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THE IMPACT OF INFORMATION TECHNOLOGY ON ADMISSION DECISIONS

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Abstract

Information systems have been adopted in many fields, no less so in the health industry. Indeed, keeping abreast of the advances of the technological age, many medical organizations have invested heavily in information technologies (IT), aiming at improving medical decision-making and increasing its efficiency. Despite their obvious advantages, the systems do not always immediately provide the vital medical information required for critical decision-making, and the decisions that are based on this partial information may result in a decreased level of quality of care and unnecessary costs.

The objective of this research is to evaluate the contribution of IT to decision-makers (physicians) at the point of care of emergency departments (EDs) by investigating whether the information systems (IS) have improved the medical outcomes, in the complex and highly stressful environment of the ED, with time constraints and overcrowding.

We evaluated the contribution of the medical information to admission decisions by using two research methods: the track log-file analysis (with statistical tools) and an experimental study. The results were obtained using a unique database containing 3,219,910 referrals to the ED on seven main hospitals in Israel. Our results lead to the major conclusion that viewing medical history contributes to many clinical and admission decisions and clearly reduces the number of avoidable admissions.

Keywords: Medical Informatics, Medical Decision-Making, Health Informatics

1. INTRODUCTION AND MOTIVATION

The healthcare sector has been investing heavily in IT in recent years (Goldschmidt 2005), with the purpose of improving medical decision-making and increasing its efficiency through improved medical processes, reduced costs and the integration of patients' data. Despite the advantages of such systems, the information that can be immediately accessed from the systems located in many of the hospitals' EDs is generally merely partial. The systems do not always immediately provide the vital medical information required for critical decision-making, and the decisions may result in a decreased level of quality of care and unnecessary costs.

In the framework of this research, we examined the value of information which is derived based on the medical history of patients that is provided to a decision-maker in the high-stress environment of an ED, with its complex conditions for providing medical care, such as different levels of time pressure and huge numbers of patients. In addition, we tried to explore the circumstances under which this information makes a greater contribution to the quality of a decision.

2. BRIEF BACKGROUND AND LITERATURE SURVEY

The background is divided into two sections: the impact of information on decision-making processes and the impact of medical information on medical decision-making.

The first section is relatively traditional and has been studied over the years. It introduces the reader to a discussion on the assessment of the value of information. The second section clarifies the unique character of this research with its many intersecting fields from various disciplines such as: management information systems, medical information systems and decision theory.

2.1 The Evaluation of Information in Decision-making Processes

Ahituv (1989) presents the three commonly accepted types for evaluation of information: subjective, realistic and normative.

The subjective assessment of information - The subjective assessment of information is based on the assessments of decision makers during their use of IS (Examples: Neuman et al. 1979, Sella 1990, Raban 2007).

The realistic assessment of information - A realistic assessment of information is obtained by measuring the difference in performance between the situation with receipt of information and the situation without receipt of information (Examples: Dickson et al. 1977, Ahituv et al. 1998, Lee et al. 1999, Geri 2003).

The normative assessment of information - A normative assessment of information is derived from normative models and from the predicted behavior of the decision maker (Examples: Simon 1972, Kahneman et al. 1979, Ahituv 1980, Ahituv 1981, Ahituv et al. 1984, Marschak et al. 1986, Ahituv et al. 1989).

These previous studies showed that none of the approaches mentioned above is completely faultless. Each has its advantages and disadvantages and the approach chosen must be the one that is most appropriate and efficient under a given circumstances (Ahituv 1989). In the framework of this research, we examined the realistic assessment of information derived from the medical history of patients that is provided to a decision-maker in the environment of an ED.

2.2 The Impact of Information Technologies on Medicine

The effects of medical IS at the point of care have been studied in previous research from different aspects. Yet, despite the increasing use of these systems by clinicians, there has been little research

documenting the effectiveness of their use. Especially rare are studies dealing with the impact of real-time medical systems on the process of decision-making in the stressful ED environment.

