



# User Communication, Design Methods Study and **Cardiac Compression Board Design**



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**Abstract:**

This research project focused on the study of user communication and design methods. By ways of study the cardiac compression board (CPR board) design, the aim of this research is to finding some useful suggestion for the future design about user communication in order to improve design. The design of cardiac compression board was used in turn to be the embodiment of the possible design proposal.

Based on the background research of the theory, medicine and product, research first explored and defined several key words; the combination of user-centered design, activity-centered design and genius design theory were applied in this project. Furthermore base on these three basic design theories, four modes of research methods were utilized in this project: 'learn', 'look', 'ask' and 'try'. Each of these four modes has several specific methods. Those methods relative to the user communication and the particular product, CPR board, were picked out for this project and utilized in. All the process of applying those methods was documented in this thesis using as the evidence of the user communication for the design. The information from user communication formed the basic of the CPR board design; the activity analysis and the capacity of designer also play a very important place to make full use of the favorable factors to form an integrated design method.

The CPR board design was based on the information collected from those four modes of research methods. All the details were tested and determined with user communication and base on the requirement from user communication. An evaluation was made to show the result of the design. It shows that the design proposal generally meet the requirements and further proof that the design

methods was appropriate for this project.

In the last chapter, the findings from the research process were listed and argued hoping to help the future research on user communication. The suggestion for future research was also list in this chapter.

**Key word:**

User communication, Design methods, Cardiac compression board, User-centered design, Activity-centered design, Genius design





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## Reading Guild:

This written component is structured into 7 main chapters. For an overview of this written component, the content of each chapter is also outlined in following figure.

- 1 Chapter 1**  
This chapter introduces the background of this study, research questions, the what, why, how of the project and the generally nowadays situation.
- 2 Chapter 2**  
This chapter aims to provide background context for further research. The general understanding of terms and contemporary research method on user communication are outlined within this chapter.
- 3 Chapter 3**  
This chapter aims to establish a general understanding of the product and the using situation. The following design motifs are the focus of this analysis:  
The principle of CPR  
The function principle (medical based)  
The using surrounding  
The using activity (related to the activity-centered design theory)  
The certain Cardiac compression board exemplar study
- 4 Chapter 4**  
The purpose of this chapter is to develop a research program which focuses on the development and testing of an appropriate cardiac compression board design proposal for certain surrounding especially on user communication.
- 5 Chapter 5**  
In this chapter, the analysis of using these methods will be documented. In the first section of this chapter, the overall communication condition was elaborated to give a detail.
- 6 Chapter 6**  
This chapter is the part of concepts development after the communication. In this chapter, different concepts will be analysis and compare. The final concept and final product will be presented as the result in the end of this chapter.
- 7 Chapter 7**  
The conclusion to the study and suggestion for future research





## Table of contents

**Abstract** ..... I  
**Acknowledgements** ..... II  
**Reading Guild** ..... III  
**Table of contents** ..... IV

### Chapter 1

**Background of the study** ..... 1  
 1.1 Research Question ..... 1  
 1.2 What, Why, How (3W about this project) ..... 2  
     1.2.1 What ..... 2  
         1.2.1.1 What is the Problem ..... 2  
         1.2.1.2 What is the Goal ..... 3  
     1.2.2 Why ..... 4  
         1.2.2.1 The reason from myself ..... 4  
         1.2.2.2 The reason from the partner ..... 4  
     1.2.3 How ..... 5  
 1.3 The nowadays situation ..... 6  
     1.3.1 The design communication situation ..... 6  
     1.3.2 The cardiac compression board situation ..... 8

### Chapter 2

**Background Research Base on Theory** ..... 9  
 2.1 Definition of terms ..... 9  
 2.2 Contemporary research method on user communication ..... 12

### Chapter 3

**Background Research Base on Medicine and Product** ..... 15  
 3.1 The principle of CPR ..... 15  
 3.2 The function principle of cardiac compression board ..... 17  
 3.3 The using surrounding ..... 20  
 3.4 The using activity (related to the activity-centered design theory) ..... 21  
 3.5 The certain product analysis ..... 25

### Chapter 4 Design Research

..... 28  
 4.1 Research approach ..... 28  
 4.2 Research methods ..... 30  
 4.3 The balances between some corresponding aspects ..... 33

### Chapter 5

**Product Development through user Communication** ..... 34  
 5.1 The overall communication state of affairs ..... 34  
     5.1.1 The users involved in this study ..... 34  
     5.1.2 The hospital involved in this study ..... 35  
     5.1.3 The manufacture involved in this study ..... 36  
     5.1.4 Choosing the using surrounding ..... 37  
 5.2 The 'learn' methods results and discussion ..... 38  
     5.2.1 Activity analysis ..... 38  
     5.2.2 Error analysis ..... 40  
     5.2.3 Character profiles ..... 46





5.2.4 Anthropometric analysis .....	47
5.3 The 'look' methods results and discussion .....	53
5.3.1 Fly on the wall .....	53
5.3.2 Shadowing .....	53
5.4 The 'Ask' methods results and discussion .....	56
5.4.1 Survey & Questionnaires .....	56
5.4.2 Extreme user interview .....	60
5.5 The 'Try' methods results and discussion .....	61
5.5.1 Scenarios .....	61
5.5.2 Role-playing .....	64
5.5.3 Paper-prototyping .....	65
5.5.4 Scale modeling .....	65
Conclusion .....	67

## Chapter 6

<b>Product Concepts Development and Final Product</b> .....	68
6.1 The overall conclusion information from communication .....	68
6.1.1 Different user analysis .....	68
6.1.2 Hospital mood board .....	68
6.1.3 The requirements list .....	71
6.2 The concepts .....	72
6.3 The detail of final concept .....	81
6.3.1 The length and width .....	81
6.3.2 The shape .....	83
6.3.3 The lower corner shape .....	83

6.3.4 The lock pattern on the front surface .....	85
6.3.5 The center of the surface lock pattern .....	85
6.3.6 The edges .....	86
6.3.7 The area of center space of surface lock pattern .....	87
6.3.8 The thickness of each step	
The distance between steps	
How many steps .....	87
6.3.9 The thickness of the CPR board .....	89
6.3.10 The position and the size of the handle .....	89
6.3.11 The curve of head holding part .....	90
6.3.12 The slope between adjacent two steps .....	91
6.3.13 The material of product .....	91
6.3.14 The color of product .....	92
6.3.15 The storage of CPR board .....	92
6.3.16 The manufacture suggestion .....	92
6.3.17 The environment thinking of the product .....	92
6.3.18 The product image .....	93
6.4 The model making .....	94
6.5 The evaluation .....	99

## Chapter 7

<b>The conclusion to the study and suggestion for future research</b> .....	100
7.1 The conclusion to the study .....	100





7.2 The suggestion for future research .....102

**Appendix**

Appendix1: Questionnaire ..... 103  
Appendix2: User communication questionnaire ..... 104  
Appendix3: Figure list .....106  
Appendix4: Table list .....108  
Appendix5: 2D drawing .....109  
Appendix6: Reference .....110  
Appendix7: time table .....111





## Chapter 1 Background of the study

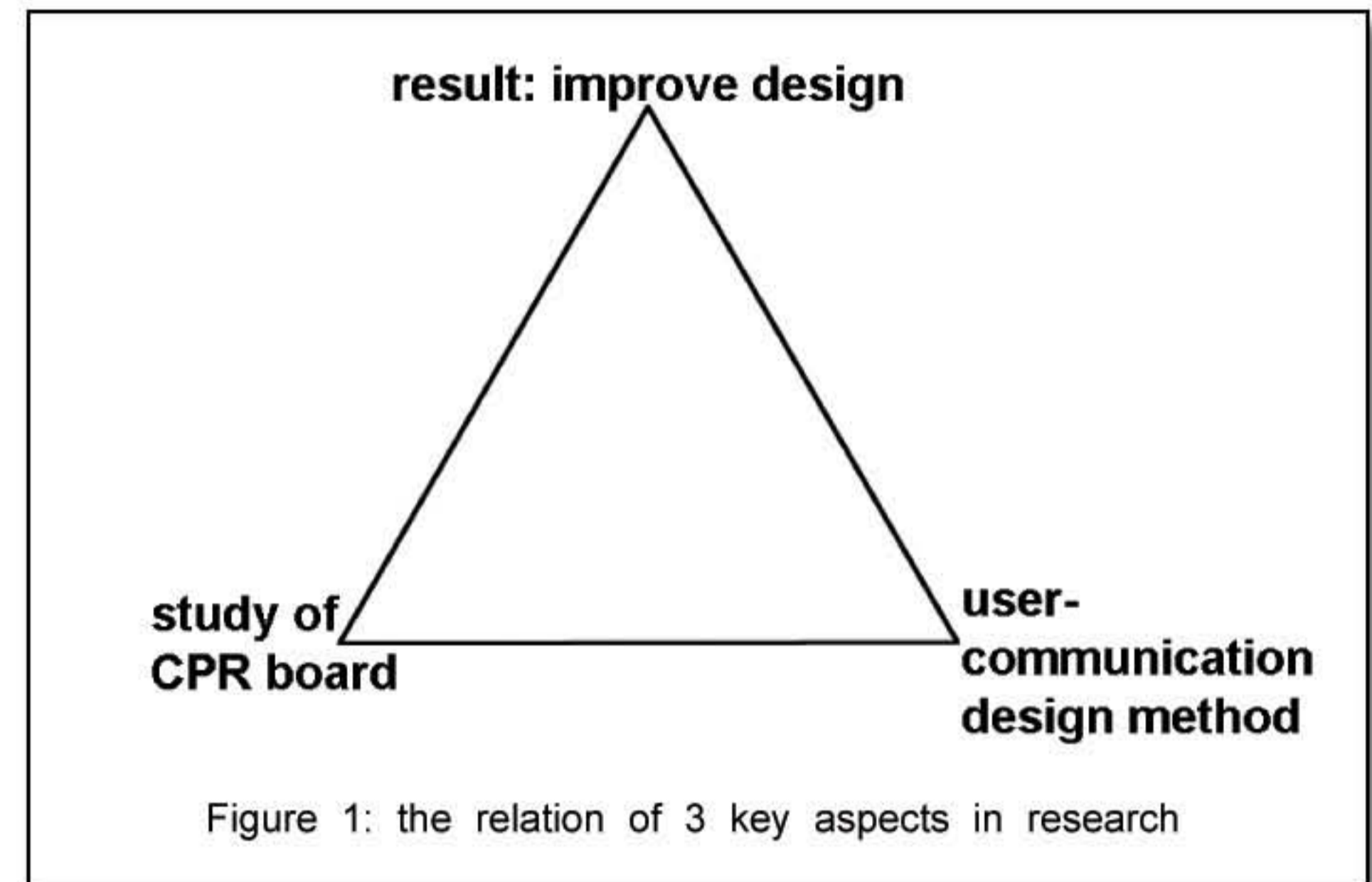
This chapter introduces the background of this study, the research question. It introduces the “What”, “Why” and “How” of this project including the goal, the proposition, the method to apply and objectives.

