

Improving the granularity of the Electronic Health Record problem list.

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Table of abbreviations

AHIMA	American Health Information Management Association
CDR	Clinical Data Repository
CDSS	Clinical Decision Support Systems
CPOE	Computerized Physician Order Entry
EHR	Electronic Health Records
HIBA	Hospital Italiano de Buenos Aires
HL7	Health Level 7
IRB	Institutional Review Board
PL	Problem List

Abstract

The problem list has become in the central feature in health information systems (HIS). An accurate, complete, and up-to-date problem list improves quality of care, allows the development and implementation of clinical decision support systems (CDSS), and enables the development of health care programs, as well as research studies. An accurate problem list also facilitates the administrative and billing processes in health systems.

This problem-oriented health record had a disparate acceptance in the medical community, but in the informatics era, the problem-oriented electronic health record allows physicians and developers to create and maintain a structured, coded problem list in a computer system and resolved an important part of the problem of access to patient's health information. The categorization of the problems in the problem list allows system to easily identify what problems are present and what are resolved conditions.

While the advantages of a problem list are known and have been published in numerous studies, physicians do not always keep the problem list accurate, complete and updated. When physicians were interviewed about why they do not use and maintain the problem list, they reported problems in different contexts. Even some of the problems because physicians do not use the problem list have been enumerated in studies like the Wright's and others, there are not enough information about strategies to improve the granularity (level of detail) of the problem list. Granularity is one of the main features to improve the accuracy of the list. In health information systems, like ours, at Hospital Italiano de Buenos Aires, where the problem list is the backbone of the system, granularity of the problem list is a key point for better health

care quality. All our clinical decision support systems, health care programs, and also, research support systems and administrative task are based mainly in the patients' problem list. An accurate problem list, with an adequate level of granularity, allow us to optimize the development of these tools and improving the quality of health care.

The main objective of this project was to measure the level of detail of the problems in the problem list testing clinical cases in two different interfaces. Two interfaces for inputting problems into the problem list were used. Current HIBA's EHR problems list interface, which provides the actual interface for problem entry into the problem list and a new prototyped interface. This last one adds new options to the process, allowing users to increase the detail level (granularity) of the problem.

This study was performed at Hospital Italiano de Buenos Aires, in Argentina. Twenty physicians participates in the test. Three clinical cases validated by medical practitioners, containing all the necessary information and controlled vocabulary with no ambiguities was used. The order in which clinical case was present was randomized. There was not time limit to perform the task.

Granularity was defined based on sensitivity of documentation, compared with what was defined for each case presented to subjects. Sensitivity for each case-strategy pair was calculated as the level of detail identified by the subject that is present in the case, divided by the total number of detail level in this case.

In general sensitivity for all the three case was 59,83% with a range 47 to 80%. 56% (47 to 80%) using interface 1 and 64% (53 to 80%) using interface 2. No statistical differences between two interfaces ($p < 0,518$). Specific data for each particular case can be found in the paper.

The key point in this paper is what level of granularity is really necessary, and this will depend on the circumstances, contexts and ways in which each hospital uses their list of problems. More study to address this problematic will be necessary.

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Introduction

The problem-oriented electronic health record has become one of the most used clinical documentation systems. Weed, in his paper from 1968, described a paper model for clinical documentation and introduced a new concept for the medical record centered on a patient's list of health problems (1) With this new way of documenting, Weed intended to reflect the logic of medical thought during the care process with the aim to improve the organization of the registry and to allow the registry to serve other purposes beyond healthcare like educational, epidemiological, preventive, administrative, and billing. This new model was based on an organization of the health record centered on a list of diagnoses, signs or health conditions. These health problems were associated with therapeutic plans and physicians' actions. The problem-oriented health record had a disparate acceptance in the medical community. In the informatics era, the problem-oriented electronic health record allows physicians and Electronic Health Records (EHR) developers to create and maintain a structured, coded problem list in a computer system and resolved an important part of the problem of access to patient's health information.

The problem list, then, became the focus of EHR systems. An accurate, complete, and up-to-date problem list improves quality of care, allows the development and implementation of clinical decision support systems (CDSS), and enables the development of health care programs, as well as research studies (2) An accurate problem list also facilitates the administrative and billing processes of health systems (3,4). Some studies consider the problem list also could be beneficiary for patients that could connect, through to social networks, with other patients sharing a common problem (5)

Problem list

According to Weed, a problem list is a list of all of patients' conditions, diseases, symptoms and signs, and any health-related findings, present or past. The problem list is not a static enumeration of conditions, but a dynamic table that can and should be updated as often as the patient's condition changes (1). Similarly the Joint Commission^A defines the problem list as the complete and updated list of conditions, including their current status and background (6). For Health Level Seven^B (HL7), the problem list includes all acute and chronic conditions, signs and symptoms, past and present (7).

Using the problem list in electronic health records (EHRs) enables easy access to patient information, such as an overview of the health history, is an important part of longitudinal care, and facilitates communication between different health professionals in the health system. Both the Institute of Medicine^C (IOM) and the Joint Commission recommend an accurate, updated and complete problem list. Under the HITECH Act^D, physicians need to maintain an up-to-date and accurate problem list of current and active diagnoses to be considered 'meaningful users' of an electronic health record and to qualify to receive federal stimulus grants (8–10).

^A The Joint Commission (TJC), formerly the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), is a United States-based, nonprofit organization that accredits health care organizations and programs in the United States.

^B Health Level Seven (HL7) is a non-profit organization involved in the development of international healthcare informatics interoperability standards.

^C The Institute of Medicine (IOM) is an American non-profit, non-governmental organization founded in 1970. Its purpose is to provide national advice on issues relating to biomedical science, medicine, and health, and its mission to serve as adviser to the nation to improve health.

^D The Health Information Technology for Economic and Clinical Health Act (HITECH Act) was enacted under Title XIII of the American Recovery and Reinvestment Act of 2009. Under the HITECH Act, the United States Department of Health and Human Services is spending \$25.9 billion to promote and expand the adoption of health information technology and to create a nationwide network of electronic health records.

While the advantages of a problem list are known and have been published in numerous studies, physicians do not always keep the problem list accurate, complete and updated (11,12). For example, a report by Wright et al found omissions in the problem list ranging from 4.7% for kidney disease to 78.5% for breast cancer (13). The same team of researchers conducted studies to understand the user's profile of the problem list and found that it is mostly primary care physicians who use and maintain this list, with little adherence by specialists (14).

When physicians were interviewed about why they do not use and maintain the problem list, they reported problems in different contexts (15). Physicians are reluctant to use the problem list because the system is not designed well to fit in to their clinical and documentation workflow. Other issues included lack of clarity about who is responsible for maintaining the list of problems, relevance of the problem list in clinical practice, and who uses the information in what ways. Another important reason relates to the content and accuracy of the problem list: many physicians acknowledge that the lists are incomplete and outdated, and their maintenance is costly and ineffective. Also physicians complain about the design and visualization of the problem list, as well as the support and training they receive to use it. Finally, there are cultural issues: in some settings, most physicians are not familiar with problem-oriented documentation, so they need to adapt to a new way of documenting patient visits.

As we see, difficulties with the problem lists encompass not only the omission of problems in the list or the elimination of resolved health conditions when patients no longer suffer from disease, but also the lack of an adequate level of detail or granularity in each problem. To

address these problems among others, AHIMA^E published policies recommending that physicians should review and update the problem list in each visit, as well as frequently reviewing the list and make appropriate modifications when the patients' status changes. Detail the appropriate content of the problem list and refine diagnoses when problems become more specific. For example AHIMA describes the following case: “chronic cough” could be updated to “chronic obstructive pulmonary disease” once a diagnosis is made (16).

