OFEK Virtual Medical Records: An Evaluation of an Integrated Hospital-Community Online Medical Information System

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The study was funded with the assistance of a research grant from the Israel National Institute for Health Policy and Health Services Research
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Executive Summary

1. Background
With health care becoming increasingly complex, there is a growing need for information about patients to be shared among the various treatment settings. In 2005, Clalit Health Services began an incremental process of implementing OFEK – an integrated, hospital-community online information system containing computerized medical data from a variety of sources (e.g., laboratories, diagnostic systems and computerized medical records). Even before the system was introduced, Clalit already had sophisticated health information technology (HIT) systems in both its community clinics and hospitals. The uniqueness of the system is in its ability to gather data from medical service providers and compile them into a standard virtual "dossier" for each patient (virtual medical records) that can be accessed by the physician at the place of treatment within seconds. OFEK makes it possible to have a two-way link between computerized records in hospital and community settings.

The implementation of an integrated information system such as OFEK is one of the ways to address the need to contain costs and the demand to improve quality of care. Such a system could reduce medical errors and repeat testing, and improve communication between hospital and community physicians, thereby making treatment more efficient and enhancing quality of care.

2. Study Goals
1. To examine the extent that OFEK was being utilized
2. To examine the effect of the introduction of OFEK on selected quality indicators and the utilization of medical services
3. To examine whether the intensity of the utilization of OFEK influences the impact on quality indicators and the utilization of medical services.

3. Methodology
The methodology section of the study report presents the way in which the utilization of OFEK was measured as well as the outcome measures selected. The section also provides information about the strategy for evaluating OFEK's impact in the community and in the hospital settings.

**Evaluating the Extent of Utilization of OFEK**
To evaluate the intensity of utilization, the study examined the frequency with which OFEK screens were consulted and the contents viewed on the screens. It also examined the association between various characteristics of the physician and the organizational unit (clinic, department or hospital) and the extent of utilization.

**Measures for Assessing Outcomes**
In cooperation with professionals at Clalit Health Services, the study identified indicators of quality of care and measures of utilization of Clalit's medical services that could be affected by
the flow of information between hospitals and community clinics through the virtual medical files.

**Strategy for Evaluating OFEK's Impact**

In order to examine the impact of OFEK's adoption by the organization, in both the community and hospitals, the study examined the changes in the outcome measures in the experimental group as compared with a control group (based on outcomes measured before and after the introduction of OFEK). The composition of the control group differed between the community and the hospital components of the study.

**a. Design of the Community Component of the Study**

In the community, T₀ ("before") was the third quarter of 2004 and T₁ ("after") was the third quarter of 2005. The experimental group included the clinics in which OFEK was operating during the study period, while the control group was made up of other clinics where the system had not yet been implemented. This design was possible due to the gradual introduction of OFEK into the community clinics.

Some of the clinics were in the catchment area of hospitals with OFEK, others not. However, even those not in the catchment area were able to benefit from online information from multiple sources within the system for all of their patients and had patients who were admitted to hospitals with OFEK (although not to the same extent as clinics within the catchment area of hospitals with OFEK). To evaluate OFEK's impact on patterns of care in the community, the study carried out analyses at three levels:

- First, the average impact of OFEK on all Clalit community clinics was examined.
- Second, the analysis was restricted to clinics within the catchment areas of hospitals using OFEK (6 hospitals under Clalit management and 2 government hospitals), as they were the clinics likely to benefit the most from the information flow between hospital and community.
- Third, the analysis was further restricted to those clinics within the catchment areas that used OFEK most extensively (those in the upper quartile of screen consultations).

For each level of analysis, a control group that matched the experimental clinics across a range of characteristics was selected. At T₀, despite some differences, the characteristics of the two groups were quite similar. To control for differences in background variables, the study used the "nearest neighbor matching" method to match the experimental and control groups. This method enabled us to match every clinic in the experimental group with one or more clinics in the control group having as similar characteristics as possible (background characteristics of the clinic, the patients registered at the clinic and the physicians working there). The difference between the changes in outcomes in the experimental group and between T₀ and T₁ in the control group was examined by difference-in-differences (diff-in-diffs) analysis. In this way, it presents the "net" effect of the introduction of the system and neutralizes the differences in the outcome variables between the experimental and control groups at T₀.
b. Design of the Hospital Component of the Study
In the hospitals, T₀ ("before") was the third quarter of 2003, while the "after" periods were the third quarter of 2005 (T₁) and 2007 (T₂). The study focused on the general surgery and internal medicine departments and the emergency rooms (ERs) in 6 Clalit hospitals. The experimental group consisted of patients in those departments who were members of Clalit. The control group consisted of patients who were members of other health plans and thus could not have virtual medical records created for them by OFEK, as it is used only by Clalit.