### 1.1 Research Question:

Here I list the research question at very beginning to make it clear to you to understand.

Research question:

**How to achieve improvement of design through user communication and design methods, by ways of a study of cardiac compression board (CPR board)**





As you see, there are three important aspects in this research question: improve design---the expected result; user communication (design method) ---the main method be studied in this project; the study and design of cardiac compression board (CPR board) --- the design of product which realize the user communication study. These three aspects are interacting. The improvement of design is the final expecting result. The user communication is the focused method which will be used to fulfill the result. The study of cardiac compression board is the certain product which will be design and put the study of user communication into practice. So figure 1 shows the interrelation of my project and study which helps to sort out the relation of these main three aspects.

## 1.2 What, Why, How (3W about this project)

### 1.2.1 What:

#### 1.2.1.1 What is the Problem:

Nowadays, for the market oriented world, the design should be more user-centered since the user is the person who will really have the “communication” with the products. If the communication between user and product is bad, the product will be dissatisfied. What will be caused directly is the decline of selling, which will lead to a vicious circle of the design-produce-market loop. Take China market as an example, although the products, the selling are not bad than some very famous international company, some of the customs still think the product from those international company are better. Excluding the reasons from branding and other steps, the lack of communication with the users or low-quality of communication is one of important reasons which lead to this result. What I want to say is although the reasons of why some of the products are popular in the market are complicated; there is no doubt that the nice communication between users and products is an advantage for some products.

In the process of every design, the user communication is a very important step which might go through all the way of the design process. However most of the designers or the product design teachers don't pay enough attention on the user communication. Most of the thoughts on this might be superficial and not so helpful. Some of the designer just assume what are the users' thoughts, and make some questionnaires which lead the users give answers





what the designers want. So in this way, these kinds of questionnaire or communications are meaningless. The information is not interoperable. The manufacture, the design company operated separately. Some of the products are just based on the imagination of the developers. I am not meaning that the imagination and innovation are not necessary. What I mean is those competence should be base on the users. For example, one company developed product. There will be a lot of companies do the similar products like the product first developer have. No one notice what is the market needing; and how to make ones own product has identity different from others. Although some of the developers notice the feedback from the market. It is alright after-development. There was already wasting a lot of money, time, material and other inputs. So the nice communication is what we required.

How to achieve this nice communication? Of course there are several methods to improve it. For example, the Post Marketing Surveillance (PMS) , the feedback from the market will be a possible way to have the communication. What I want to emphasize here that the consideration of it during design process is very important method and the problem which should be improve. So the most functional method is involving the users in the process of developing. If the design communications can be helpful and work in a functional way, the design result, the product, will have a higher degree of satisfaction from the users.

The further problem is how to communicate with someone might without design background or totally different background. So the way of communication and design methods should be

carefully considerate. As the designer, we shouldn't take anything for granted. There is bidirectional communication. What the designer familiar is might not be understand by the user, meanwhile what the user familiar, for example the field of medical knowledge, the law, the agriculture, etc., are also not familiar by the designers. Thus, with the different professional background, the communication between the users and designers are even more difficult. This is also a problem about communication.

#### 1.2.1.2 What is the Goal:

The goal of this research is to develop an appropriate practical design suggestion the cardiac compression board with emphasis on user communication and design methods and by the research process finding some useful suggestion for the future design user communication.

What I want to achieve is the improvement of the user communication which is a part of design methods, and then to achieve improvement of design, improve the quality of product, subsequently improve the degree of satisfaction of users. So for this paper, the main goal is not only the product itself but to the same extent the process of design.

Since I am doing the project of cardiac compression board, it is relative to the Medical Specialty. So how to have better communication with the different professional background is also the aim of this project. With case study of CPR board, the nurses and the patients are the actual users of CPR board. Through the design of it, I try different ways of communication. Since the real users should be included in the design process to enhance user





communication. The eventual central proposition of result is to find out a functional way to communicate which will help other designers to do the design communication in the similar situation.

The CPR board is a typical case for designer in this situation. The users of CPR board are the patients and nurses without design background usually. Nowadays in the design process of the CPR board, there is a lack of the concern of users' communication through design method. What I want to do is to improve the user communication as it is used in the study and find out a better method with the study of CPR board.

## 1.2.2 Why :

Why I choose this topic as my master thesis, there are two aspects of reasons:

### 1.2.2.1 The reason from myself:

For my personal reason, I will go to work in school after the education. So I think maybe to work as a teacher if it possible, knowing how to design or how to communicate with user is more important or valuable than knowing a certain specific topic design. User communication is an indispensable part during every design project. How the design communication goes on and which design methods are used will influence the design during the design process. I want to study it by focusing on the users relations in the design of CPR board, to see how the communication influences the process and the result.

What I want to achieve is the improvement of the user communication which is a part of design methods, and thus improve the quality of the product, subsequently improve the degree of satisfaction of the users.

### 1.2.2.2 The reason from the partner:

In the practical period, I have been working with the Nursing department of Hiak, the cooperation was very well. The teachers and students in nursing department are willing to communicate, which will help me a lot during the process of user communication study. The possible networks they have, the hospital or maybe the medical device manufacture, can be the advantage. I have already





done some research in this area. I will use this cooperation, and make the CPR board as a case study.

### 1.2.3 How :

In order to achieve nicer result, realization and expositing clearly, the 50% practical / 50% written theory is be utilized in this thesis. Base on the theory and method research, I did the practical research on user communication. It was be result in a three-dimensional model in the thesis in response to the study of communication methods. An evaluation of the process and the outcome is included in the chapter next to the last.

The user-centered theory is be utilized during the design process especially focus on the user communication. Combing with the theory of activity-centered design and genius design, this project tries to give a good example that how to communicate with users.

Relative to the requirements from users, the competence of designer is also very important. The process of product developing is a process balanced between the requirement of users and designers competence. So it is one aspect I try to control.

Because I have the cooperation relationship with the Nursing department of Hiak, the communication with users will be take place firstly in the nursing students. Those nursing student are professional nurses already. The professional knowledge they have will be very helpful for my research.

For the design process and research methods used, In order to improve the user communication, I tried different ways of communication and did the design research, for instance, interview, observation, activities and questionnaire etc. However all these research methods are be guided or conducted to tell the





result. For example, the directed storytelling, asking users to tell story about specific times they performed an action or interacted with the product, which is one of the methods in interviewing. For the case study of CPR board, the nurses are one part of the users. So the role-play and scenarios were used separately or simultaneously in this research. The real situation is an advantage which I can utilize by the cooperation with the nursing department.

Beside the verbal communication, the non-verbal behavior is also method of communication. We can get a lot of meaningful information from the gesture and non-verbal behavior.

The certain product study analysis gives me a lot of ideas for design, thus the study of the nowadays research and nowadays product is be done.

The real situation test is a way to check the outcome of the user communication. Whether the product works well is the first hand information from the users.

### 1.3 The nowadays situation:

#### 1.3.1 The design communication situation

The design communication is a very important part during design. However there are several problems of the user communication in design process.

##### 1. who should be the main body to communicate

Many designer think the communication for granted as the user is the passive aspect. In fact, the user communication should be a process of bidirectional. The unidirectional communication is unethical and inefficient and it promotes a passivity that in the long run will weaken our civilization. "The process of communication should be seen as a process of negotiation where the position of the originator of the information and that of the interpreter enter in contact searching for a common terrain." <sup>1</sup> (Design and the social sciences: making connections, 2002, p34)

##### 2. how to communicate

The designer should remember that people can only understand things that relate to things that they already understand, and out of that scope it is very difficult to communicate.

As I said previously, the user probably have no deign background, so the way of communicate is another aspect which the designer usually misunderstand.

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1. Design and the social sciences: making connections, 2002, p34





### 3. the system of communication

Now, a lot of designer knew that it should be the user communication in the process of design. Just like you can not design a coffee machine without ask the coffee drinkers.

However the user communication now is not integrated. It usually does but not well dose.

A small questionnaire was made to show general nowadays user communication. The people who replied this questionnaire are product design students and young product designers in Norway and China. There are totally 46 sheets of answers.