Why granularity is important.

Granularity is one of the main features to improve the accuracy in the EHR problem list. Several organizations, including HL7, the Joint Commission, AHIMA, and national programs in the U.S. such as Meaningful Use, all recommend a problem list updated and with an appropriate level of detail. It is also necessary to mention that in Health Information Systems, which rely increasingly on problem lists, the granularity of this list will be key in the implementation success of care programs and clinical decision support systems. In this sense, and related with the development of CDSS, Sittig et al, comments in one study that one of the barriers in the implementation of CDSS is the difficulty in finding “good” problem lists, and recommends taking action to improve the problem lists (and also the use of free text) like an option to reach better CDSS (17).

If we analyze the reasons why physicians do not use the problem list, some of the complaints focus on the content of the list (15). Users argue that the level of detail is not appropriate and that the granularity of the problem list is not always useful for making decisions. Indeed, this is

^E The American Health Information Management Association (AHIMA) is an organization working in medical record management field.

a vicious circle: first physicians do not complete and update the lists, and then they complain that the list is not complete or does not have the appropriate level of detail.

Which is the best granularity for the problem list? In other words, which is the best level of detail? This is a controversial question. Is not easy find evidence in what is an appropriate level of detail that could define a "good problem list", but some things, we know, are beneficial for the quality of the problem list. First: there is no option for improve the level of detail once the problem has been created, so, is important to capture the best granularity at the time that the problem is being inputting into the problem list. Second: better level of detail, better info to allow user to take decisions. With a low granularity, info could be poor, and the problem list could only works for a reminder list, but no give users the data they need to take further decisions. Third: terminology and clinical representation standards can help us to aggregate data if we need to decrease the granularity, but this not works in the reverse situation.

Is the high level of granularity a benefit for all health care team related with health care process? Is the same for physicians than for nurses? Even more, is it the same for generalists than specialists? This is maybe other question difficult to answer... This topic could be addressed thinking in two big context: patients vs. populations, or physicians' decisions vs. public health decisions. Even there are not formal studies in this field, is known that thinking in a specific patient, more is more. I mean, when better and more detailed is the information that you have, easy will be to take a decision. And this is true for generalists (main creators of the problem lists (14,18)) but also for specialists and nurses. Maybe this could be different if we talk about populations and not any patient in particular. Thinking in populations, two big possibilities can be analyzed. First, if we are thinking in the implementation of health care

programs or clinical decision support systems, there are no doubt the highest levels of granularity that our problem list has, the best performance of our implementation we reach. Second: if we thinking in reports (governmental, regionals, performance measures, etc.) or statistics, it could be better have aggregated data, and in this case less is more, I mean: less granularity, bet performance, in this sense physicians decisions could be more benefit with granularity than public health decisions. This last situation can be save using terminology standards to aggregate the information. In this way, having high level of granularity we can achieve aggregated info, but not in the reverse situation, we cannot obtain granular info beginning with poor detailed data. (Figure 1)

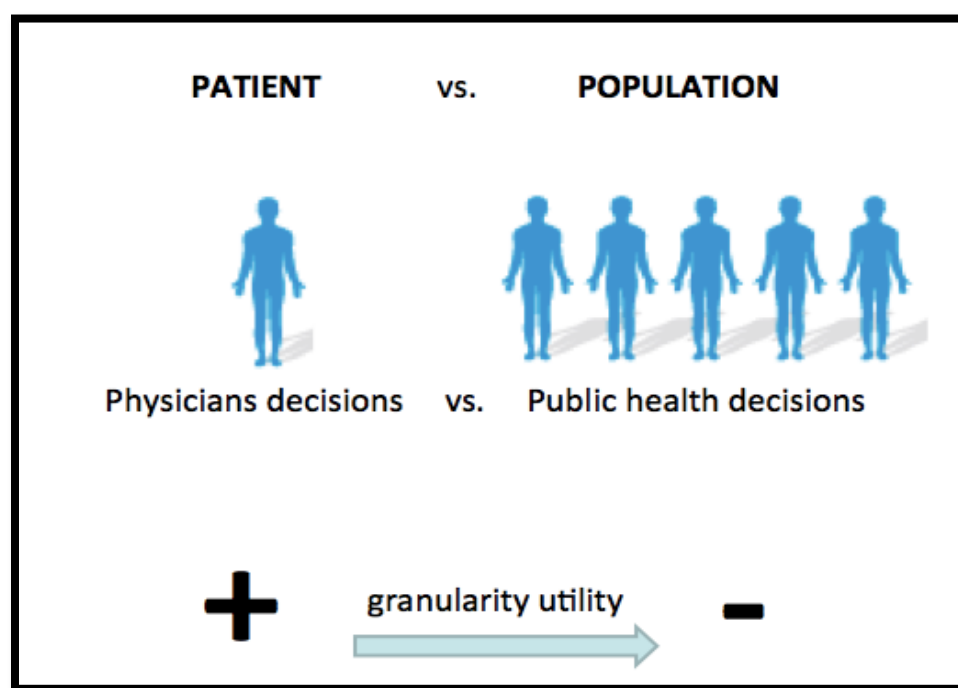


Figure 1: Patient vs. Population

Why granularity is important at HIBA.

In health information systems, like ours, at Hospital Italiano de Buenos Aires, where the problem list is the backbone of the system, granularity of the problem list is a key point for

better health care quality. All our clinical decision support systems, health care programs, research support systems and administrative tasks are based primarily on patients' problem lists. An accurate problem list, with an adequate level of granularity, allows us to optimize the development of these tools and improve the quality of health care.

Literature review

When I reviewed the literature published on seeking experiences that will improve the granularity of a problem list, no evidence was found in this regard. While, as mentioned in the previous section, there are experiences that systems have been improved using strategies for improving problem lists (13,20–26) few studies have been found on the increased granularity of a problem list.

Objective

The main objective of this project was to measure the level of detail of the problems in the problem list testing clinical cases in two different interfaces.

For this project, two interfaces for inputting problems into the problem list were used:

- Current HIBA's EHR, which provides the actual interface for problem entry into the problem list.

- A new prototyped interface, with new options available for use. This interface adds new options to the process, allowing users to increase the detail level (granularity) of the problem.

The design for the study is to test how granularity of the problem list, testing the process of creates a new problem in the electronic health record problem list. This process was test with a group of physicians using clinical vignettes that "guide" them to select some problems related with the clinical case.

Methods

Setting

This study was performed at Hospital Italiano de Buenos Aires. This study was carried out at the Hospital Italiano of Buenos Aires (HIBA), an academic medical center equipped with 750 beds. Annually, the hospital discharges 50,000 patients and provides 2.8 million outpatient visits. The hospital has a Health Maintenance Organization with 150,000 members. HIBA uses its own developed problem-oriented EHR (28) that registers the care process of patients in all settings (outpatient, inpatient, emergency unit, and home care). The problem list is processed by a terminology server, and all the problems are codified by a local identification number (thesaurus number), that has a reference to SNOMED CT (29–31).

The study was performed in Spanish; results were published in English.

Subjects

20 physicians were randomly selected in

Informed Consent was requiring from all subjects before participation.

Inclusion criteria

- Physicians (staff or residents).
- 6 months of use of EHR minimum.

Exclusion Criteria

- Physicians working at Medical Informatics Department or involved in preparing the study.

Sample

3 cases (vignettes) validated by medical practitioners, containing all the necessary information and controlled vocabulary containing no ambiguities was used.

