, leaders from all FOSS health information technology projects could be invited to share their experiences and technical innovations in open source software. For example, the Indivo and Tolven projects have innovative solutions for the use of coded data and document standards that may be useful to other open-source projects.

***Registry of Support Vendors and Software Modules for FOSS EHR Systems:*** To assist practices in finding third-party support firms for various FOSS EHR systems, an online registry could be developed to provide a roster of vendors along with their service offerings and pricing. A search feature would allow practices to find vendors in their areas and to view the different services and pricing offered.

Such a registry could also contain a list of the newest features and add-on modules offered by the FOSS EHR projects, as well as user reviews of these resources.