From the answer we can see that most of them think user communication is very important, but the people think it is not very important or not necessary still takes a certain percentage. 32 of them do user communication sometimes. 18 of them think it works sometimes. Fortunately none of them choose the option 'I don't think it is useful'. For the methods of user communication, the verbal/written interview and questionnaire takes a big percentage. Compare to those well known methods such observation, interview; some methods like role-play, immersion, and behavior-mapping have little selector. Referring to the communication round, 2 times and many times have a lot of supporters.

(Appendix 2)

Therefore, it can general concluded that the user communication already arouse the attention of designers, but it still have some problems during the user communication process.





### 1.3.2 The cardiac compression board situation

The cardiac compression board now is just a piece of plywood or plastic board without any identity. What more seriously is this kind of cardiac compression board can not satisfy the need of nurses when execute CPR.





## Chapter 2 Background Research Base on Theory

This chapter aims to provide background context for further research. The following areas of research are explored (in sequential order):

- The general understanding of terms
- Contemporary research method on user communication

### 2.1 Definition of terms

Since this project is base on the user communication and design method, and especially focus on how to communicate with the users. I have to give a definition of communication and related design theory.

#### **Communication:**

In Oxford English Dictionary

II. Senses relating to the imparting or transmission of something

**b.** *spec.* The transmission or exchange of information, knowledge, or ideas, by means of speech, writing, mechanical or electronic media, etc.

(Oxford English Dictionary)

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#### 2 In Merriam-Webster dictionary,

1 archaic : share

2 a : to convey knowledge of or information about : make known <communicate a story> b : to reveal by clear signs <his fear communicated itself to his friends>

3 : to cause to pass from one to another <some diseases are easily communicated>intransitive verb 1 : to receive Communion

2 : to transmit information, thought, or feeling so that it is satisfactorily received or understood <two sides failing to communicate with each other>

3 : to open into each other : connect <the rooms communicate>

(Merriam-Webster Dictionary)

#### 3. Oxford English Dictionary





Although there are a lot of context to give the definition of this term, however we can see that communication is way to transfer or exchange information in general.

So the way of communication is not a one-way transfer of information, it should be a bi-directional transfer of information.

What's more we can comprehend from the definition is the ways of communication are various. It can be writing, speech, listening, and feeling.

In this project, the communication is the way to understand the users. What the communication donates is getting the information and exchange information between the users and designer. What got from the communication are the foundation sources to design. Those primary data or uses secondary sources were collected. The process of data collecting is a way of communication. Then the feedback exchange between the user and designer also is the process of user communication. The post marketing surveillance (PMS) is also the process of user communication. In this project, it is not focus on the post market period. The main aim is to achieve design by the user communication. Making the users involved into the design process is the way to improve it.

#### **User-centered design:**

There is no absolutely authoritative definition of user-centered design. But we all know that user-centered design (UCD) is a project approach that puts the intended users of a site at the centre of its design and development. In broad terms, user-centered design (UCD) is a design philosophy and a process in which the needs, wants, and limitations of end users of an

interface or document are given extensive attention at each stage of the design process.<sup>4</sup>

(Designing for interaction, 2nd edition, p33)

In the best (or at least the most thorough) UCD approach, designers involve users in every stage of the project. Designers consult users at the beginning of the project to see if the proposed project will even address the users' needs. Designers conduct extensive research to see what the users' goal is. Then, as designers begin ideation, the users are brought in to help generate concepts. Designers evaluate and test prototype with users as well.

So we can see that the users' goal is very important in UCD, since it is the focus from very beginning and it is what the users ultimately want to accomplish.

#### **Activity-centered design:**

Activity-centered design (ACD) doesn't focus on the goals and preferences of users, but instead on behavior surrounding particular tasks. Activities can be loosely defined as a cluster of actions and decision that are done for a purpose.

Many of the products we use today were designed using activity-centered design, especially functional tools like appliances and cars. Activity-centered design allows designers to tightly focus on the work at hand and create support for the activity itself, instead of for more distant goal. Thus, it's well suited for complicated actions or for products with varied and large amounts of users.

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4. Designing for interaction, 2nd edition, p33







Figure 2  
Cello is a product that definitely designed using activity-centered design

Like user-centered design, activity-centered design relies on research as the basis for its insights, albeit differently. Designers observe and interview users for insights about their behavior more than about their goals and motivations. Designers catalog users' activities and tasks, perhaps add some missing tasks, and then design solutions to help users accomplish the task, not achieve a goal.<sup>5</sup>

(Designing for interaction, 2nd edition, p35)

### Genius design:

Genius design relies almost solely on the wisdom and experience of the designer to make design decision. Designers use their best judgment as to what users want and then design the product based on that judgment. User involvement, if it occurs at all, comes at the end of the process, when users test what the designers have made to make sure it really works as the designer has predicted.

5. Designing for interaction, 2nd edition, p35

This is not to say that designers who practice genius design don't consider users---they do. It's simple that the designers either don't have the resources or the inclination to involve users in the design process. Designers use their personal knowledge (and frequently the knowledge of the organization they're working for and research from others) to determine users' wants, needs, and expectation.<sup>6</sup>

(Designing for interaction, 2nd edition, p43)

6. Designing for interaction, 2nd edition, p43





Table1: Three Approaches to Design

Approach	Overview	Users	Designer
User-centered design	Focus on user needs and goals	The guides of design	Translator of user needs and goals
Activity-centered design	Focus on the tasks and activities that need to be accomplished	Performers of the activities	Creates tools for actions
Genius design	Skill and wisdom of designers used to make products	Source of validation	The source of inspiration

From the table above, we can see the main differences between the three design theories/ approaches. The design communication is a way to understand user and meanwhile to achieve better product which occurs all the way of design, the communication with user, the communication with literature, the communication with technology. In this project, the main focus is the communication with user. Whereas it doesn't mean that it has to be totally about the users. Since the information from user that one designer can collect is just one part of the whole. So the activity-centered design theory and genius design theory were utilized together. But the activity-centered design theory and genius design theory are also based on the user communication.

## 2.2 Contemporary research method on user communication

*Research methods are procedures and strategies that could prove useful in implementing a piece of research work.*<sup>7</sup>

---Edvard Befring

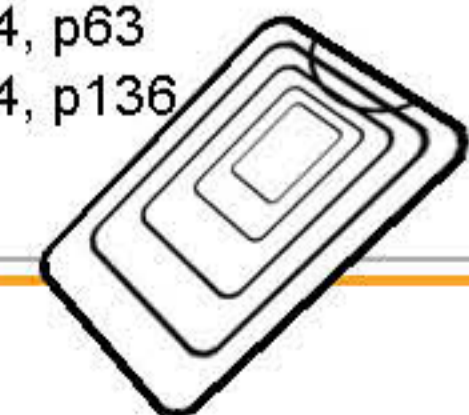
(Research methods, ethics and statistics, 2004, p63)

The methods can be used for understanding people, for understanding what benefits they want from products, for understanding how to deliver this through the design and for evaluating design concepts. However the methods are not equally suited to each of purposes. Each of the methods has particular properties that affect its suitability for use at different stages of the design process and under different operational constraints.<sup>8</sup> (Research methods, ethics and statistics, 2004, p136) For example, some of the methods may be particularly useful in understanding people; some may be useful in evaluation process, others in familiar the setting of the products and others in understanding the activities.

With respect to user communication, most of the methods may belong to the empirical methods. Private camera conversation, focus group, experience diaries, reaction checklist, field observation, questionnaires, interviews, immersion, etc. are all based on the experience. Those methods are commonly used more or less in the design process.

7. Research methods, ethics and statistics, 2004, p63

8. Research methods, ethics and statistics, 2004, p136





**Private camera conversation:**

This method involves participants entering a private booth and talk to a video camera about a product or product concept.

**Focus groups:**

The focus group---a technique originally developed within the discipline of market research--- is group of people gathered together to discuss a particular issue. The discussions could cover, for example, users' experiences of using a particular product, their attitudes towards the aesthetics and functional aspects of a particular product, information about the contexts in which they will experience the product and the types of pleasure or displeasure that they associate with a particular product, or simply their general preferences and dislikes with respect to product design.

**Experience diaries:**

Experience diaries are mini-questionnaires that are issued to users in order that they can make a note of their experiences with a product over a period of time.

**Reaction checklist:**

Reaction checklist is a list of potential reactions that a person may have to a product.

**Field observation:**

Field observation involves watching people in the environment in which they would normally experience a product. Because the investigator directly observes the participant, this gives a degree of

validity that might be lacking in investigations that rely on participants' reports.

**Questionnaires:**

There are two categories of questionnaires---fixes response questionnaires and open-ended questionnaires. With fixes response questionnaires, people are either presented with a number of alternative responses to a question and asked to mark the one that they feel is most appropriate, or they are asked to register the strength with which they hold an opinion on a scale. With open-ended questionnaires, respondents are asked to write their own answers to questions.

**Interviews:**

Here the investigator compiles a series of questions that are then posed directly to participants, usually in a face-to-face situation or perhaps over the telephone. There are three broad categories of interview---unstructured, semi-structured and structured.

**Unstructured interview**

In an unstructured interview the investigator will ask respondents a series of open-ended questions. This type of interview may be most appropriate in situations where the investigator has little idea, in advance, of what the issues of concern to the people experiencing the product might be.





### Semi-structured interview

With a semi-structured interview, the investigator would normally have a clearer idea of what he or she considered to be the relevant issues for an evaluation and thus of the sorts of issues that he or she might expect respondents to cover when answering question.

### Structured interview

Structured interviews ask the respondents to choose a response from within a pre-set range.

### **Immersion:**

This technique involves the investigator experiencing a product himself or herself and evaluating the pleasurability of the product on the basis of their own experience.<sup>9</sup>

(Designing pleasurable products---an introduction to the new human factors, 2000)

I don't elaborate what methods this project use in this chapter. The argument of choosing methods in this project will go into particular in the chapter 4.