The order in which clinical case was be present was randomized. There was not time limit to perform the task.

IRB approval

This study was approved by Institutional Review Board (IRB) at OHSU (Number: IRB00010533) and HIBA (Number: 2077).

Clinical cases

Three representative clinical cases were selected for this study by a team of internal medicine physicians, family physicians and medical informaticians. Six cases were created with selection of the best three, taking account of the problem frequency created in the EHR and the best cases that allow measure the granularity (level of detail or attributes). The text of each case was given on printed cards to each subject for standardized presentation of study participants. Each clinical case was reviewed in detail, and the maximum level of detail was identified by consensus of the team for subsequent data analysis.

For example: You are working in the Intensive Care Unit at HIBA. In that service a 41-year-old male with history of hypertension and diabetes type 1 is hospitalized for right calcaneal osteomyelitis refractory to treatment with Piperacillin / Tazobactam. Use the electronic medical records to input the problem for which the patient is hospitalized.

This case has 5 levels of detail. Levels of detail (granularity) are the following:

1	Osteomyelitis	Clinical Finding
2	Refractory to treatment	Other attribute
3	Piperacillin / Tazobactam	Other attribute
4	Calcaneus	Finding site
5	Right	Laterality

The total numbers of examination findings were tabulated for each of the 6 cases (In the study only three of the six were used).

Documentation strategies:

Two documentation strategies were used for this study: (1) a version of current HIBA's EHR, which provides the actual interface for problem entry into the problem list; (2) a new prototyped interface, which consists of a new version with new options available for use. To minimize variability (distraction with the new interface, extraneous menus and options, etc.), the decision was to create the prototyped as similar as possible to the actual version for this study.

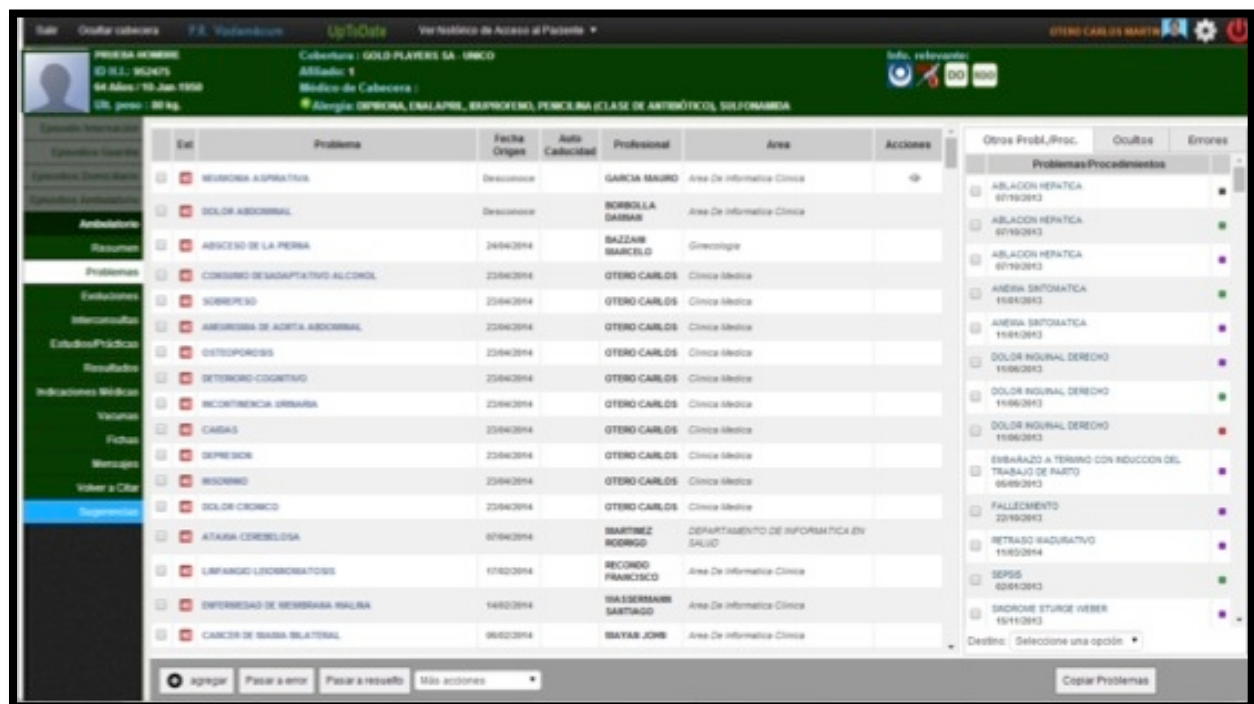
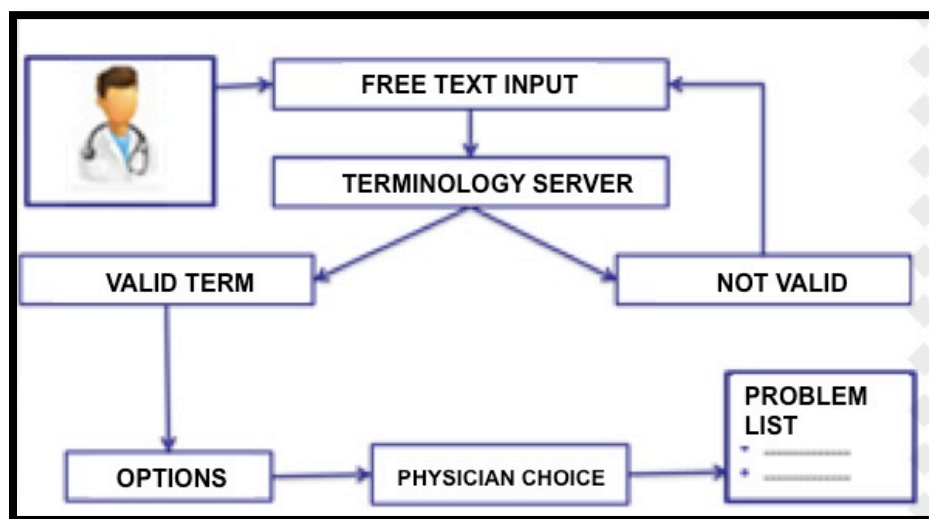


Figure 2: HIBA's EHR Problem List

Figure 2 shows the HIBA's EHR problem list module. This is the main screen for input problems into the problem list, but this action can be performed in several modules of our EHR (like CPOE module, clinical notes module, etc.). In all the cases the "action" to inputting a problem "calls" the same screen.

Figure 3 shows how the process to add a problem works in our system. When the physicians input a problem in free text in the search box of the screen, this text is processed by HIBA's terminology server and identify as a valid term or not. If the term is not valid (for example the physician writes "prescription" that is not really a health problem) the system alert the user that this term is not valid, or not allowed and ask for a new input. When the term is valid, the system offer the best match for this input and also offer other option related with this search. Finally the physicians can select the preferred term or one of the other options and the problems goes to the problem list



. Figure 3: Inputting problem process.

