Developing an educational tool to promote evidence-based treatment in health care

A pilot study

Ben-Richard Sletten Ebbesvik

Research proposal for master's thesis in Software Engineering at

Department of Computing, Mathematics and Physics,
Bergen University College

Department of Informatics,
University of Bergen

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University of
Applied Sciences

Contents

Chapter 1

Introduction

1.1 Motivation

1.2 Research questions

- Can we make a data structure representing the paediatric possible asthma guideline Republic of Kenya 2016 in a very generic way?
- Based on the data structure, can we generate suitable scenarios, with multiple choice question with answer elements for training and evaluating health personnel?
- How can we structure the learning material to best train medical students, doctors, clinical officers, nurses and other health workers in the paediatric possible asthma guideline Republic of Kenya 2016?

1.3 Structure of the thesis

Chapter 2

Background

2.1 Clinical Practice Guidelines

For a clinician, Fervers, Carretier, and Bataillard (2010) claims that increased medical knowledge is associated with an exponential growth of scientific data and published material. It is impossible to keep up, as well as integrating all the new information into daily practice to give patients the best possible care. Masic, Miokovic, and Muhamedagic (2008) gives an example where a general practitioner should read 19 articles per day to keep up with the new medical information, while only having time to read one hour per week. The clinician will spend more time reading articles than treating patients.This problem is known as academic isolation.

Evidence Based Medicine (EBM) suggests that instead of routinely reading dozens of articles, the clinicians should target their reading to specific patient problems. Developing clinical questions and then searching for the answer (problem based approach), may be a more productive way to keep up with the new medical knowledge (Masic, Miokovic, and Muhamedagic 2008). The EBM definition further puts an emphasize on integrating the best evidence in decision making with the clinicians expertise and the patients values and expectations (Masic, Miokovic, and Muhamedagic 2008).

The concept of EBM is about transferring knowledge from clinical research into clinical practice, and Clinical Practice Guidelines (CPG) can play an instrumental role in this process (Fervers, Carretier, and Bataillard 2010).

The Institute of Medicine (IOM) has given the following definition of clinical practice guidelines: "CPGs are statements that include recommendations intended to optimize patient care. These statements are informed by a systematic review of evidence and an assessment of the benefits and costs of alternative care options" ((US) et al. 2011)

The definition given by IOM covers the goals in EBM, and also takes the cost into account. In fact, Clayton and Hripcsak (1995) have shown that in some situations good use of appropriate guidelines and protocols can reduce as much as 25% of the cost of healthcare.

Even though the CPGs have proven to improve the quality of health care while reducing practice variability and the cost of patient care (De Clercq, Kaiser, and Hasman 2008), it is well recognized that CPGs have had a limited effect on changing the clinicians practice methods. Cabana et al. (1999) lists the following reasons:

- Lack of awareness.
- Lack of familiarity.

- Lack of agreement with the content.
- Lack of self-efficacy.
- Lack of outcome expectancy.
- Inertia of previous practice.
- External Barriers; the guidelines are not easy to use, not convenient, cumbersome and confusing.

One example of external barrier is the Guidelines for the Diagnosis and Management of Asthma (National Heart Lung and Blood Institute and U.S. Department of Health & Human Services 2007), which consists of 440 pages. Such a large journal is not convenient to use at the point of care. According to Shortliffe (1998), CPGs in monographs and journal articles tend to sit on book shelves at the time their knowledge could prove the most valuable to the clinicians.

- Medical knowledge increases. Hard to keep track
- Guidelines is a summary of the available evidence of the medical conditions and provide management and recommendations
- A well-developed guideline reduces variations in care, improves diagnostic accuracy, promotes effective therapy and discourages ineffective therapies all which contribute to improved quality of care (citation)
- The CPGs are not used enough
- Dissemination and implementation
- Large volume of excisting guidelines. Difficult to use at the point of care
- Dissemination
- Different practice even in the same country

2.2 Serious games

2.3 Asthma

2.3.1 Challenges

2.4 Related work

2.5 Summary

Chapter 3

Method

3.1 Design study

3.2 Focus group

3.3 Workshop

The 22nd of February we had a workshop. The purpose of the workshop was to

- Identify components in the treatment plan of asthma patients.
- Identify difficulty levels, and how the questions will be more detailed for every difficulty level.
- Make a learning map.

The antecedences for the meeting was

- Professor in computer science Yngve Lamo. Background in model driven engineering and health informatics.
- Assistant professor in computer science Svein Ivar Lillehaug. Background in health informatics.
- Postdoctoral fellow Fazle Rabbi. Background in model driven engineering.
- Medical doctor and PhD student in health informatics Job Nyangena.
- PhD research fellow in interaction design Rosaline Barendregt. Has written a master thesis in gamification.
- PhD candidate in computer science Suresh Kumar Mukhiya.
- Master degree student in computer science Ben-Richard Ebbesvik.