Theoretical frameworks to assess the potential value of medical information have been established only in the recent years (Claxton et al. 2005, Basu et al. 2007). Claxton (2002), Walker et al. (2005) showed that interoperability between healthcare providers would enable computer-assisted reduction of redundant tests and found positive financial returns. Shabtai (2006) evaluated the contribution of IT to improvement in the medical decision-making processes and concluded that physicians with different expertise use different information components from medical IS and that the medical history of patients can improve decision-making and its outcomes in the internal medicine departments. Our research contributed to the field by focusing on the stressful point of care - the environment of an ED with all its units. The expansion in our research includes analyses of decision-making such as: admission decisions and choosing the proper diagnosis. In addition, we innovatively included in the research a unique DB of referrals of patients to the DE which consists of all relevant population for our study, rather than be satisfied with modest samples which only partially represent a valid population, as performed in the previous studies.

The impact of using information systems on medical decision-making has been studied in past research. We show below some interesting results which support our research:

- The introduction of additional information and care options increases decision complexity (Redelmeier et al. 1995).
- Physicians retrieve only limited amount of the relevant information without time constraints (Hersh et al. 1998).
- Physicians use electronic medical records (EMRs) systems for far fewer tasks than the systems supported (Laerum et al. 2001). Additionally, many hospitals use local EMR, but there is no standard data model (Lejbkowicz et al. 2004).

General implications and outcomes of health information technology (HIT):

- Determining diagnostic and therapeutic strategies (Shortliffe 1987, Wyatt et al. 1990, Johnston et al. 1994).
- A clinical support system effectively triages patients in an ED by using a limited amount of information (Michalowski et al. 2007).
- The increase in national health expenditures and the desire to improve the quality of healthcare are driving the widespread adoption of HIT (Goldschmidt 2005).

A survey of the literature leads to various implicit and explicit recommendations for further research on the main issue that is the target of this research: the impact of medical information (obtained from medical information systems) on decision-makers (physicians). Specifically, we focus on the contribute on of information technologies as EMR systems as the investigated source of the medical history in the EDs, rather than on other sources of medical information without an IS (as hard copy patient record, physical examinations or speaking with the patient) which have been appeared in previous research (such as: Hampton et al. 1975). Additionally, we add the locality of the information by differentiating between medical history which existed as local EMR in certain hospitals and integrative medical history which can be provided, electronically, by many other decentralized health suppliers (such as: external medical clinics and external labs).

3. OBJECTIVES, RESEARCH QUESTIONS AND HYPOTHESES

3.1 Objective and Research Question

The main objective of this research is to assess the impact of integrative medical IS on various admission decisions of the physicians in the high-stress environment of EDs. Hence, our research question is: ***What is the impact of medical information obtained by integrative medical IS on medical decision-making at the point of care of an ED?***

3.2 Research Variables and Hypotheses

Major hypotheses

Admission decisions

We attempted to discover the relationship between the use of medical history and the general admission decision.

The viewing of medical history, a major variable of the research, is formulated on the basis of recorded data regarding the different types of viewed medical information regarding the patients. The use of medical history is a variable which measures the actual use decision-makers make of the medical history from a unique medical IS which operates as an EMR system. This system is operated in many hospitals and health suppliers (including the ones of our research) and has the ability to share electronic medical information and integrative medical information between many distributed health suppliers (including external medical clinics, imaging institutions, labs and hospitals).

Sox et al. (2007) explained how, through the processes of decision analysis (such as admissions' decisions); a physician can reach valid, reasonable conclusions regarding medical treatment despite imperfect information about the patient. The authors emphasized the importance of medical history as a means to attain those conclusions. Walker et al. (2005) argued that there is positive relationship between the viewing of medical history and an improved medical care performance including admission decisions. Goldman at el. (2006) argued that children with abdominal pain receive a more effective medical care (including better admission decisions) when the physician viewed the medical history. The following hypothesis was tested:

H1: There is a relationship between viewing medical history (via the EMR system) and admission decision to a hospital. It was divided into two specific hypotheses:

H1.1: There is a positive relationship between viewing medical history (via the EMR system) and a decision to admit a patient to a hospital.

H1.2: There is a negative relationship between viewing medical history (via the EMR system) and a decision to admit a patient to a hospital, resulting in a single-day admission.