OFEK's impact in hospitals was analyzed at two levels. At the first level, the study analyzed data on all the above departments. At the second, the analysis was limited to the departments that used OFEK extensively (those in the upper quartile of screen consultations).

As in the analysis of community clinics, the "nearest neighbor matching" method was used to select the control groups on a broad range of characteristics (demographic background characteristics, complexity of illness and type of illness). As a result, there were almost no significant differences in background characteristics between the two groups. As before, the study examined the difference between the experimental and control clinics in the change of outcomes between T₀ and T₁ by using diff-in-diffs analysis.

4. Main Findings
The findings are presented first for community clinics, and then followed by the findings for hospitals. We present the estimated impact of the programs on the various outcome measures as reflected in the comparison between the changes in the experimental and control groups as identified through the diff-in-diffs analysis.

a. Findings from the Community Clinics
• Extent of utilization: The study examined the utilization of OFEK over the period 2005–2008. The utilization of OFEK in the clinics greatly increased between 2005 (start of project) and 2006 and continued rising over the following two years, albeit at lower rates. The highest utilization rates (especially of screens showing clinical results) were at clinics in catchment areas of Clalit hospitals.

The study presents first the outcomes in the community for clinics in the catchment area of hospitals with OFEK that made extensive utilization of the system. We then present the results for all clinics in the study.

Impacts in the Clinics in the Catchment Area of Hospitals with OFEK that Made Extensive Utilization of the System
• Imaging tests: The introduction of OFEK was associated with a significant decline of 12% in the total imaging tests conducted at the clinic. Out of the 27 imaging tests examined, there was a significant decline in the quantity of tests for 13 of them. The change in all of them was greater than 10%. For four tests (dorsal spine X-ray, ribcage X-ray, nasal cavity X-ray, and...
abdominal imaging to track the passage of a contrast medium through the small intestine, there was a decrease of 30% or more.

- **Lab tests**: There were mixed trends regarding lab tests. OFEK did not bring about a statistically significant decline in the overall quantity of lab tests at the clinics. However, when we examined this measure by type of test, we found the following: a significant decline in 12 lab tests (e.g., thyroid function, protein in urine and protein in blood) and a significant increase in 4 lab tests (e.g., blood type testing). There was no significant change in the remaining 22 tests.

- **Quality indicators**: At the same clinics, OFEK was associated with improvements in 8 of the 17 indicators of quality in the community that were chosen for examination as they were likely to be affected by the flow of information between hospitals and community clinics (e.g., improvement in the rates of eye testing for diabetics and hospital admission rates for patients with heart failure).

- **Visits to emergency room, hospital admissions and medication**: The introduction of OFEK did not affect the total number of hospital outpatient visits, visits to ER, hospital admissions and medication prescribed by physicians, insofar as we did not find a significant difference between the changes in the experimental clinics and those in the control clinics regarding these measures.

**Outcomes in Other Clinics**

- An examination of the impact on outcomes at the level of all clinics in the catchment areas of hospitals using OFEK, or all clinics in the study, revealed a weaker impact on regarding imaging, lab tests and quality of care.

**b. Data from the Hospitals**

- **Extent of utilization**: The use of OFEK in hospitals increased significantly each year albeit not to the same extent as in the community clinics. As expected, we found that hospitals that also used OFEK as their basic computerized medical-record system made greater use of the system than other hospitals did.

**Impacts in all Hospital Departments**

- **Lab tests**: The introduction of OFEK in the internal medicine departments resulted in a decrease in the quantity of lab tests. Between 2005 and 2007, there was a significant reduction of 6% in the quantity of lab tests performed in internal medicine wards in the experimental group, compared with the control group. The impact by type of test ranged from 2%–11%. No impact was found in the departments of general surgery.

- **Imaging tests**: No impact was found on the quantity of imaging tests such as upper and lower abdominal sonar imaging, ribcage X-rays and kidney sonar for inpatients in either internal medicine or general surgery departments. However, there was a decline in the internal
medicine departments of 20% in the average quantity of 3 tests – CT scans of head, abdomen/hip, and chest.

The hospitals did not have relevant quality indicators that we could use to examine OFEK's impact on quality of care. The service utilization indicators – for ambulatory hospitalizations with no overnight stay, repeat hospitalizations and the percentage of hospitalizations among all ER Patients – served not only as indicators of utilization but also, to a limited extent, as indicators of certain aspects of quality of care.

- **Ambulatory and repeat hospitalizations**: No impact was found on ambulatory hospitalizations (hospital admission with no overnight stay) or emergency repeat hospitalizations (within a week of discharge) to internal medicine or general surgery departments.

- **Rate of hospital admissions out of all ER patients**: No impact was found on the hospitalization rate of patients presenting at emergency rooms.