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9. Designing pleasurable products---an introduction to the new human factors, 2000





## Chapter 3 Background Research Base on Medicine and Product

Cardiac compression board is designed to be the device which will be used in certain environment during executing cardio pulmonary resuscitation (CPR).

It's a device which will help to save the life of patients. So whether it will be functional and fast used is the most important part of this device. In another way to say, the central qualities of cardiac compression board are functional and fast using.

This chapter aims to establish a general understanding of the product and the using situation, establish their significance to the cardiac compression board design and discuss their implication of use in context to the user communication. The following design motifs are the focus of this analysis:

- The principle of CPR
- The function principle (medical based)
- The using surrounding
- The using activity (related to the activity-centered design theory)
- The certain Cardiac compression board exemplar study

### 3.1 The principle of CPR:

In order to understand the reasoning of design of cardiac compression board, it has to have the knowledge of cardio pulmonary resuscitation (CPR). So at the very beginning of discuss of function, it will introduce the medical principle of CPR first.

#### When the CPR will be executed:

When the victim stops breathing and the pulse disappears, the cardio pulmonary resuscitation (CPR), first aid techniques using artificial respiration and external cardiac massage, will be utilized.

#### ● The principles of CPR:

It is necessary to understanding the importance of the function what the heart, respiration to blood circulation. The heart is divided into left-and-right cardiac atrium and left-and-right ventricle. The blood is pressured up from the right atrium via the right ventricle, and then it is sent to alveolar pulmonary in order to obtain blood oxygen by dialysis, and then into the left atrium through the pulmonary veins, back to the left ventricular pressured by main artery delivering to the body to maintain the vitality of cell functions. Especially for cardiac and brain cells, the oxygen is even important.

There is 80% nitrogen, 20% of oxygen in air, including some other gases. We know that through laboratory analysis there is still about 80% nitrogen, 4% carbon dioxide, and the oxygen is reduced to 16% in the air after human breath and then exhale.





This analysis let us know that the amount of oxygen is still sufficient supply of our normal requirements via the normal breathing and exhaling. So artificial respiration blowing air into the lungs, with the cardiac massage to encourage the recycling of blood from the lungs to exchange oxygen to the brain and body is an efficient way to maintain brain cells and organ tissue survival. The requirement of doing CPR, it has to situate the patients in a hard surface and keep the patients' airway is open. This is the function principle of cardio pulmonary resuscitation (CPR).

- **The importance of CPR:**

Because of the termination of human respiratory and heart beat, brain, heart and organs gradually necrosis because lack of oxygen supply. Within **four** minutes the oxygen in the lungs and blood can still maintain oxygen supply. So in four minutes, fast first-aid CPR will help to keep brain cells from damage and have full recovery. In 4-6 minutes, it is possible to have brain cells damage depending on the situation. There will be varying degrees of damage more than six minutes. But it would surely caused necrosis of brain cells due to oxygen deficit for ten minutes or more.

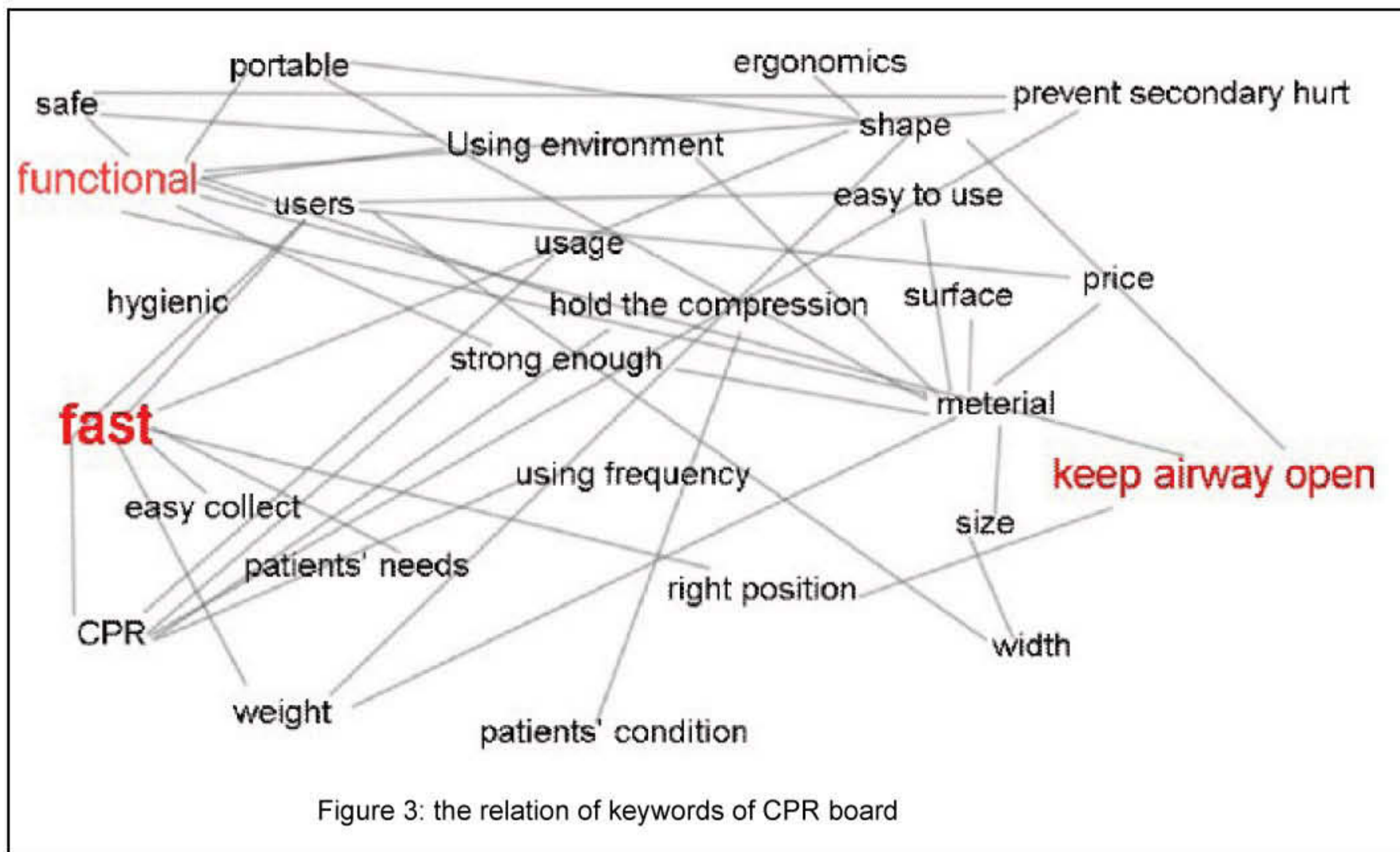
**4-6 minutes-----Fast! Time! Life!**





### 3.2 The function principle of cardiac compression board:

After understand the principle of CPR itself, we know the “fast” and “functional” may be the most important requirements for the cardiac compression board. Base on the users communicate, many aspects are listed to help to have a brainstorm.



So in figure 3, we can see the complicate relation within many key words of CPR board.

It is also a brainstorm of design which organizing the aspects together. It highlights three words: fast, functional and keep airway open. There are many links towards FUNCTIONAL, and FAST. It can be the aim of detail design. For example, when decide the size of board, it have to consider the function and fast factors.

So because functional and fast is the most important factors to consider, the analysis of these two functions were been done.



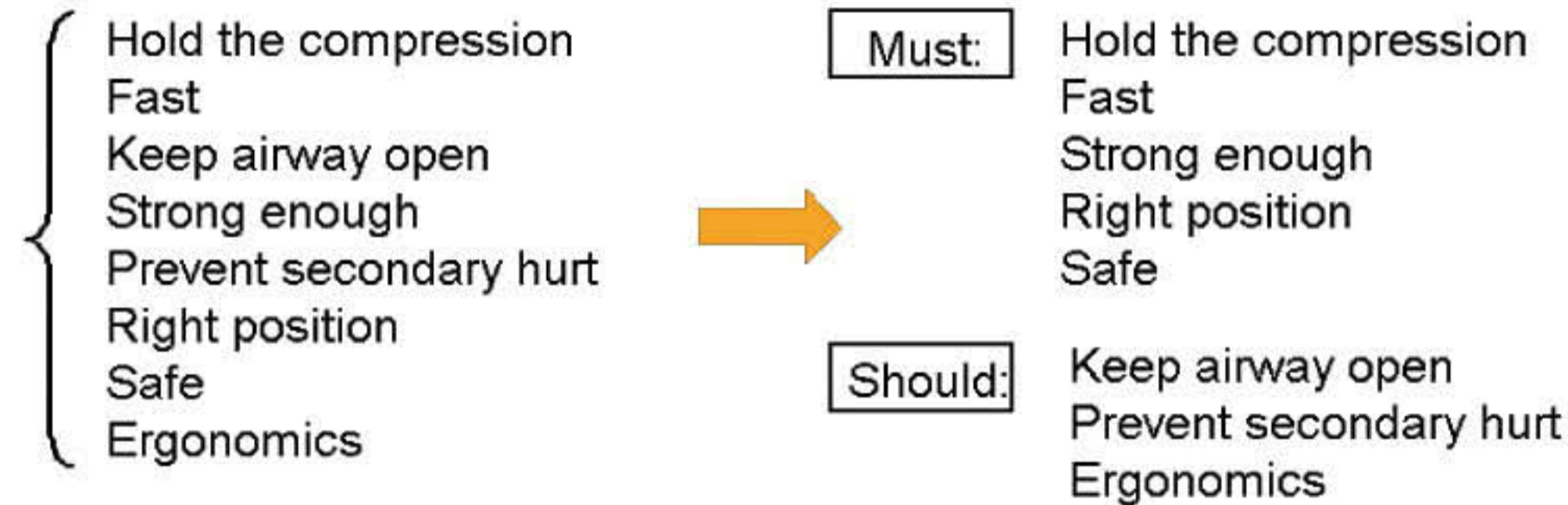


● **The analysis of “function” factor of CPR board:**

In this table, it divided the function into two levels. In first level, those key words list have priority to consider. And then, they are subdivided into “Must”, and “Should” level. The “Must” level is the most important function that the CPR board has to have.