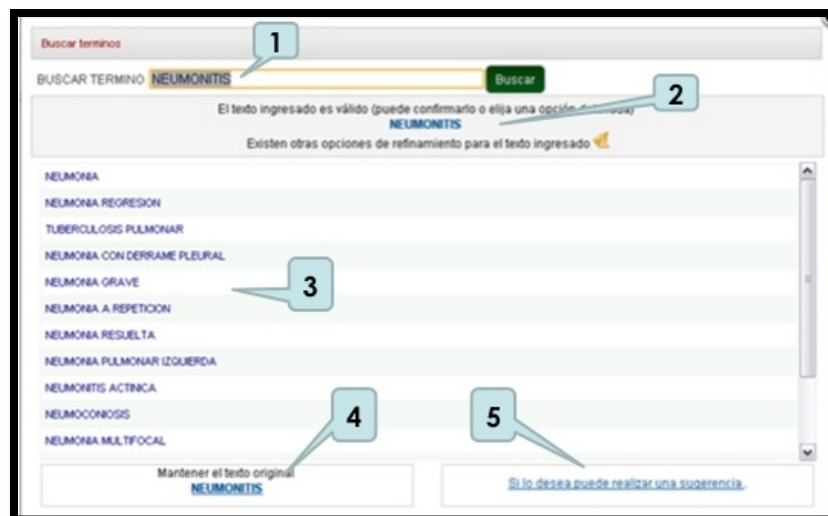


Figure 4: Interface 1

In the current interface for add a problem in the problem list (Figure 4) you can identify the following section:

1. Searching box: the users write here in free text what the want to input in the problem list
2. Preferred term: this section shows, which is the preferred term, related with the best coincidence, according to what the doctor has written.
3. Other options: other terms that could be interesting for the physicians according with the search criteria.
4. Selected term: shows the term that was selected
5. Comments section: users can make comments and suggestions

Figure 5 shows the new prototyped version that was created for this study.

The image shows a web-based medical terminology interface. At the top, there are tabs for 'Búsqueda de Términos' (selected) and 'Categorización'. A 'Sugerencias | Ayuda' link is in the top right. The main search area has a 'Buscar términos:' label, a text input containing 'NEUMONITIS AGUDA', and a 'Buscar' button. Below this, the 'Términos válidos:' section shows 'NEUMONITIS AGUDA' as the preferred term (callout 2). To its right, 'Agregar Calificadores:' allows selecting clinical course (e.g., 'NINGUNO', 'INICIO ANTIGUO', 'EPISODIO', 'RECURRENTE', 'CRONICO', 'CRONICO PERSISTENTE') and severity (e.g., 'NINGUNO', 'LEVE', 'LEVE A MODERADO', 'MODERADO', 'MODERADO A SEVERO', 'SEVERO') (callout 6). Below the preferred term, 'Opciones frecuentes:' lists related terms like 'NEUMONIA', 'NEUMONIA ALERGICA ESTIVAL', 'NEUMOCOCONDIS', 'NEUMONIA PULMONAR', 'NEUMONIA LIPOIDEA', and 'NEUMONIA LEVE' (callout 3). A 'Ver 12 opciones más' link is also present (callout 4). The 'Clasificación según ANA:' section shows a tree structure for 'Por tipo' with options 'NEUMONIA TIPO 1', 'NEUMONIA TIPO 2', and 'NEUMONIA TIPO 3' (callout 5). At the bottom, the 'Problema o procedimiento a agregar:' field contains 'NEUMONITIS AGUDA' (callout 7). Below it, a 'Definición:' section provides a brief description: 'Trastornos pulmonares en los cuales los tejidos pulmonares profundos resultan inflamados.' (callout 8). A 'Cancelar' button is on the left, and a 'SIGUIENTE ►' button is on the right (callout 9).

Figure 5: Interface 2

In this new prototyped interface you can find the following sections:

1. Searching box: for input the problem that users are trying to add in the PL.
2. Preferred term: shows the preferred term, related with the best coincidence, according to what the doctor has written.
3. Other options: other terms that could be interesting for the physicians according with the search criteria. In this case, order by frequency of use in our system.
4. Other option not frequents: to see other option that are not frequent in the system
5. Classifications: options related with the search criteria organized by national or international classifications (terminology standards or medical associations).
6. Attributes: details that can be add to the problem, like finding site, laterality, course, etc.)
7. Problem selected: shows the problem selected, but also shows how the problem is being created if you add attributes.
8. Definitions: you can find here the definition of this health problem.
9. End button: to finish the process.

These were the two interface use during the tests.

Presentation of cases:

Each subject was exposed with 3 clinical cases and was ask to document pertinent problem using each of the 2 strategies, resulting in 6 case-strategy pairs per subject. Each card with the case was present immediately before documentation with the individual strategy. This procedure was repeated for each case. To avoid any systematic bias related to the presentation of the clinical vignettes and the documentation interface, cases were present sequentially for each subject participant. (case 1 - interface 1, case 2 - interface 2, case 3 - interface 1, case 1 - interface 2, case 2 - interface 1, case 3 - interface 2)

Clinical case number 1

You are working in the Intensive Care Unit at HIBA. In that service a 41-year-old male with history of hypertension and Diabetes type 1 is hospitalized for right calcaneal osteomyelitis refractory to treatment with Piperacillin / Tazobactam. Use the electronic medical records to input the problem for which the patient is hospitalized.

This case has 5 levels of detail. Levels of detail (granularity) are the following:

1	Osteomyelitis	Clinical Finding
2	Refractory to treatment	Other attribute
3	Piperacillin / Tazobactam	Other attribute
4	Calcaneus	Finding site
5	Right	Laterality

Clinical case number 2

You receive a male patient, 68 years old, with not important health history, referred from an ambulatory clinic to be admitted at the hospital with diagnosis of acute community pneumonia in right lung base.

This case has 5 levels of detail. Levels of detail (granularity) are the following:

1	Pneumonia	Clinical Finding
2	Community Pneumonia	Clinical Finding
3	Acute	Course
4	Lung base	Finding site
5	Right	Laterality

Clinical Case number 3

35 years old patient consult with acute stabbing type pain in right shoulder. Record the reason for consultation in the EHR.

This case has 5 levels of detail. Levels of detail (granularity) are the following:

1	Pain	Clinical Finding
2	Acute	Course
3	Stabbing	Other attribute
4	Shoulder	Finding site
5	Right	Laterality

Data analysis:

Granularity was defined based on sensitivity of documentation, compared with what was defined for each case presented to subjects. Sensitivity for each case-strategy pair was calculated as the level of detail identified by the subject that is present in the case, divided by

the total number of detail level in the case. For example, for the case in the example if the physician documents osteomyelitis of calcaneus, sensitivity would be 40% (2 of 5 levels).

1	Osteomyelitis	Clinical Finding
2	Refractory to treatment	Other attribute
3	Piperacillin / Tazobactam	Other attribute
4	Calcaneus	Finding site
5	Right	Laterality

Results

20 tests were performed during April 2014. The following table shows main features of participants.

Age (mean) (years)	39
Sex (women)	55%
Specialty	
Internal medicine	45%
Family physicians	55%
Role	
Staff	60%
Trainee	40%

Tests were performed at Hospital Italiano de Buenos Aires. All participants accepted participate in the study. Data were recorded in paper documents in Spanish, translate and analyze.

Results | Clinical case 1 | Osteomyelitis

The following table shows the data for the clinical case number 1. In this table each line is a participant, and each column is a level of detail. For detail level two groups are defined: interface 1 and interface 2. A point was assigned to each level of detail documented by the participant in each case. Sensitivity for each case was measure as the total level of detail identified by the subject that is present in the case, divided by the total number of detail level in the case.