One of the most important decisions in an ED is whether to admit or discharge the patient (the admissions rate). In addition, we checked the impact of viewing medical history on the natural proportion of single-day admissions, not from a clinical perspective but from a managerial one (we do not claim that any single-day admission is necessarily a flawed clinical judgment). We observed how the proportion of single-day admissions fluctuates when a medical history of patients is inspected properly. We assumed that part of the single-day admissions are uncalled for, and could easily be prevented given a proper medical history. These scales have assisted researchers in previous studies in the field (Shabtai 2006, Shabtai et al. 2007). Additionally, Cooke et al. (2003) claim that in order to optimize the treatment provided to a patient, it is best to limit the time period in an ED or observation ward to not more than a single day. Denman-Johnson et al. (1997) claimed that by using various types of information, there are capabilities of reducing the short-term admissions to most of the ED wards.

One main aspect of this hypothesis was checked regarding the locality of information: Interoperability vs. Local EMR (We differentiated between medical history which existed as local EMR in certain hospitals and medical history which was exclusively provided online by various interoperable services from other decentralized health suppliers).

Differential diagnoses

Swap et al. (2005) showed that certain elements of the chest pain history (retrieved from IS) are associated with increased or decreased likelihoods of a correct diagnosis of acute myocardial infarction (AMI) and they identify those elements. We checked the relationship between the viewing of medical history and performing a more accurate differential diagnosis (DD). Specifically, we

checked whether an additional view of the medical history (via the EMR system) leads physicians to a more accurate DD in chest pain scenarios. We formulated the following hypothesis:

H2: There is a positive relationship between viewing medical history and choosing the correct DD.

This hypothesis enabled us to check the impact of medical history on the type of diagnosis made by decision-makers. We chose to focus on the main code of diagnosis marked by the tested physicians as the main DD (AMI DD). Practically, we differentiated between two types of DDs: AMI and non-AMI.

4. METHODOLOGY

The research used two methods that were designed in order to complement and enrich one another:

- Track log-file analysis using statistical tools such as comparison of averages, correlation and regression analysis provided us with a realistic view of the ED environment. (Main Method)
- Experimental study - Experiments that simulate the complicated reality of an ED environment, representing the medical decision process. (Secondary Method)

4.1 The Track Log-File Analysis

The analyzed log-files were based on data from seven main hospitals owned by Clalit health maintenance organization (HMO) in Israel, which use an integrative IS to share medical information from distributed health suppliers. These following variables were derived from the log-file analysis:

- The independent variables: viewed medical history, type of medical insurance, ED unit, DD, and information components used (sensitivities, details of previous hospitalizations and more).
- The dependent variables: admission decisions and single-day admissions.

For research purposes, the patients were divided into two groups:

- Patients, for whom medical history was viewed via the IS, were defined as the research group.
- Patients, for whom medical history was not viewed via the IS, were defined as the control group.

The objective was to assess the actual effect of the use of medical information on the performance of physicians with regard to their clinical decisions.

4.2 The Experimental Study

In the experimental study, we compared the performance of physicians who had access to complete clinical information on patients to that of physicians who lacked such access. The main stages of designing the experiment were:

- Selecting the medical scenarios – The cases have been chosen from the most common clinical scenarios in the national center for health statistics (NCHS[1]). The selected scenarios also appeared on the books of the educational commission for foreign medical graduates[2] (ECFMG) in order to be recognized as having optimal credibility. According to the NCHS, the four most common specific principal reasons given by adult patients (aged 15 years and older) for visiting the ED were, in descending frequency: chest pain, abdominal pain, back pain and headache. We chose for our experiment the most common reason for visiting the ED, the chest pain.
- Constructing the medical scenarios - The cases were developed by a panel of six senior physicians in cooperation with an international medical simulation center (MSR institution[3]) and were finalized with a pilot study. The technical data have been added to the ECFMG instructions from

[1] NCHS is the United States' principal health statistics agency. It designs and maintains a number of systems that produce data related to health concerns. See at: http://www.cdc.gov/nchs/

[2] The ECFMG assesses the readiness of international medical graduates to enter residency or fellowship programs in the USA. See at: http://www.ecfmg.org/

[3] MSR organization, the Israel international center for medical simulation,. See at: http://www.msr.org.il/

several previous relevant researches on chest pain and AMI diagnosis (Goldman et al. 2003, Lee et al. 2000, Panju et al. 1998, Pope et al. 2000).