This analysis helps me to understand the function during design to know which the most important thing to be provided with is.

1st level of function:



2nd level of function:



In “Must” level, “hold the compression” is the basic function of CPR board. It will help the nurses or people executing CPR to save the life. As it is understand from literally, it is easy to understand. However it refers to many things. Where it is to be placed to hold the compression, how to save the compression for long lasting process efficiently, what material is suitable for hold the compression, what kind of surface or texture is suitable to hold the compression and so on. All of these have to think when I design the CPR board toward how to hold the compression. It is also referring to the other aspects in “Must” level: strong enough, right position and safe. So the aspects have mutual inter-relations.

Table 2: the different level of ‘function’





● **The analysis of “fast” factor of CPR board:**

As what introduced in previous part, the time is the life of patients. The most important thing is to execute first aid with 4 minutes. Those 4-6 minutes is the most important time whether the patient can be saved or not. For the design of CPR board, there are many aspects which can influence the using time. As I list in the brainstorm figure 3, I concluded those aspects in the following table. The dividing was also made in the aspects of fast factor. The aspects in first level of fast have more influential to fast factor.

1st level of fast:

- { Suitable size and shap
- { Suitable material
- { Easy collect
- { Light weight
- { Easy to use

2nd level of fast:

- { Portable
- { Fit the using environment
- { Hygienic
- { Using frequency
- { Easy to clean
- { Patients' condition
- { Get the device in good condition
- { Combine with other device

Table 3: the different level of 'fast'

The suitable size and shape is very important towards “fast”. Many of the existing board don't consider it very much. Since the existing board using in hospital is a part of the ward bed. So the size and shape of board have to compromise to the size and shape of the ward bed. This is a typical situation of place the unimportant before the important. I will give an example analysis of certain existing CPR board in the following parts including size and shape analysis.

The material is an aspect referring to many other aspects. It partly decided the weight of the whole product. It also related to the “safe”, “strong enough” and “hold the compression”.





### 3.3 The using surrounding

The using surrounding includes outdoor and indoor surrounding two parts.

- Indoor: On board, home, office, hospital, swimming pool, factory, etc.

Outdoor: On beach, in mountain, on highway (car accident), etc.

In another way to classification: man-made surrounding, nature surrounding.

- Man-made surrounding: On board, home, office, hospital, swimming pool, factory, on highway (car accident), etc.

Professional lifesaver Equipments condition

Nature surrounding: On beach, in mountain, etc.

The different surrounding where the CPR is executed decides the conditions the surrounding can provide. However wherever the CPR take place, it has to follow the principle that the surface where place the patient should be flat, hard enough and place the patient in the right position. If the surface is uneven or situated outdoor place like land of lawn has gravel, it will cause serous second hurt of the spine or ribs. In the other hand, if the surface is too soft, like sofa or mattress, the CPR will be useless since the heart massage will not be functional.



Figure 4: different using surrounding





### 3.4 The using activity (related to the activity-centered design theory)

Since the activity-centered design theory is to be used in this project, the activity analysis is necessary to do.

In figure 5, it generally shows the activities of the process during CPR and using the cardiac compression board in hospital situation nowadays.

It is a part of activities about the cardiac compression board. In fact, all the activities about the cardiac compression board can be divided into three parts according to the time sequence: before CPR, while CPR, after CPR. Take hospital sick ward surrounding as an example, what lists in figure 5 shows the activities including “before CPR” and “while CPR”. These two parts are process of emergency parts. The third part: after CPR is a part without time limited. It is mainly about how to store the cardiac compression board. However how to store the CPR board is also an influential part for the later using of the CPR board. It has to maintain the board in good condition and easy to fetch.

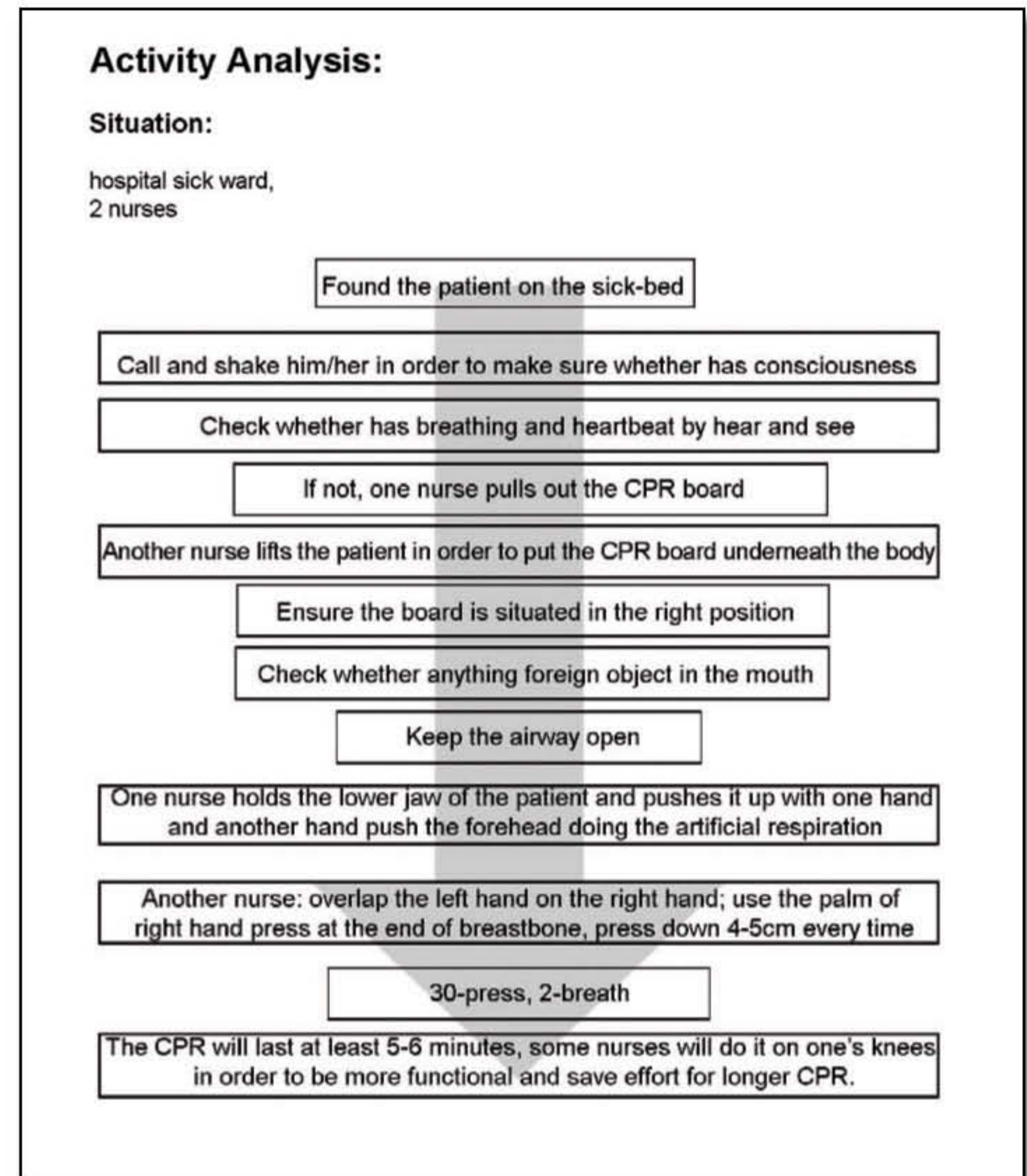


Figure 5: the activity analysis of CPR executing in hospital sick ward





## Activities Before CPR:



1.



2.



3.



4.

1. Find the patient on the sick-bed
2. Call and shake him/her in order to make sure whether has consciousness
3. Find the patient in consciousnessless condition
4. Check whether has breathing and heartbeat by hear and see

Figure 6: the activity analysis of 'before CPR'





## Activities While CPR:



5.



6.



7.



8.



9.



10.



11.



12.

5. One nurse pulls out the CPR board
6. Another nurse lifts the patient
7. Ensure the board is situated in the right position
8. Check whether anything foreign object in the mouth
9. One nurse holds the lower jaw of the patient and pushes it up with one hand and another hand push the forehead
10. Doing the artificial respiration
11. Overlap the left hand on the right hand; use the palm of right hand press at the end of breastbone, press down 4-5cm every time
12. Nurse do it on one's knees

Figure 7: the activity analysis of 'while CPR'





## Activities After CPR:



13.



14.



15.



16.



17.

- 13. Get the board ready to put back
- 14. Clean all the stuffs are in the way
- 15. Put the CPR board back
- 16. Aim the right place by regulate
- 17. Put the stuffs in the way to the original place

Figure 8: the activity analysis of 'after CPR'





### 3.5 The certain product analysis

The existing cardiac compression board can be generally classified into two parts: the portable ones and fixed ones.



Figure 9: the existing CPR board

After search the existing cardiac compression board using today in hospital, it is found that most of the CPR board are combine with the ward bed. So I choose one typical existing CPR board to give

a certain analysis in order to understand clearer and help the design.