	INTERFACE 1						INTERFACE 2					
	Osteomyelitis	Refractory to treatment	Piperacillin / Tazobactam	Calcaneus	Right	TOTAL	Osteomyelitis	Refractory to treatment	Piperacillin / Tazobactam	Calcaneus	Right	TOTAL
P 1	1			1	1	0,6	1			1	1	0,6
P 2	1			1	1	0,6	1			1		0,4
P 3	1			1	1	0,6	1			1	1	0,6
P 4	1			1	1	0,6	1			1	1	0,6
P 5	1			1		0,4	1			1	1	0,6
P 6	1			1	1	0,6	1			1	1	0,6
P 7	1			1	1	0,6	1			1	1	0,6
P 8	1			1	1	0,6	1			1	1	0,6
P 9	1			1		0,4	1			1	1	0,6
P 10	1			1		0,4	1			1	1	0,6
P 11	1			1	1	0,6	1			1	1	0,6
P 12	1			1		0,4	1			1	1	0,6
P 13	1			1		0,4	1			1	1	0,6
P 14	1			1		0,4	1			1	1	0,6
P 15	1			1	1	0,6	1			1	1	0,6
P 16	1			1	1	0,6	1			1	1	0,6
P 17	1			1	1	0,6	1			1	1	0,6
P 18	1			1	1	0,6	1			1	1	0,6
P 19	1			1		0,4	1			1	1	0,6
P 20	1			1	1	0,6	1			1	1	0,6
	1	0	0	1	0,65	0,53	1	0	0	1	0,95	0,59

Sensitivity was 56% with a range 40 to 60. For interface number 1, sensitivity was 53% (40 - 60 %) and for interface 2 was 59% (40 - 60 %). No statistical differences between two interfaces ($p < 0.749$).

In this case three kinds of detail or attributes to the problem list were identified. These are: laterality, finding site and other attributes (as conditions of the therapy, for example in this case refractory to treatment and antibiotics use in the therapy).

Attributes or modifiers are the terms that deep the detail of each problem. For this study I use the SNOMED CT classification for these attributes.

In this case in particular, laterality was documented in 65% of the times when interface 1 was used and 95% when interface 2 was used.

For finding site both interfaces capture 100% of this attribute.

In the other hand, no participants choose to go deep in detail about other attributes like therapy and treatment condition (refractory) in this case.

	INTERFACE 1	INTERFACE 2
Laterality	0.65	0.95
Finding site	1	1
Other attributes	0	0

Results | Clinical case 2 | Pneumonia

The table in this case shows the same structure as in the case 1.

	INTERFACE 1					TOTAL	INTERFACE 2					TOTAL
	Pneumonia	Community Pneumonia	Acute	Lung base	Right		Pneumonia	Community Pneumonia	Acute	Lung base	Right	
P 1	1	1				0,4	1	1	1			0,6
P 2	1	1	1			0,6	1	1	1			0,6
P 3	1			1		0,4	1			1	1	0,6
P 4	1		1	1		0,6	1		1	1	1	0,8
P 5	1		1			0,4	1		1	1	1	0,8
P 6	1		1	1	1	0,8	1		1	1		0,6
P 7	1	1				0,4	1	1		1	1	0,8
P 8	1	1	1	1	1	1	1	1	1	1	1	1
P 9	1	1	1			0,6	1	1	1			0,6
P 10	1	1	1			0,6	1	1	1			0,6
P 11	1	1	1			0,6	1	1	1			0,6
P 12	1	1	1			0,6	1	1	1			0,6
P 13	1	1	1			0,6	1	1	1			0,6
P 14	1		1			0,4	1		1			0,4
P 15	1	1	1			0,6	1	1	1			0,6
P 16	1	1				0,4	1	1				0,4
P 17	1	1	1			0,6	1	1	1			0,6
P 18	1	1	1			0,6	1	1	1		1	0,8
P 19	1	1	1			0,6	1	1	1			0,6
P 20	1	1	1			0,6	1	1	1			0,6
	1	0,75	0,8	0,2	0,1	0,57	1	0,75	0,85	0,3	0,3	0,64

Sensitivity was 60.5% with a range from 40 to 100%. Was 57% (40 – 100 %) for interface 1 and 64% (40 - 100 %) for number 2. No statistical differences between two interfaces ($p < 0.5158$).

Considering details in this case course was registered 80% of the times using interface 1 and 85% using interface 2. In this case, finding site was only documented in 20 and 30%, laterality 10 and 30% using interface 1 and 2 respectively. Other attributes (in this case, type of pneumonia) were registered 75% of the times.

	INTERFACE 1	INTERFACE 2
Course	0.8	0.85
Finding site	0.2	0.3
Laterality	0.1	0.3
Other attributes	0.75	0.75

Results | Clinical case 3 | Shoulder pain

	INTERFACE 1					TOTAL	INTERFACE 2					TOTAL
	Pain	Acute	Stabbing	Shoulder	Right		Pain	Acute	Stabbing	Shoulder	Right	
P 1	1			1	1	0,6	1			1	1	0,6
P 2	1			1		0,4	1			1	1	0,6
P 3	1			1	1	0,6	1	1		1	1	0,8
P 4	1	1		1	1	0,8	1	1		1	1	0,8
P 5	1			1	1	0,6	1			1	1	0,6
P 6	1	1	1	1	1	1	1	1	1	1	1	1
P 7	1	1	1	1		0,8	1	1	1	1	1	1
P 8	1		1	1		0,6	1		1	1	1	0,8
P 9	1			1	1	0,6	1			1	1	0,6
P 10	1			1	1	0,6	1			1	1	0,6
P 11	1			1	1	0,6	1			1	1	0,6
P 12	1			1	1	0,6	1			1	1	0,6
P 13	1			1		0,4	1			1	1	0,6
P 14	1	1		1	1	0,8	1	1		1	1	0,8
P 15	1			1		0,4	1			1	1	0,6
P 16	1			1	1	0,6	1			1	1	0,6
P 17	1			1		0,4	1			1	1	0,6
P 18	1			1		0,4	1			1	1	0,6
P 19	1			1		0,4	1			1	1	0,6
P 20	1			1	1	0,6	1			1	1	0,6
	1	0,2	0,15	1	0,6	0,59	1	0,25	0,15	1	1	0,68

Sensitivity was 63.5% (range 40 to 100%). For interface 1: 59% (40 – 100 %) and for interface 2 68% (60 – 100 %). No statistical differences between two interfaces ($p < 0.743$).

About details in this case course was documented 20% for interface 1 and 25% for interface 2. Finding site was documented 100% of the times in both interfaces and laterality was registered 60% in interface 1 and 100% in interface 2. Other attributes like type of pain was documented only 15% in both interfaces.

	INTERFACE 1	INTERFACE 2
Course	0.2	0.25
Finding site	1	1
Laterality	0.6	1
Other attributes	0.15	0.15

General results

In general sensitivity for all the three case was 59,83% with a range 47 to 80%. 56% (47 to 80%) using interface 1 and 64% (53 to 80%) using interface 2. No statistical differences between two interfaces ($p < 0,518$).

		INTERFACE 1	INTERFACE 2
GENERAL	Course	0.50	0.55
	Finding site	0.73	0.77
	Laterality	0.45	0.45
	Other atributes	0.25	0.3

Users comments

While this study focused on granularity document for the physicians, as the value of sensitivity, users' comments were also saved. The most relevant comments are the following:

"...The problem list is a guide. This list is not updated frequently, therefore, information such as evolutionary characteristics of disease become obsolete..."

"...Too much details often creates duplication of the problem, since the system is not mature enough to recognize them as the same and join them..."

"...I understand that the list of problems is useful for managing programs for chronic diseases, so grouping the information would facilitate the work of many, because of this I do not add details..."

"...The problem list should serve to have a quick idea of the patient, the details should go in the clinical notes..."

"...The physicians in charge of the patient should update and detail the list, is not my responsibility..."

"...I am not sure how much detail should I put... is this important???..."

"...The process must be fast, you can not take too much time putting details that are not useful... They are not useful, no?..."