### Departments Making Intensive Utilization of OFEK

- In general, the direction and magnitude of the impacts on the wards with high OFEK use were similar to those reported above for all hospital wards. One exception was internal medicine departments. In these departments, there was a much greater impact in wards with more intensive utilization on the average quantity of the 3 CT scans. In addition, there was a considerable and significant decrease in the average number of ambulatory hospitalizations (with no overnight stay) between 2006 and 2007 as well as on the number of abdominal sonar tests between 2003 and 2005.

### 5. Discussion

When we began the evaluation of OFEK, we encountered two contradictory views:

1. One was that OFEK is expected to have a considerable impact on service utilization and quality of care.

2. The second was that OFEK is not expected to have a large impact on quality of care and efficiency of services, because few physicians would use it and because the information about what is done in hospitals could not truly contribute to what is done in the community, and vice versa.

The findings reveal a more complex picture. OFEK's introduction into community clinics and hospitals had significant impact on a number of important outcome measures. These impacts could have considerable medical and financial implications. However, less impact was found on a number of other important outcome measures. The impact was greater in community clinics than in hospital departments, perhaps due to the two different study designs and the different measures utilized in each of them.
However, there are several limitations of the study, which may have prevented us from realizing the full extent of the impact. Due to the pace at which the system was introduced into the community, the timeframe for comparing experimental and control clinics was relatively short, which limits the ability to assess OFEK's longer-term impact in the clinics. This is supported by the fact that the utilization of OFEK increased with time – both in the community and in hospitals – and that the extent of its impact in hospitals where the system was examined for a longer period increased with time. We also found that OFEK had a stronger impact in clinics where it was more extensively utilized. Thus, as time passes and additional clinics increase their use of OFEK, the impact can be expected to increase.

In addition, the study was confined to examining service utilization and medical quality indicators already available in the Clalit database. There may be additional impact indicators that should be defined and measured in order to fully examine all the possible benefits.

6. Contribution of the Study
The study makes an important contribution to the professional literature on the impact of information systems on health services. Few studies have examined organizations that have introduced online systems integrating information from multiple electronic data sources in the hospital and the community. The findings of the study can be utilized to inform decisions regarding how much to invest in the development of such systems by the health plans as well as in Israel's national medical records project. It can also contribute to the development of the methodology for evaluating a broad range of computerized medical information systems in Israel and abroad.

7. Directions for Action and Further Study
Clearly, strengthening utilization of the system is an important step in enhancing its contribution. Thus, the further exploration of ways of enhancing utilization is an important direction. One step that has already been taken in Clalit is the introduction of a new computerization platform that will facilitate the use of information systems by the physicians, including OFEK. Furthermore, it is important to consider the examination of additional outcome measures that can provide a fuller perspective on the benefits of the program.

The study demonstrates the benefits of the flow of information between hospitals and community clinics and shows that the information originating in hospitals contributes significantly to medical quality indicators and the utilization of medical services. The same is true, but to a lesser extent, in the reverse direction. Another aspect that should be examined is the costs of the program, in order to provide a broader basis to assess the benefits in relation to the cost.
Acknowledgments

A great many people assisted us in preparing and conducting the study and writing the report and we are grateful to them all.

Firstly, we thank Dr. Ehud Davidson, head of the Hospital Division of Clalit Health Services, and Dr. Orit Yakovson, head of Clalit's Community Division, who gave time and thought to our meetings with them to discuss the study design and implications.

We are grateful to the many professionals at Clalit Health Services who helped us with various aspects of the study at different stages: Nurit Huller, Daniel Mustacchi and Rachel Berkovich, who introduced us to OFEK and helped us to understand the system. Particular thanks to Nurit Huller, for preparing the Track Log files, which document and retrieve entries into OFEK screens, and Amit Nachman, who helped us plan and organize the hospitalization files for the study. We also thank Felice Antebi for her help designing the community component of the study. Warmest thanks to Erez Battat for his hard work preparing the community-clinic and hospitalization data files.

We extend our thanks to Prof. Itamar Shalit and Dr. Shlomi Codish – and above all to Dr. Julian Zelingher and Dr. Gideon Stein – who helped us formulate measures of quality and service utilization for the hospital departments we examined, and to Noa Catz for her help formulating equivalent measures for the community clinics. We also express gratitude to Dr. Ran Balicer and Sigal Regev-Rosenberg for their useful comments on our findings about community clinics and Dr. Eytan Wirtheim, Prof. Haim Bitterman, Dr. Jacob Dreier and, again, Dr. Julian Zelingher for their comments and insights about the study findings regarding the hospital departments.

Finally, we thank our colleagues at the Myers-JDC-Brookdale Institute who helped us throughout the study, above all Dr. Assaf Ben-Shoham, who worked with us and served as methodology advisor for this complex study, Prof. Revital Gross for her helpful insights, Prof. Jack Habib, director of the Institute, Bilha Allon, who edited the report, and Leslie Klineman, who prepared it for publication.
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