The CPR board using in the school training room is the certain product I will analysis. The reason I choose it as the target product is because it the same like as the ones commonly using in hospital. What's more is because of it is the primary basic look of the CPR board.

This certain CPR board is a piece of plywood placed as the head of bed in usual. When the CPR is executed, it is take out using as CPR board. There is totally no identity for this CPR board. What the product shows to the users is unclear which may confused the user how to use it. Especially in emergency, the situation will be even worse.



Figure 10: the ward bed in hospital





- **The size of the existing CPR board:**

Length: 75 cm

Width: 50 cm

Thickness: 0.7-0.8cm

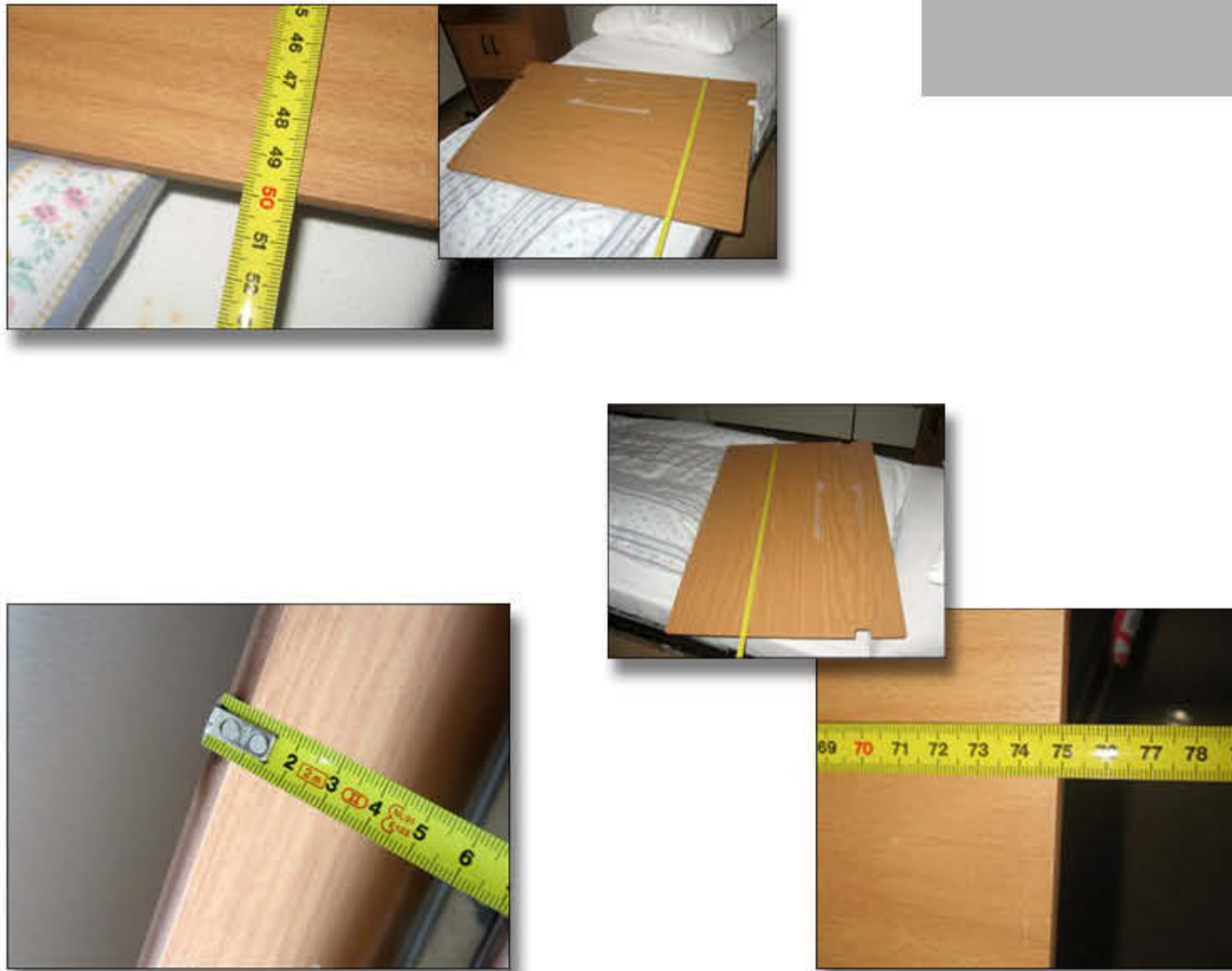


Figure 11: the size of existing CPR board

The size of nowadays existing CPR board is not suitable for the ergonomic requirement of the body. The size now is decided by the size of the head of the ward bed. As I said previously, it is a way of put the cart before the horse. The wrong size of the CPR board will cause many difficulties while using. It will use more material than need and then it will proceed the problem of weight.

- **Weight:**

4.35 KG

As the wrong size of the CPR board, the existing CPR board is quite heavy. It reaches 4.35KG. So since the heavy weight, the CPR board is not easy to use when taking out and putting back which will slow down the speed of saving and first-aid.



Figure 12: the weight of existing CPR board





- **The ways to connect the ward bed:**



Figure 13: the way to connect of existing CPR board

As you see in the figure 13, the CPR board is get stuck by the component on bed. It is the way to fix the CPR board on bed which is also the way to block the using of the CPR board. Since it is not very easy to take out and put back, the CPR board always situated in a semi-ready situation. Even the professional nurses are not proficient to taking it.

- **Material**

This CPR board is made of plywood to satisfy the hard surface.

- **Color**

The color of this CPR board is the common color of plywood not considering any other aspects, for example the emotional aspects.





## Chapter 4 Design Research

Chapter 2 has explained the general theory and methods might be used for this project. The previous chapters has established the context in a holistic sense, identified the image of the existing product. With the understand from medical aspect, it shows the context of how to use and using surrounding. The purpose of this chapter is to develop a research program which focuses on the development and testing of an appropriate cardiac compression board design proposal for certain surrounding especially on user communication. The following subjects are examined in this chapter:

Research Approach

Research Methods

The balances between some corresponding aspects

### 4.1 Research approach

As stated in 1.2.1.2, chapter one “What is the Goal” part, the goal of this research is ‘to develop an appropriate practical design suggestion the cardiac compression board with emphasis on user communication and design methods.’ This by nature implies creative practice is required to fulfill or address the research goal. However it is difficult to fulfill or address without a supporting approach. Therefore, there are three primary approached for this study.

User-centered design

Activity-centered design

Genius design

#### **The reason of using these three approaches:**

Since the user communication is the mainly part I want to study, so the user plays a very important place in this study. As stated in chapter two, the user-centered theory or approach is a project approach that puts the intended users of a site at the centre of design and development, and moreover, the users’ goal is very important in UCD, since it is the focus from very beginning and it is what the users ultimately want to accomplish.

However the users’ goal is hard to cater all. In addition, it may changed by time and the change of other elements. It is often hard to define. What’s more is the number of users who the designers can reach is just a small part of the whole. Some time the UCD may result in a solution that is narrowly focused.





So the activity-centered design and genius design were also be utilized in the process of this project.

The activity-centered design is focus on the behavior. The behavior towards a certain thing has a general wide comprehension no matter on time and space. The purpose of every activity is not necessary a goal. Of course, sometimes goals and purpose can be the same or similar. The purpose is generally more tangible than goal. Just because it is more tangible and focused, sometimes it has limitation. Since the activity is step by step. Sometimes the solution is not the solution for whole problem but for a step of activity. You may not see the forest for the trees. So the designers should be the one can control the whole and take use their own experience and competence. Therefore, the genius design approach is joining in this project. In addition, the designers, like everyone else, carry around their own experience and prejudices. Without too many opinions from the others, the genius design is a fast and personal way to work. As it is fast and personal, so it is flexible, allowing designers to focus their efforts where they see fit. By the free feeling of design, the designers may be able to think more broadly and innovate more freely.

However it is not to say that designers who practice genius design don't consider users. They do. So in this project, the user-centered approach, the activity-centered approach and genius design approach are integrated together in order to fulfill or address the goal of this project: develop an appropriate practical design suggestion the cardiac compression board with emphasis on user communication and design methods.