"...When more detail I put, more difficult is to keep the list updated..."

"...You should put only the basics... You should, right?..."

This comments were analyzed, using some qualitative techniques, and results are reflect in the following section. This is not an qualitative study, this comments were obtained during the test. These tests were focus in measure the granularity of the problems in the EHR problems lists, and not in the context of a formal qualitative study, but, in view of the interesting value of these opinions, this comments were saved and analyzed. Topics emerged from these comments are:

- **Ownership as a real big problem:** no one of the participant in the study mentions the problems and the quality of the problem lists as an own responsibility. Even when much of them should cover this role in our hospital policies. All the times that anybody mentioned something about the responsibilities of maintenance, referred to this issue as a problem of others.
- **Policies respect problem list are unknown for most:** in our hospital there are policies that refer to roles in the maintenance of the PL, its scope and utility. While these

policies are part of the training on admission to the institution, physicians do not remember, or even if they remember it, they do not apply them.

- **Utility of the problem list is not clear:** even when the uses and utility of the PL are clear for the hospital, this is not so clear for the users. Several of them do not know how the problems in the PL are used for the implementation of health programs and CDSS, research projects and bill and administrative tasks.
- **Maintenance is a big challenge (at least recognized by users...):** the maintenance of the problems lists is a big challenge. The PL becomes inaccurate easily. The PL usually is incomplete, and in other cases the opposite situation also appear, diseases that patients no suffer any more, remain in the PL after the pathology ends. This problem is recognized by physicians, even so, they do not much efforts to keep the PL accurate.
- **Is not clear what level of detail is needed:** this is one of the big problem and directly related with this study. Physicians do not know which level of detail is needed. But not only physicians, there are not papers in the literature related with this particular topic. The level of detail should be an agreement between hospitals need and physicians expectations.
- **And why more detail could be useful:** in the same way, most of the physicians participating in the tests have not clear ideas in why more detail could be useful for their practice. People related with capacitation in the use of EHR should address this topic, and generate documents explaining why is useful, but also, generating a debate to find, all together, the appropriate level of detail.

Discussion

The key problem is what level of granularity is actually required in the problem list, and this is a topic not easy to address. This issue could be influenced by several situations, like:

- Uses and policies: uses and policies about the problem list define which level of detail would be the necessary. It is different how much detail do you need if you are thinking a problem list as a guide for clinical care than if you think this list for other purpose like clinical decision support systems. Also, it is still more different if you applied this information to research, billing and administrative process. Policies about documentation that define the role of the problem list should address this specific topic and must be clear in inform how is the standard and why more detail could be beneficial.
- Where providers will agree to spend extra time to reach the required level of detail: this is not an easy point. You probably could have the role of the problem list clear, the policies declared and the uses for the PL defined, but if you not have your physicians aligned with this policy will be very hard to advance in a quality documentation process. Many times, beyond that users recognize the value of putting more detail on the problems of health, time, the dynamics of the work or other circumstances make it difficult to meet the set parameters. It is therefore very important to agree with the doctors and different users what level of detail or granularity useful, and what level they are willing to document without altering (or altering it minimally as possible) their workflow.

- And finally: do physicians know which level of detail they really need? and this is one of the most challenging issues. How to convince doctors that they need something that they do not know they need yet? A clear example is when doctors try to retrieve information contained on the system for the development of research protocols. Physicians often require information with a level of detail that usually they do not document... then ... how the systems can respond, with the tools available at the time, to these requirements? By this I mean that doctors ultimately know the value of having detailed or granular information, but not even recognize that they are responsible for documenting this level detail when creating and maintaining PL. This is a point where you have to work hard with users, because it is a quick "reward" that doctors can receive, and would be interesting to show them this.

Several studies show advances in "capture" problem to complete the problem list, but there are not evidence in what level of detail are adequate. In other way, the problem with the problem list is known by most of the people related with the clinical documentation process, data management teams and health information systems. In this regard, many publications and studies have addressed the issue . While systems have been developed and have been published solutions referring to "complete" the problem list from rules that identify these health problems in the clinical data repository (CDR) of a HIS or from natural language processing (NLP) tools to extract these problems from free text, almost none of these works refers or deepens in the level of detail that these problems require. These tools , which proved useful in the detection of health problems that existed in the patient records , but they were not in the PL, recognized these problems and incorporate them in the PL(by different methods , with or without validation by the physician). Such systems end up generating a general problem , with a low level of detail. This response to the known problematic of incompleteness of the PL was effective in most cases , and is very useful to meet government targets as meaningful use,

for the generation of reports, or for the implementation of programs of care , that require an aggregate level of data, without more detail, but might not be useful when having to make decisions against a particular patient, or for the development of clinical decisions support systems in order to avoid false positives or false negatives. In the latter sense, then it would be interesting to advance the definition of appropriate levels of details at each purpose, and try to implement these tools according to the levels defined by each institution.

Hospitals must be clear how they think to address this problem, and policies must be published and agree with users.

Policies about PL are deficient (ownership and maintenance responsibilities are not clear). The policies regarding the clinical documentation are often deficient, but also, the policies relating to the problem lists, their quality, maintenance and level of detail are almost zero. The responsibilities in reference to who is the owner of the problem list and who is responsible for maintain it up-to-date and accurate is not clear . Beyond this in some institutions this is defined, but the communication of these policies is poor, and often , doctors do not know which is their role and responsibility regarding to the problem list. In reference to the required level of granularity , that is almost always missing in these policies, both because neither is clear what level of detail would be appropriate, but on the other, because it problematic has been historically delayed compared to larger problematic as ensure that physicians write at least something on the problems lists. Would be reasonable to work with physicians to improve these policies, making them accessible and communicate efficiently. The best way to move forward on these topics is, in my understanding, committing the same users in the definition

and scope of these policies and incorporate them in the development of strategies for dissemination of this policies.

Granularity is a complex issue. Difficult to standardize how to measure the “level of detail”. Define the level of granularity needed in a problem list is not just the problem. As we know that level of granularity have in our database. How to know what level of detail our problem lists have if we do not have standards to measure it?. The level of detail is a challenge not only for its implementation, but also by the lack of international standards to regularize the way that the level detail can be measured. In addition, find the granularity on data we already have in our databases, is an almost impossible task, because we have no longer the gold standard to know that level of detail was correct. This gold standard are the patients and what's wrong with them, and only the attending physician, the day that they visit, knows that information. By this I mean that the granularity is a prospective project, you cannot, or would be very difficult, to correct or improve the granularity of data previously saved.

Addressing the idea of how to measure and improve the level of granularity of the problem lists, international terminology standards appear as a valid option. One of them, SNOMED CT, could be useful for those information systems that code their data with this terminology.

SNOMED CT is an internationally standard terminology, and one of the most comprehensive. Is owned, maintained and distributed by the International Health Terminology Standards Development Organization (IHTSDO).

SNOMED CT is composed by:

- Concepts [C]

- Descriptions [D]
- Relationships [R]

Concepts are representations of clinical entities and has a unique code known as a concept identifier. Concepts are organized by hierarchies, from the general to the specific (Figure 6). Descriptions are terms related to a concept, like a synonym, describing the same idea. Each concept may or may not have more than one description. Relationships link each concept to other concepts. This are some examples published by SNOMED CT to clarify what a relationship is: One type of link is the "is a" relationship which relates a concept to the more general concepts. For example, the concept "viral pneumonia" has an "is a" relationship to the more general concept "pneumonia". These "is a" relationships define the hierarchy of SNOMED CT concepts. Other types of relationship represent other aspects of the definition of a concept. For example, the concept "viral pneumonia" has a "causative agent" relationship to the concept "virus" and a "finding site" relationship to the concept "lung" (19) (Figure 7). The SNOMED structure divides the diagnostic, signs and symptoms in a tree scheme of low to high granularity, and also provides attributes for each diagnosis (laterality, severity, causal agent, etc.).