Figure 3.1: Workshop with Yngve Lamo, Rosaline Barendregt, Suresh Kumar Mukhiya, Svein Ivar Lillehaug, Fazle Rabbi and Job Nyangena

Figure 3.2: Workshop with Yngve Lamo, Rosaline Barendregt, Suresh Kumar Mukhiya, Svein Ivar Lillehaug, Fazle Rabbi and Job Nyangena

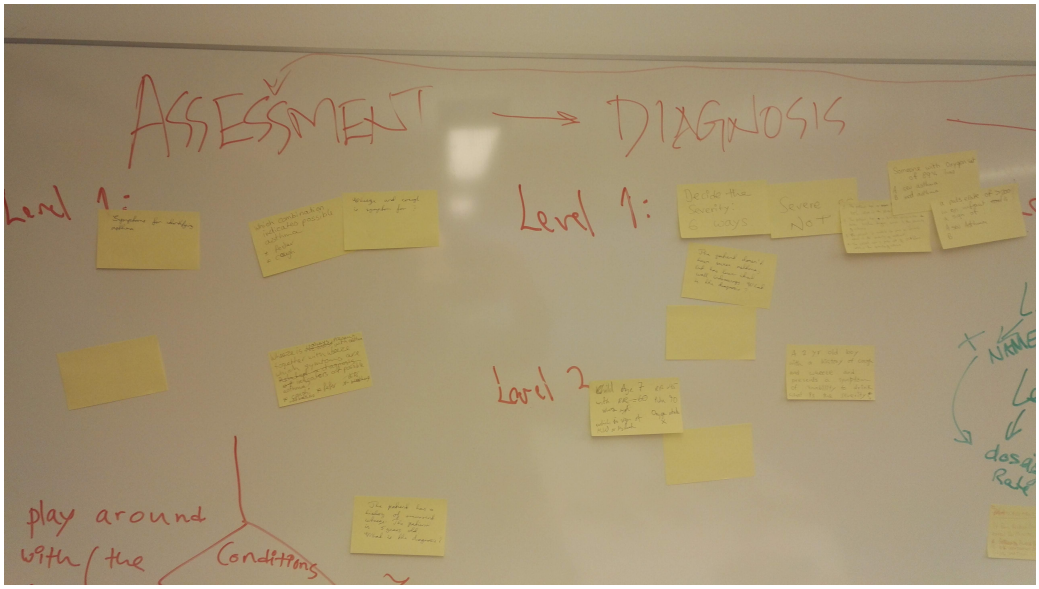


Figure 3.3: Workshop with Yngve Lamo, Rosaline Barendregt, Suresh Kumar Mukhiya, Svein Ivar Lillehaug, Fazle Rabbi and Job Nyangena

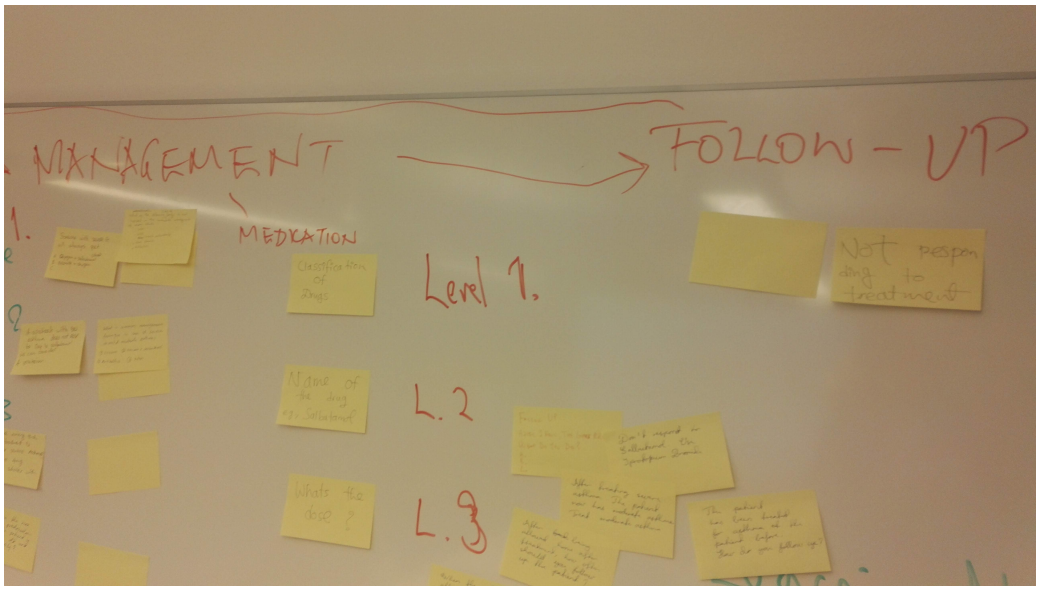


Figure 3.4: Workshop with Yngve Lamo, Rosaline Barendregt, Suresh Kumar Mukhiya, Svein Ivar Lillehaug, Fazle Rabbi and Job Nyangena