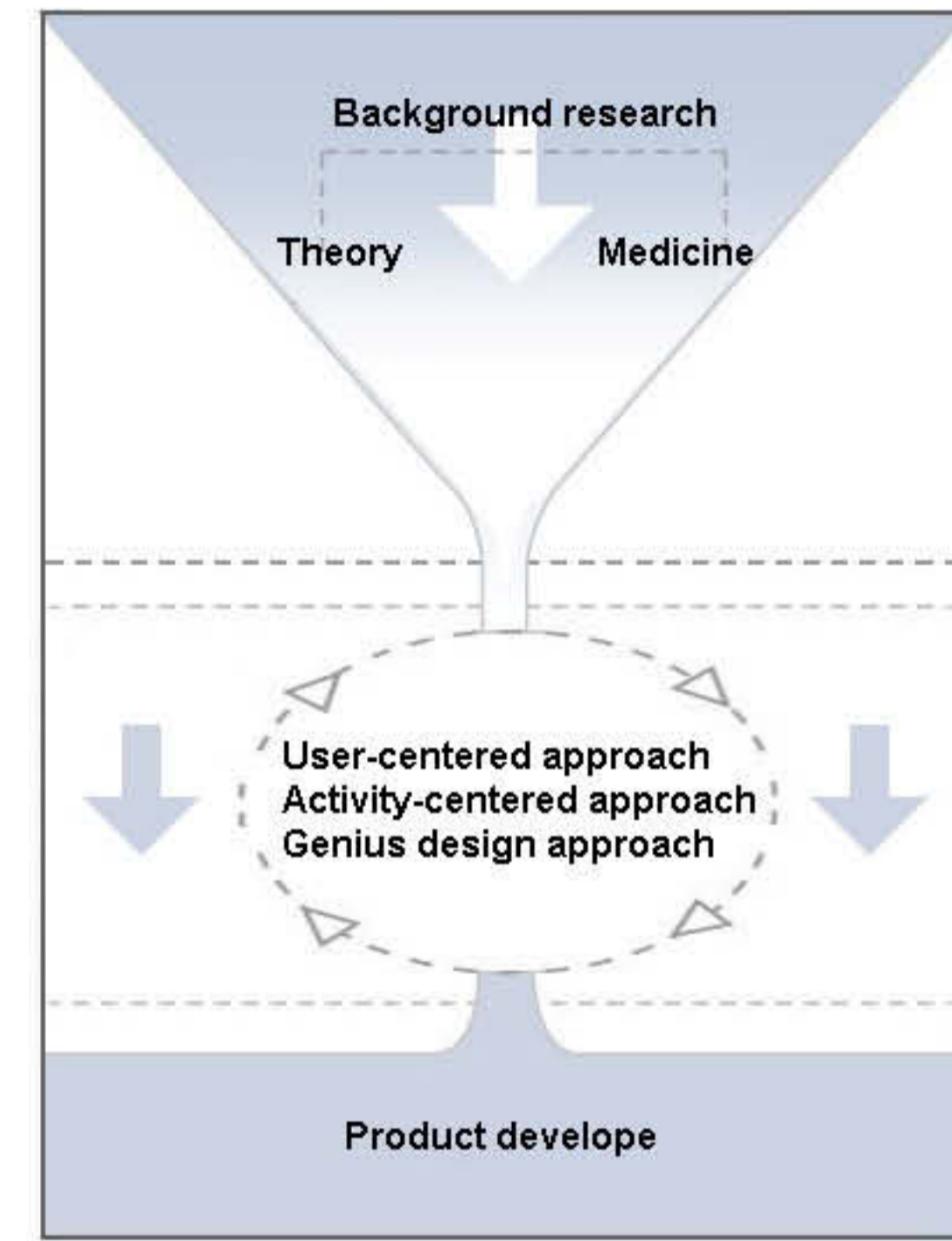


Figure14 the research approach





Above all is the argument for the choosing of design approach. In this project, the product development research methods can be primary divided into four modes: 'learn', 'look', 'ask' and 'try'.

'Learn' mode is the way to analyze the information you've collected to identify patterns and insights.

'Look': observe people to discover what they do rather than what they say they do.

'Ask': enlist people's participation to elicit information relevant to your project.

'Try': create simulations to help empathize with people and to evaluate proposed designs.<sup>10</sup>

(IDEO method cards)

The first three modes are used as a means of supporting the research through design process. The research for design focused on supporting material required for the cardiac compression board design proposal.

The last mode 'Try' places emphasis on design practice as a means of inquiry and producing knowledge. Design practice is used to develop the cardiac compression board with the background research in chapter 2 and 3. The cardiac compression board design proposal is in turn used to as an evidence to reflect how to improve the user communication.

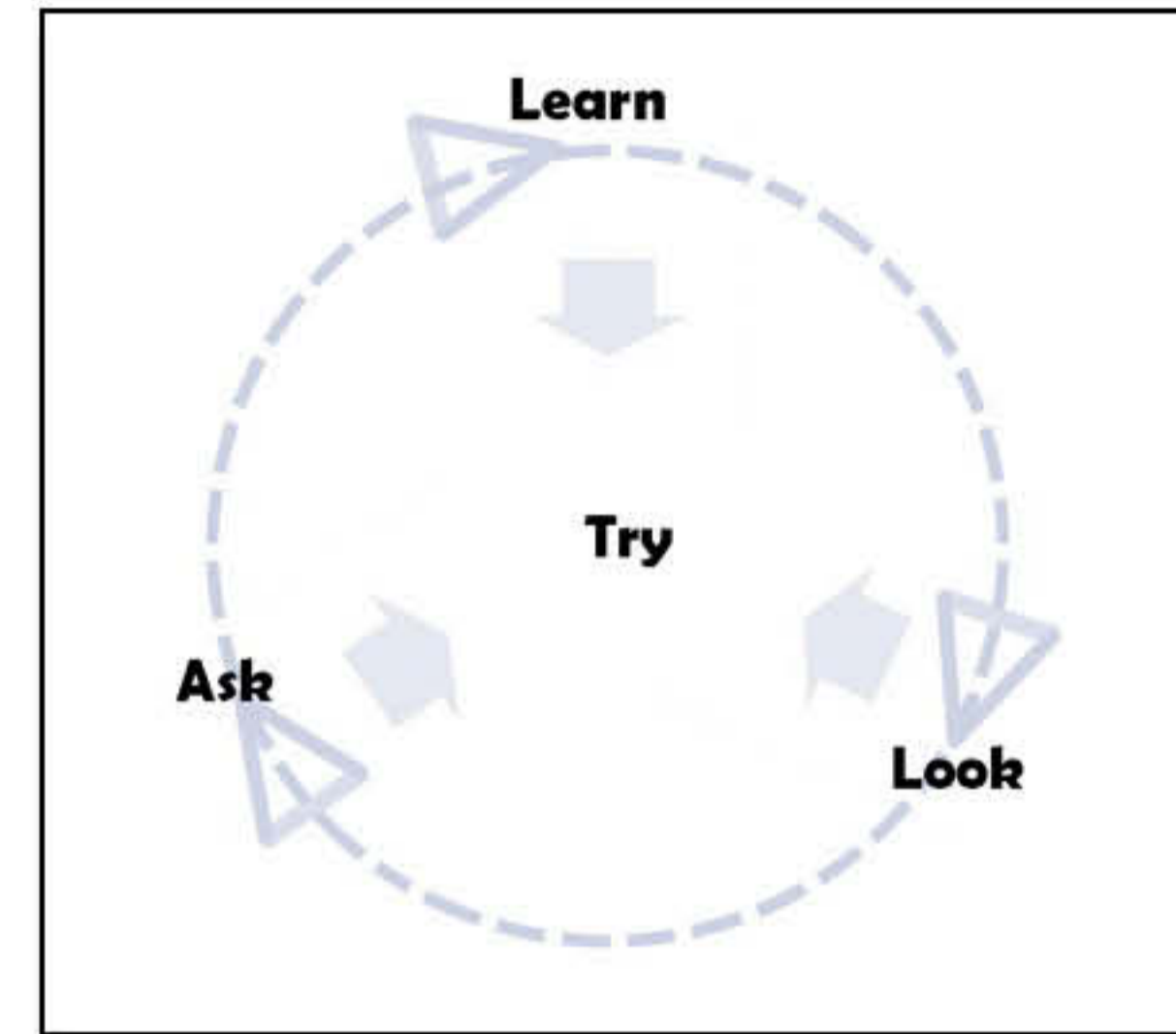


Figure15 the relation of the four modes of research

Figure15 illustrates the relation of the four modes of research

#### 4.2 Research methods

This section discusses the selection and design of research methods employed in this study. When considering fulfilling the goal of this study in the process of developing and testing of an appropriate CPR board design proposal, the need to use multiple research methods becomes evident.

According to the IDEO method card, there are 4 kinds of design methods as inspiration. For instance, the medicine is a quite

10. IDEO method card





complicate field to understand, so in the very beginning. The 'learn' method, like activity analysis and anthropometric analysis are required. The development of the CPR board design proposal requires a range of qualitative, quantitative and iterative research through design methods. Meanwhile, testing of the design proposal requires different research methods altogether. I picked out those methods relative to this study which utilized in the product develop process.