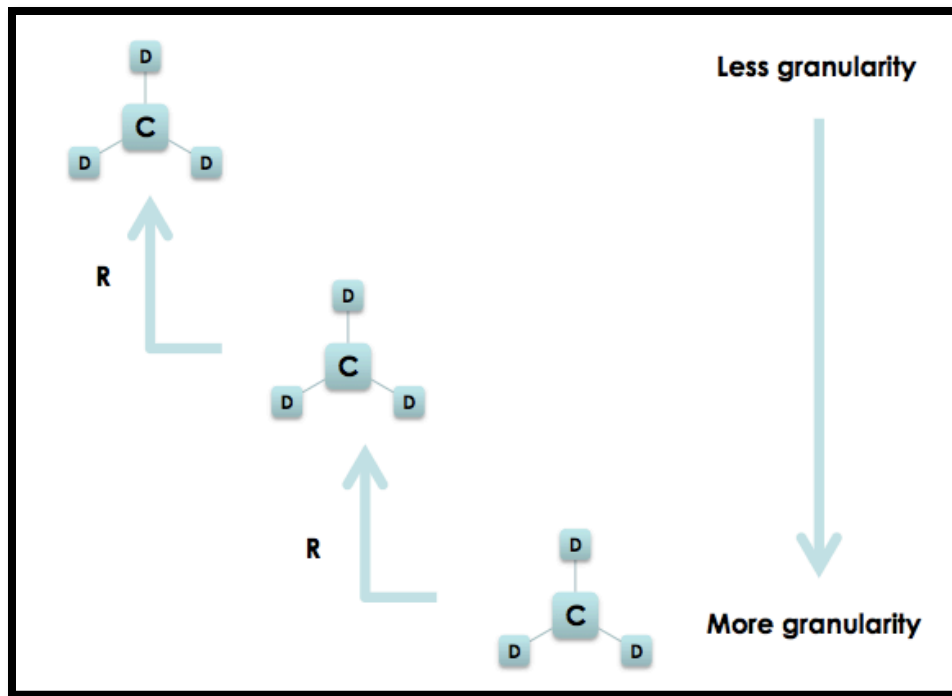


Figure 6: SNOMED CT structure 1

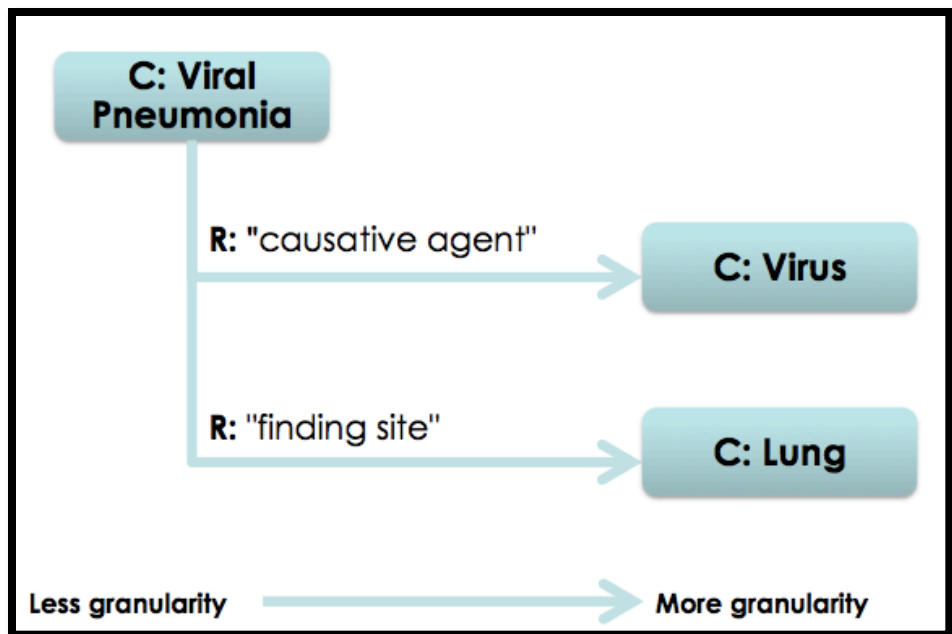


Figure 7: SNOMED CT structure 2

Using the structure of SNOMED CT, could create support tools for documentation that recognize the entered term and offer refinement options in order to add more detail to the

problem that is being created in the PL. In other words, if the system identifies the problem that is entering in the list, could offer terms existing previously in the system, but with more level of detail, but also, could provide attributes for those terms that could "complete" the concept, as being: the finding site, laterality, course, etc. SNOMED would become an ally in order to offer tools that improve the user documentation process, increasing the level of granularity of the problem list.

Users experiences are disparate: Other big challenge looking for gathering more detail for the problem list is the fact that users experiences respect the PL are very disparate. While some uses the PL a lot, some others only use it as minimum (others almost nothing). This add other difficult to de project to improve granularity, that is that you must work with different kind of users, going for experts to indifferent, and you should be prepared to work with this two universes. But this is not the only thing, sometimes, you have motivated users, but the flow in their works makes some times impossible to give more time to the documentation process, so, you have also be alert to this situations, and incorporate this not only in the education and communication process but also in the development of the project related with the topic and in the design of the strategies to improve the granularity.

Interfaces could not be the solution. One of the first approaches to improving performance in this area is to improve the interfaces for input problems into the problem list. Knowing the techniques of usability applied to the field of health, and the benefits that this strategy has demonstrated in the last time, could understand that better interfaces for input problems, adding even support tools based on international standards of terminology, as discussed earlier, may be beneficial for improving the level of detail in the problem list. This, however is

not as well, this association is not as linear. In this study, although the goal was not to test the interfaces, two interface were used , the current and traditional in our EHR and a new one, which incorporates SNOMED CT as background for improving the options offered and the development of interfaces using users centered design techniques. However, no significant differences could be detected respect one interface against the other. This does not imply that improving the interfaces is not beneficial, but it gives an idea that the problem is at least more comprehensive , and involves other aspects beyond the design of the loading screens . Strategies to address global solutions will be necessary to solve such problems.

This is just a thing in the quality of documentation problem. The problems regarding the quality of information are becoming more common and have been being addressed on numerous occasions in the last time. The conflict over the level of detail is just one more topic in the great problem of the quality of the information. In this sense, it is clear that the problem must be addressed together, rather than in isolation, to optimize strength and resources, and achieve an overall improvement in the quality of the data. These strategies should incorporate users in development of education and training programs, as well as in generating policies that give support to this and in the communication processes by which these policies will be announced.

Limitations

Perhaps one of the main limitations in this study is the small number of doctors who participated in the tests. While it is worth clarifying that it is not easy to have at least an hour of each physician, participating for free in the study, perhaps a more numerous sample had shown more conclusive results. However this study shows a trend on how doctors perceive the increase of granularity in the problem lists, and which level of detail they use to document. Also this study opens a lot of unknowns that must be addressed in different studies. Furthermore,

this study, although with limited users, contribute to the institution with a clear idea of the problems of communication of the policies relating to clinical documentation and the lack of knowledge by users of the applications and utilities of the problem list.