- The research took place in the form of a website-based application that served as an ED environment. In each experiment, the tested physician randomly received three scenarios with only one of the following access patterns: with a full mandatory access to the simulated IS or lack of any access to the simulated IS.
- In the course of the experiment, the tested physician decided on the medical strategy during all stages including:
  - Viewing medical history and the physical examination.
  - Designing the diagnostic workup plan.
  - Deciding on the DD and whether to admit/discharge the patient.

5. FINDINGS

5.1 The track log-file analysis

The analyzed log-files were based on data from seven main hospitals owned by Clalit HMO in Israel. Clalit uses an integrative IS to receive integrative medical information from distributed health suppliers at the point of care. The objective was to assess the actual effect of the use of information provided by the system at the point of care (the ED) on the performance of physicians with regard to their various clinical decisions. This objective was accomplished by analyzing the log-files of ED referrals during the years 2004 to 2007 (including admissions and discharges).

Figure 1 presents the total number of referrals to the hospitals in our sample. The log-file consists of 3,219,910 samples of referrals (921,386 admissions and 2,298,524 discharges). We could not disclose the names of the hospitals that are involved for reasons of confidentiality and privacy.

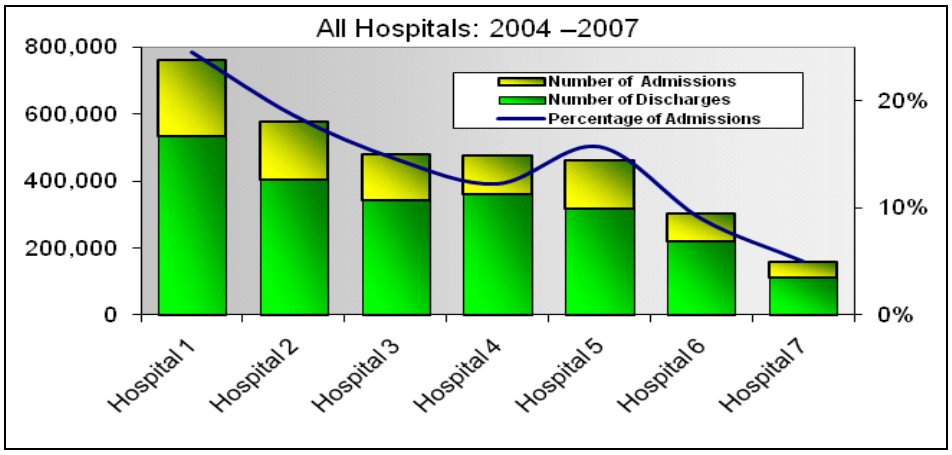

Figure 1. Total admissions and discharges in all hospitals

Multivariate logistic regression findings

We perform logistic regressions for two independent variables: **Admitted** (dichotomous dependent variable: 1- admit or 0 - discharge) and **Single-Day admissions** (dichotomous dependent variable: 1- if the patient has been admitted for a single day or 0 - if the patient has been admitted for a longer period of time). The method for running the regressions consists of three blocks of variables:

- Block 1 - Treatment variables: **history viewing** (dichotomous: 1- if the medical history was viewed via the IS or 0- if the medical history was not viewed via the IS), **age** (continuous variable represents the age of the patient), **insurance** (dichotomous: 1- if the patient is a member of Clalit

HMO, for whom full medical history is available via the IS or 0- if the patient is not a member of Clalit HMO) and **gender** (dichotomous variable represents the gender of the patient).

- Block 2 - Control variables for **type of department**: (such as: internal medicine and surgical).
- Block 3 - Control variables for different **hospitals** (due to various differences such as policies).