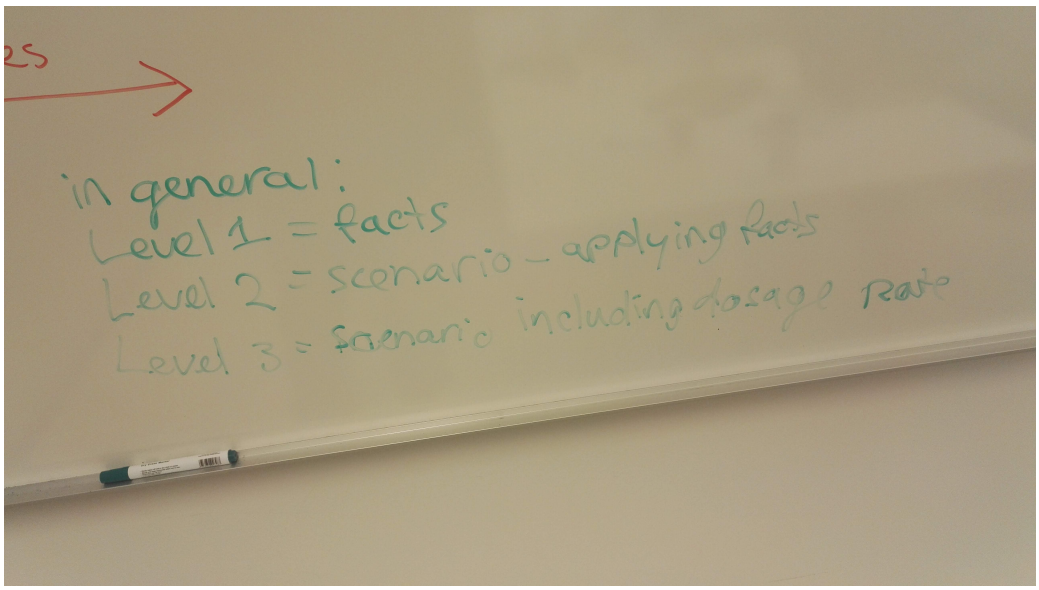
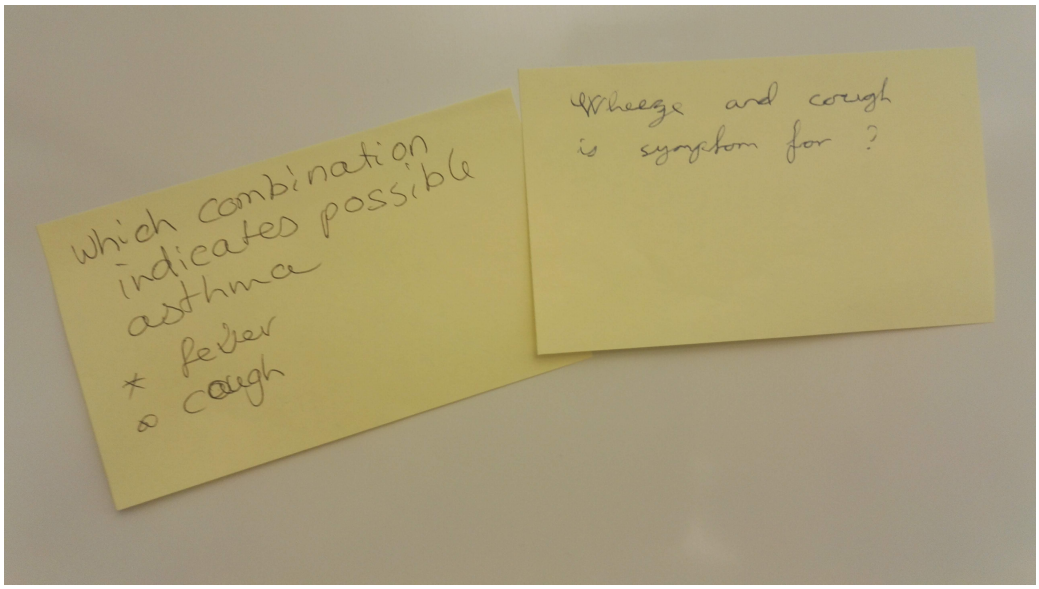