This study was developed at the Hospital Italiano de Buenos Aires, in Argentina, this is a teaching hospital, reference inter alia, in the use of health information systems. Most of our doctors were trained in the same institution, and have used the problem oriented EHR since its formation as residents, therefore, they are frequent users of the system and they know this kind of documentation. With this I 'm saying that this study, replicated in other institution, especially in Argentina, where the problem oriented documentation process is not used frequently, could shed worse results. However this study is valid to address and implement improvement measures regarding the granularity required in the list of problems

Similarly , the work was conducted in Spanish and the results were then translated into English. For this reason , and knowing some differences in the structuring of language, both tests as some considerations regarding the solutions , such as the use of standard terminologies should be validated in other languages.

PL is not use in the same way in all places. Other major complication is trying to improve the granularity in the list of problems is that this list is not used in the same way everywhere. So , while some hospitals use the PL as the basis of their systems of information , centralizing all clinical processes, education and research tasks, billing and administrative issues, including implementing clinical decision support systems and clinical care programs using this list, others however , use the list only to meet goals or government mandates (as meaningful use, for example) and do not use the information contained in the list for more than this. In between, of

course, there are endless options. The way in which the PL is used, and the roles and tasks that are triggered from it , largely determine the role of the PL and will define the level of detail necessary for this need. Therefore, it is very difficult to generalize on what is the appropriate level of granularity, and this could be seen as a limitation, since the study was conducted in an institution that focuses its processes in the PL, and implements all its tools from this list of problems. Maybe other hospitals, less focused on this list, need , or even currently register data in the problem list with less detail.

Level of detail is difficult to measure. As discussed before, measure the degree of granularity is a difficult task. No single or international standards exist for measuring the granularity, but also are not many publications on this topic so you can make as a guide and to make some comparisons. This study takes as basis for measurement of granularity the concept of sensitivity. Sensitivity for each case-strategy pair was calculated as the level of detail identified by the subject that is present in the case, divided by the total number of detail level in the case. This was extracted from similar articles that used this method to measure the detail level in the data capture system (27) but not necessarily on the same topic. So, in this sense, there is very little data to compare these results with others as a validation process of the information obtained.

It is not easy to standardize the way that problems are detailed. As we saw in this study, the usage profile of the different attributes is not the same for all health problems, so while in some pathologies the anatomical site is considered a primary attribute, and is detailed by all or almost all physicians who participated in the test (like the case of osteomyelitis) in other problems hardly was documented (like pneumonia). The behavior of medical versus how add

granularity is different not only in different problems, but also in reference to the same health problem, in some cases, in doctors who added a high level of detail, this level is not necessarily coincident, adding some enhance the anatomical site or laterality, while others add data relating to the course. Because of this, it is very difficult to standardize what kind of attributes are used more and which less.

What this study adds to HIBA projects?

The PL is the axis in our health information system, so quality is important. The quality of information is a limiting factor in information systems like ours that bases all its care tasks, research projects and administrative process in the list of problems, hence all strategies related to improving the quality of data improves ultimately hospital processes, and ultimately the quality of patient care. The HIBA to been working in recent years on measures for improving the quality of the information in your system, in this project, improved granularity in the list of problems in one of the main topics, therefore, this study serves not only as a basis for the implementation of improvements, but also opens new doors for the development of new studies on improving aspects that were evident in this work.

The policies define that PL should have the maximum granularity as possible. About which granularity is needed in the PL, our policies refer to the clinical information must be documented with the highest level of detail as possible . Thus the golden moment , when the doctor faces the patient and has all the information necessary to comply with this requirement, is not lost. The details that are not registered at this time will be very difficult to recover then , therefore , is very important to capture the maximum level of detail at this time. This level of detail will then be used, for example, to develop CDSS , but also may be used , through

terminology standards -based processes for use in tasks requiring less granularity . This is possible always that the PL has the appropriate level of granularity , but will be impossible if the level of detail is minimal . Because the hospital has a terminology server that can perform these processes so they do not interfere in the daily work of these , and so that it is "transparent" to the user, is that the hospital decided that its policy is to require to physicians to register the problems in the PL with the maximum level of granularity as possible.

In reference to that, the study shows that:

- Physicians do not know the policies: As much as the policies are written, published, accessed from the website of the hospital and be part of the training in the use of information systems, doctors are unaware of these policies. The doctors who participated in the test had not clear what his role against the list of problems, which were your responsibilities in reference to maintaining this list, and what level of detail required. Therefore be necessary to deepen communication strategies for these policies reach users.
- Many doctors have not clear which is the utility. There are, in the literature a lot of evidence that problem-based EHR has improved the systems of documentation and quality of health care, yet many physicians who participated in this study unknown, which is the use of the PL. Many of them only recognized the PL as a model for documentation, but not give any relation that the data contained in the list of problems are used to a lot of activities in the hospital. Similarly, although surprising, many doctors do not associate what they recorded in the problem list, which is then recovered when they asking data for reports or research projects. Thus it is not uncommon to

understand why doctors several times asking for data with a level of detail not typically incorporated into the PL.

- There is a large scatter in terms of the way that PL is used. Even in this brief sample, there is a wide disparity in how doctors use the problem list. While some use it frequently and document appropriately, though not always with the best level of detail, others use it only on rare occasions. This could be understood if we think in different specialties, referring to specialists would receive patients already created problems in their records and would not need to create them because they receive patients referred to their primary care physicians. But this is not so true, within the same specialty physicians, even within primary care, the use of the PL is very uneven. Studies to try to understand why this happens will be needed.
- The development of new interfaces might not be enough to solve the problem. As discussed earlier, although the design of new interfaces could be beneficial to improve the level of granularity in the problem list, this alone could not solve the problem. The HIBA has been work in the redesign of its interfaces with techniques of user-centered design. Within this project plans to modify the screens for input problems in the list. In principle, he understood that this could be helpful to improve the list of problems, but the study did not show significant differences in this. Thus although can be beneficial, more comprehensive strategies will be needed to address this problematic, and only change the interface might not be enough.
- Mapping vs. Post coordination. In the use of terminology standards like SNOMED CT, you can use mappings, that means that you use the terms existing in the standard or

post-coordination that mean that you "create" the problems with the attributes and relationships. International standards recommend to maintain post-coordination in a minimum level. One strategy to consider is that has to do with "make" the problem versus selecting a problem already created. In this study the level of detail selected agree with the mappings. Users tend to select "complete" problems and this will favor the use of mappings, which is beneficial to the systems of management, because it allows fast comparability and enables an easy interoperability. These options offer these terms as "ready" and thus obtain a double benefit , first facilitate the task of documenting, but on the other, unify criteria, allowing easy research process and standardize terms for a disease registry.

- Studies involving users could be beneficial. In this case, as in all, incorporate users in the new studies and invite them to participate in the design and development of new strategies could be beneficial. Incorporate them not only for the design of new interfaces, but also to understand the problematic and agree on policies to improve the clinical documentation and design strategies for the communication of these results could be beneficial. Hear them and make them part to the improving processes is always positive, so in this case there would be the same. Moreover, in this case, the requirements and policies may even stress or annoy doctors, they must, ultimately devote more time to the documentation, in order to achieve more and better detail level. So, incorporate them from the start can then facilitate the tasks of implementation.

Conclusion

Faced with the difficulty of finding evidence in which is the appropriate level of detail of the problem list, this study initially intended to be a breakthrough in detecting the level of detail that doctors would agree to document. The key point in this paper is what level of granularity is really necessary, and this will depend on the circumstances, contexts and ways in which each hospital uses their list of problems. This study is an approximation to some trends in this issue. Education, policies and information technology should address this topic in order to find equilibrium between what Health Information Systems need, and what users agree to do.

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