The combination of those two regressions reflected the pure contribution of medical information to the actual current decision of admission and is especially important to the rate of short-term admissions. The objective of the multivariate logistic regression is to receive the statistical validity while the impact of the historical information is adjusted in relation to the remaining variables in accordance with the principles of regression as demonstrated in previous researches (Cabrera 1994, Kooperberg et al. 1991, Baker et al. 1998). The findings were valid and significant for almost each group that was examined: hospital, type of insurance, department type, various DDs and locality of information. Here are a few main research results:

Logistic regressions on admission decisions (H1):

Tables 1 and 2 present the outcomes of the logistic regression regarding the impact of the variable "history viewed" and other variables on the admission decision to a hospital and on the rate of single-day admissions (Block 2 -control for type of department and Block 3 -control for type of hospital, are not shown here, but were included in these regressions). The left column of each table presents the variables in the regression while the second column to the left presents the coefficient of each one of the variables. The third column to the left presents the standard- deviation error while the fourth column to the left presents the significance of the statistical test performed. The fifth column presents the odds-ratio (OR) and the last two columns to the right indicate and present the confidence interval of 95% for the values of OR. We are focusing on adjustments of our treatment variables and mainly on the "history viewed" variable.

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
1.434	1.413	1.423	<0.001	.004	.353	HistoryViewed
1.033	1.033	1.033	<0.001	.000	.032	Age
.913	.902	.907	<0.001	.003	-.097	insurance
1.169	1.155	1.162	<0.001	.003	.150	Gender
		.023	<0.001	.007	-3.789	Constant

Table 1. A Logistic regression on the decision to admit.

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
.853	.829	.841	<0.001	.007	-.174	HistoryViewed
.980	.979	.979	<0.001	.000	-.021	Age
.948	.925	.936	<0.001	.006	-.066	insurance
1.065	1.039	1.052	<0.001	.006	.051	Gender
		.433	<0.001	.022	-.836	Constant

Table 2. A Logistic regression on single-day admissions.

Summary of results from tables 1 and 2:

- History viewing – when history is viewed the number of admissions increases by 42.3% ($p<0.001$, adjusted odds ratio (OR) =1.423) and the number of single-day admissions decreases by 15.9% ($p<0.001$, adjusted OR=0.841).
- Age - when the age of the patients increases in a one year, the number of admissions increases by 3.3% ($p<0.001$, adjusted OR=1.033) and the number of single-day admissions decreases by 2.1% ($p<0.001$, adjusted OR=0.979).
- Type of insurance – when the insured patients are members of the Clalit HMO, the number of admissions decreases by 9.93% ($p<0.001$, adjusted OR=0.907) and the number of single-day admissions decreases by 6.4% ($p<0.001$, adjusted OR=0.936).
- Gender – for male patients, the number of admissions increases by 16.2% in comparison to female patients ($p<0.001$, adjusted OR=1.162) and the number of single-day admissions increases by 5.2% ($p<0.001$, adjusted OR=1.052).

Findings of the contribution of the locality of information to admission decisions:

Tables 3 and 4 below are edited with the regressions' results regarding the locality of information. The left column of each table presents the variables. Each location of information (external and local) has two columns, as follows: the left column presents the coefficient of each variable in the regression and in the same column in parentheses the standard-deviation is shown. The right column presents the odds-ratio and in the same column in parentheses the significance level is shown. We focus on adjusting the results from our treatment variables and mainly on the "history viewed" variable.

Local History Viewed		**External History Viewed**		**Variables in the Equation**
OR (Sig.)	**B (S.E.)**	**OR (Sig.)**	**B (S.E.)**	
1.429 (<0.001)	.357 (.004)	1.166 (<0.001)	.154 (.008)	HistoryViewed
1.033 (<0.001)	.032 (.000)	1.033 (<0.001)	.033 (.000)	Age
.913 (<0.001)	-.091 (.003)	.909 (<0.001)	-.096 (.003)	Insurance
1.162 (<0.001)	.150 (.003)	1.16 (<0.001)	.148 (.003)	Gender
.022 (<0.001)	-3.795 (.007)	.026 (<0.001)	-3.658 (.045)	Constant

Table 3. A Logistic regression on the decision to admit for different locations of information.