Figure 3.5: Workshop with Yngve Lamo, Rosaline Barendregt, Suresh Kumar Mukhiya, Svein Ivar Lillehaug, Fazle Rabbi and Job Nyangena



Chapter 4

Developing a learning tool for health workers

4.1 Extracting knowledge from the clinical practice guidelines

4.2 Data models

4.2.1 DPF metamodeling

4.2.2 Entity model

4.2.3 Workflow model

4.2.4 Game model

4.3 Game engine

4.3.1 Reward system

As each question in a quiz are related to a certain discipline or a certain task, the student will be measured how well he performed on each of these disciplines. For the asthma guideline, we have identified four disciplines. Assessment where the student will be tested in the initial examination. Diagnosis, where the student will determine a diagnosis as well as the severity. Management, where the student will determine which actions should be done to treat and best give the best care to the patient. The last discipline is the follow-up, where the student will be tested in evaluating the treatment, give advise to and educate patient and caregivers, provide the right medication and regular follow-up.

By splitting up the score in disciplines, the student can easily see which areas he is strong and where he needs more training.

We can also adapt the questions in each discipline to the students level. If the student has proven to be very good in providing the right amount of medicine to asthma patient, we can provide more difficult questions to challenge the student some more. If he struggles at setting the right diagnose, we can provide more basic questions to strengthen the students basic knowledge.

The disciplines should be automatically picked from the entity (and worflow?) model.

The tree structure of discipline scores. Diagnosis have examination, investigation, setting the severity. Management have advises, medication, admit, surgery and so on.

The student will also be provided with a total score, which will be the average score of each of the disciplines. The student can compare the total score of e.g. the asthma quiz and the jaundice quiz, and see which medical condition he needs to train more on.

Each question will have several answer alternatives the student can choose from. Each answer alternative will have a reward or penalty related to them. The correct answer will have a great reward, while wrong answers will have a small penalty. The quiz author will have the opportunity to specify the rewards, such that he can give even smaller penalties for partly correct answers. The idea of the reward- penalty system is to increase learning. if the student answers wrong the first time, he will be given the possibility to reflect over the question once more or perhaps read the guideline to learn before he commits his second attempt. We are aware that providing a minus score for making an attempt can be very demotivating, but it is to avoid the situation where a student gets the same (or better) score for making ten attempts than only needing one attempt. A small penalty will have a very small impact when the reward per question is high, but in situations where the student performs very poorly and ends with a negative total score, it is possible to adjust this to a small positive score on presentation for the student. Not giving a too harsh feedback for trying to learn.

A solution to having a not very strict game, encouraging to playing and learning, one can also have a very strict examination version. The idea is that after examination, the results will be sent to the lecturer (or a governing body of some kind) to evaluate what the overall knowledge of the students, as well as details of what the students are really good in and where do they struggle. The lecturer can then target the weak of points of the students in one of the next lectures.

4.3.2 Unlocking harder levels at a certain category

(somewhere in the paper I need to refer to Eides, Kristensens and Lamos paper, and discuss the knowledge, learning and student maps and that they need to prove basic knowledge in some disciplines before they can unlock content in other disciplines.)

4.3.3 Visualization of game statistics

4.3.4 Automatically generating new questions

4.4 The mobile application

- React
- React-Native
- React-Native-Navigation (Wix)
- Redux
- React-Redux
- Redux-Thunk
- Highcharts
- Jest

4.4.1 React-Native and Redux

4.4.2 User interface and flow of the user interaction

4.5 Architecture of the whole system

4.5.1 Visualization

4.6 Evaluation

Chapter 5

Discussion

5.1 Research questions

5.2 Limitations of the model

- Can't ask questions like "what are the symptoms for severe asthma?"
- Difficult to ask what NOT to do. If the vertex doesn't exist, only an empty string gets returned. Can only be used were we actually have written "don't admit to the hospital" as an example with hospitalization.
- The inheritance makes it difficult to generalize some questions. We can't make a template which asks about the Rate a medicine should be taken with. We need to specifically ask for that medicine. To be able to ask for a general medicine, one solution can be to introduce a new tag which compares the substring of the type of the vertex. Another solution is to use the meta model and not the instance model. We don't use inheritance on diagnosis because of this.
- To avoid the problem described in the previous point, we don't use inheritance on Diagnosis. A limitation here is that a patient can only have one diagnosis.

5.3 Observations

5.4 Challenges

5.5 Reflection

Chapter 6

Conclusions

6.1 Further research and development