Local History Viewed		**External History Viewed**		**Variables in the Equation**
OR (Sig.)	**B (S.E.)**	**OR (Sig.)**	**B (S.E.)**	
.853 (<0.001)	-.159 (.008)	.873 (<0.001)	-.136 (.016)	HistoryViewed
.979 (<0.001)	-.021 (.000)	.979 (<0.001)	-.021 (.000)	Age
.934 (<0.001)	-.069 (.006)	.937 (<0.001)	-.065 (.006)	Insurance
1.053 (<0.001)	.051 (.006)	1.053 (<0.001)	.052 (.006)	Gender
.427 (<0.001)	-.852 (.026)	.424 (<0.001)	-.859 (.026)	Constant

Table 4. A Logistic regression on single-day admissions for different locations of information.

Summary of <u>main</u> results from tables 3 and 4:

- Viewing two types of information contributes independently to admission decisions: local medical history from certain health institutes and information exchanged between several decentralized health institutes. Furthermore, local medical history contributes more than external medical history to the admit decisions, and the number of single-day admissions <u>decreases</u> slightly more when local medical history is viewed than when external medical history is viewed.

5.2 The Experimental Study

The experiments were performed on 102 physicians who differed in a range of characteristics such as seniority level (55 physicians were interns and 47 physicians were senior). Dealing with real practical decision-makers increases the external validity (Jarvenpaa et al. 1985). Additionally, 53 physicians were provided with an access to the simulated IS and 49 physicians were not provided with such access. The difference in the number of physicians with and without access to the IS is due to the random access patterns to the simulated IS. In general we had three simulated cases:

- In case number 1, without any additional information from the simulated IS, the normative medical decision of the physician should be to discharge this patient and the main DD is not one of the diagnoses related to AMI. On the contrary, with additional information from the simulated IS, the normative medical decision of the physician should be to admit this patient and the main DD is one of the diagnoses related to AMI.
- In case number 3, without any additional information from the simulated IS, the normative medical decision of a physician should be to admit this patient and the main DD is one of the diagnoses related to AMI. On the contrary, with the additional information provided by the simulated IS, the normative medical decision of the physician should be to discharge this patient and the main DD is not one of the diagnoses related to AMI.
- In case number 2, which serves as a control case, in both cases (with or without additional information) the normative medical decision of the physician should be to admit this patient and the main DD is one of the diagnoses related to AMI.

We chose to show only the results of cases 1 and 3, since these are the two valid cases of the experiment (Case no. 2, was verified to serve as a control case in our results, and is not shown here). Tables 5-8 present the regressions' outcomes regarding the impact of the **independent variables**: **history viewed** (dichotomous: 1- for physician who had access to the simulated IS or 0- for the physician who did not have such access), **seniority** (dichotomous: 1- for senior physician or 0- for intern physician), **specialty** (dichotomous: 1- for internal medicine or 0- for other specialties) and **Time** (continuous: measured in seconds) on the **dichotomous dependent variables**: **a decision to admit** to a hospital (1- admit or 0- discharge)) and on the **Main DD** (1- AMI DD or 0- not AMI DD).

Case 1: A Logistic regressions on admission decisions and on the main DDs:

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
39.103	4.421	13.147	<0.001	.556	2.576	HistoryViewed
7.412	1.003	2.91	0.044	.512	1.126	Seniority
0.997	0.679	.885	0.099	.827	-1.363	Specialty
1.496	1.049	1.253	0.013	.091	.225	Time
		.051	0.030	1.006	-2.972	Constant

Table 5. Case 1: A Logistic regression on the decision to admit

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
44.090	3.637	12.663	<0.001	.637	2.539	HistoryViewed
8.860	1.094	3.113	0.033	.534	1.136	Seniority
0.972	0.901	.0.941	0.067	.241	-0.599	Specialty
1.457	1.151	1.312	0.007	.112	.335	Time
		.046	<0.001	.668	-3.082	Constant

Table 6. Case 1: A Logistic regression on the main DD (AMI DD)

Case 3: A Logistic regressions on admission decisions and on the main DDs:

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
.307	.022	.082	<0.001	.675	-2.503	HistoryViewed
1.167	.103	.346	0.047	.620	-1.061	Seniority
.956	.835	.894	0.001	.034	-.112	Specialty
1.509	1.019	1.200	0.051	.331	.541	Time
		79.621	<0.001	1.028	4.377	Constant

Table 7. Case 3: A Logistic regression on the decision to admit

95.0% C.I. for OR		Odds Ratio	Sig.	S.E.	B	Variables in the Equation
Upper	Lower					
.613	.115	.265	0.002	.428	-1.327	HistoryViewed
.942	.305	.521	0.027	.411	-.861	Seniority
.994	.892	.954	0.005	.021	-.091	Specialty
1.645	1.006	1.387	0.027	.391	.669	Time
		2.357	0.007	.319	.857	Constant

Table 8. Case 3: A Logistic regression on the main DD (AMI DD)

Main results from tables 5 – 8 (regarding our main independent variable):

Case 1

- History viewed ($p<0.001$) – when history is viewed the rate of admissions increases by 1,214.7% (95% CI=4.421-39.103, adjusted OR=13.147).
- History viewed ($p<0.001$) – when history is viewed the rate of AMI diagnoses increases by 1,166.3% (95% CI=3.637-44.09, adjusted OR=12.663).

Case 3

- History viewed ($p<0.001$) – when history is viewed the rate of admissions decreases by 91.8% (95% CI=0.022-0.307, adjusted OR=0.082).
- History viewed ($p=0.002$) – when history is viewed the rate of AMI diagnoses decreases by 73.5% (95% CI=0.115-0.613, adjusted OR=0.265).

Summary of the main findings:

- In general, the experiment results supported our results from the log-file analysis by supplementing statistical significance with clinical robustness.
- Viewing medical history contributes to admission decisions (adjusted to other independent variables such as: time of treatment, seniority level, type of specialty, experience of the decision-maker and etc.). Not only does it clearly reduce the number of unnecessary admissions (case 1), but it also clearly increases the necessary admissions for all physicians (case 3).
- Viewing medical history assists in determining the correct main diagnosis (case 1 and case 3) and especially helps identify (case 3) or refute (case 1) an AMI diagnosis.

Table 9 presents the hypotheses results:

Results from Method 2: Experimental study	**Results from Method 1: Track log-file analysis**		**Hypothesis**
Empirical Approved/ Rejected (Significant: case 1,case3)	**Locality of information + Approved - Rejected**	**Approved/ Rejected (Significant)**	
√ (<0.001, <0.001)	Local and External (+)	√ (<0.001)	H1.1: There is a positive relationship between a view of medical history and a decision to admit a patient to a hospital
- (not measured in this method)	Local and External (+)	√ (<0.001)	H1.2: There is a negative relationship between a view of medical history and a decision to admit a patient to a hospital, resulting in a single-day admission
√ (<0.001,0.002)	- (not measured in this method)		H2: There is a positive relationship between a view of medical history and choosing the DD with the highest probability in the medical scenario

Table 9. Summary of hypotheses results. (Local information: the previous admissions to the hospital of the current referral. External information: the aggregated medical history from the other information sources not including the hospital of the current referral.)

6. CONCLUSIONS

In summary, our results lead to the major conclusion that viewing medical history using medical IS contributes to clinical and admission decisions (in many ways and in many clinical scenarios). We can also conclude that by integrating two methods, we acquired a deeper understanding of the ED as a point of care. Additional specific conclusions:

- Viewing medical history contributes to admission decisions. This contribution was discovered both in the track log-file method and also in the course of the experimental study.
- Both types of location of information contribute to admission decisions (local medical history slightly more than external medical history).
- Viewing medical history assists in determining the correct main diagnosis and especially helps identify or refute an AMI diagnosis.

7. CONTRIBUTION

The main purpose of our research was to contribute to scientific knowledge by providing additional insight into various fields of medical informatics. We enumerate several contributions:

- Focusing on the stressful point of care of the ED, and using a unique database containing a sample population of patients from all the relevant population.
- Focusing on using integrative real-time medical information from decentralized medical suppliers.
- Shedding a light on the positive relationship between using medical history and performing a more accurate diagnosis.

The findings of this study may also contribute to physicians (by enhancing the efficient use of information resources) and to patients (by improving healthcare services).

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