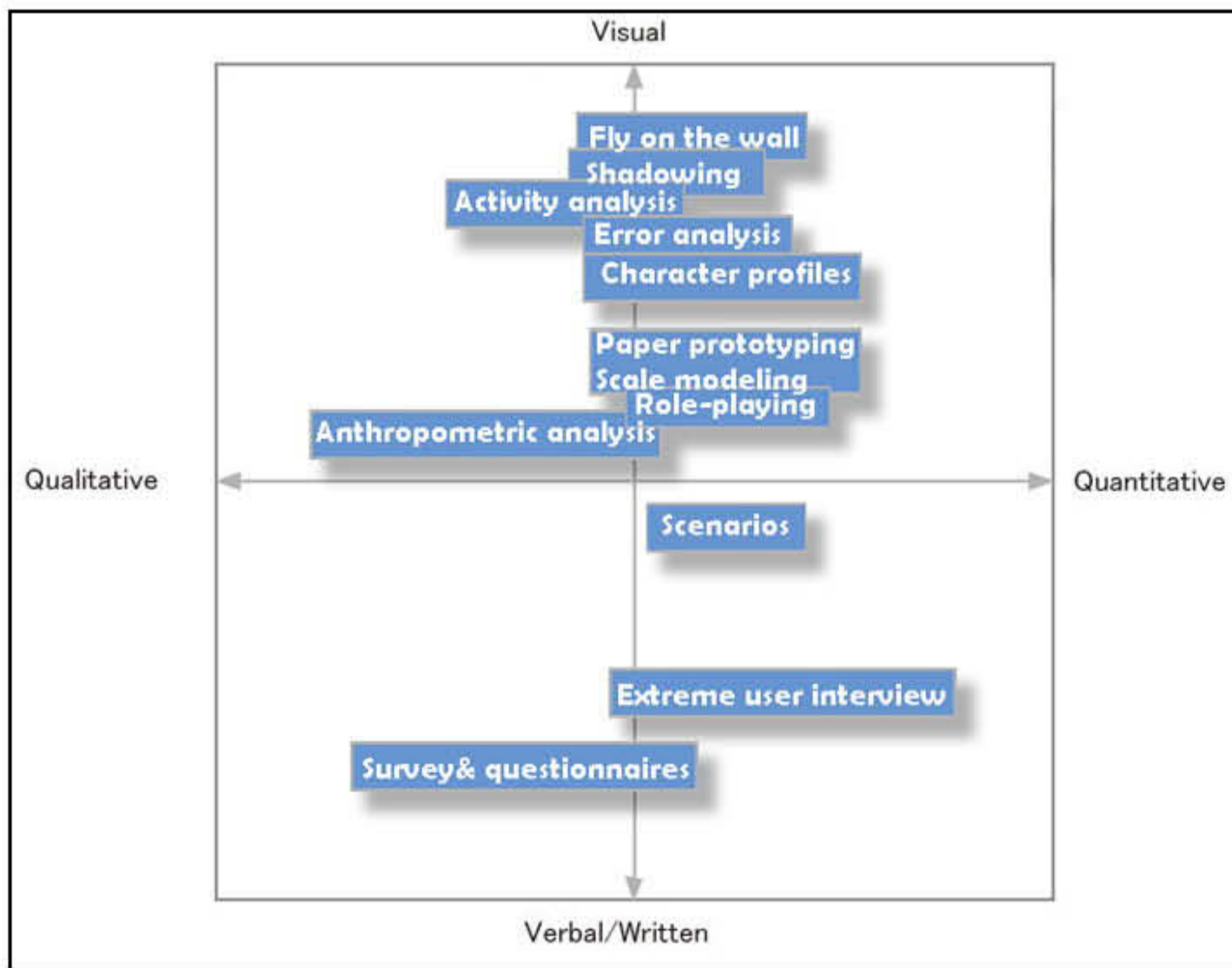


Figure16 the range of the research methods

Figure 16 illustrates the range of some research methods selected for this investigation in produce development process especially on user communication

The research methods selected for this investigation can be categorized as follows:

- 'Learn' methods
- 'Look' methods
- 'Ask' methods
- 'Try' methods

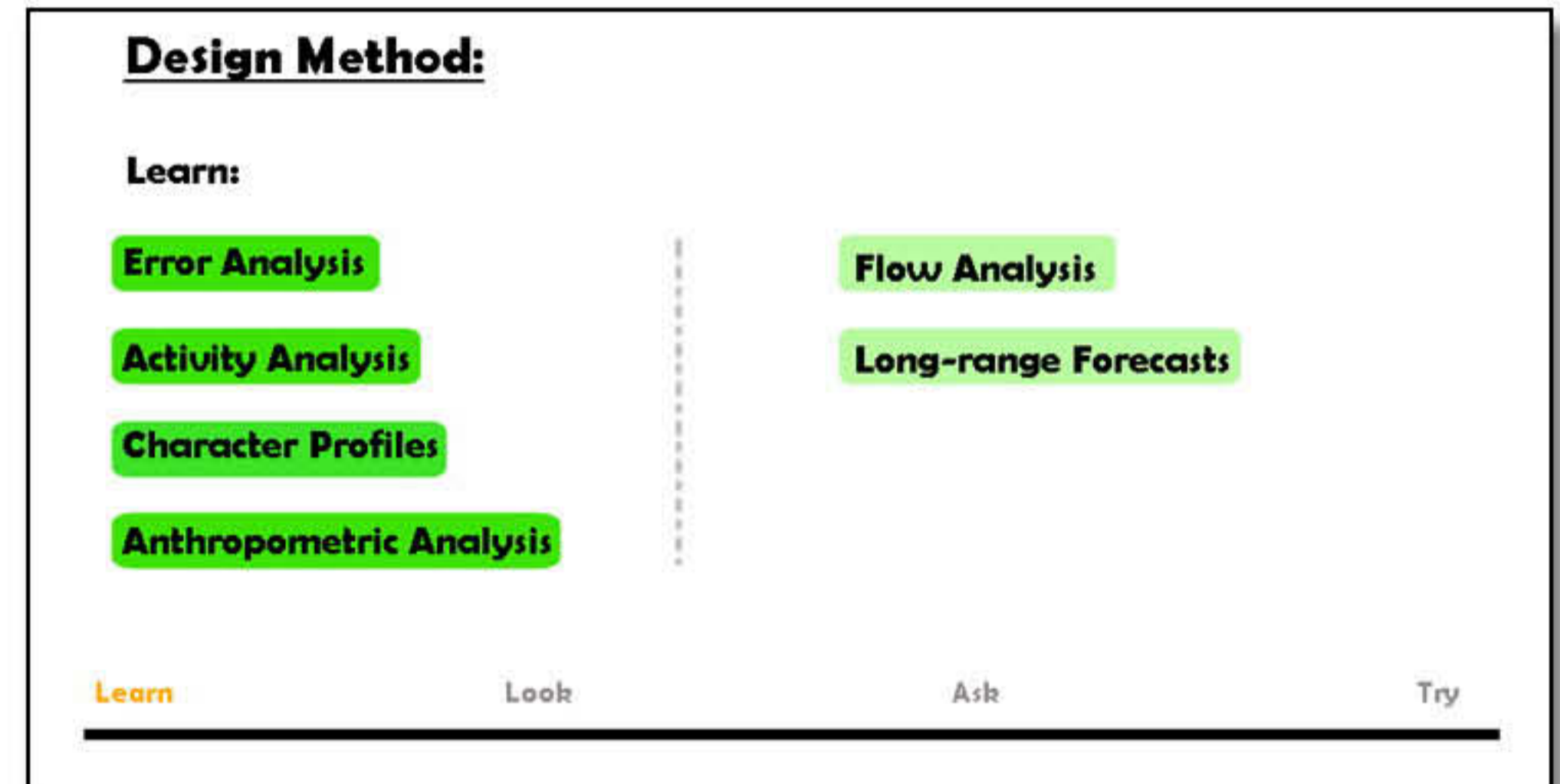


Figure17 the 'Learn' methods





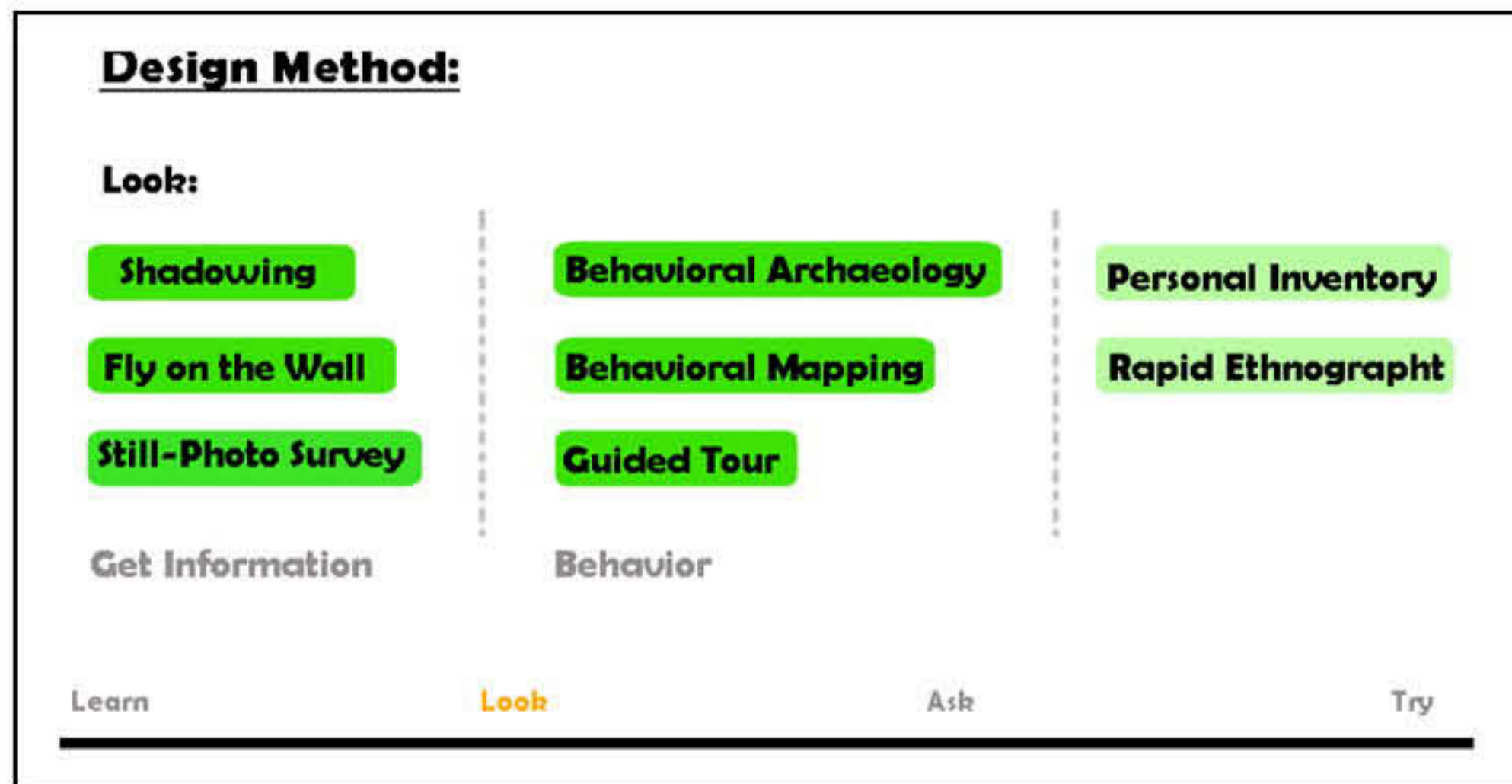


Figure18 the 'Look' methods

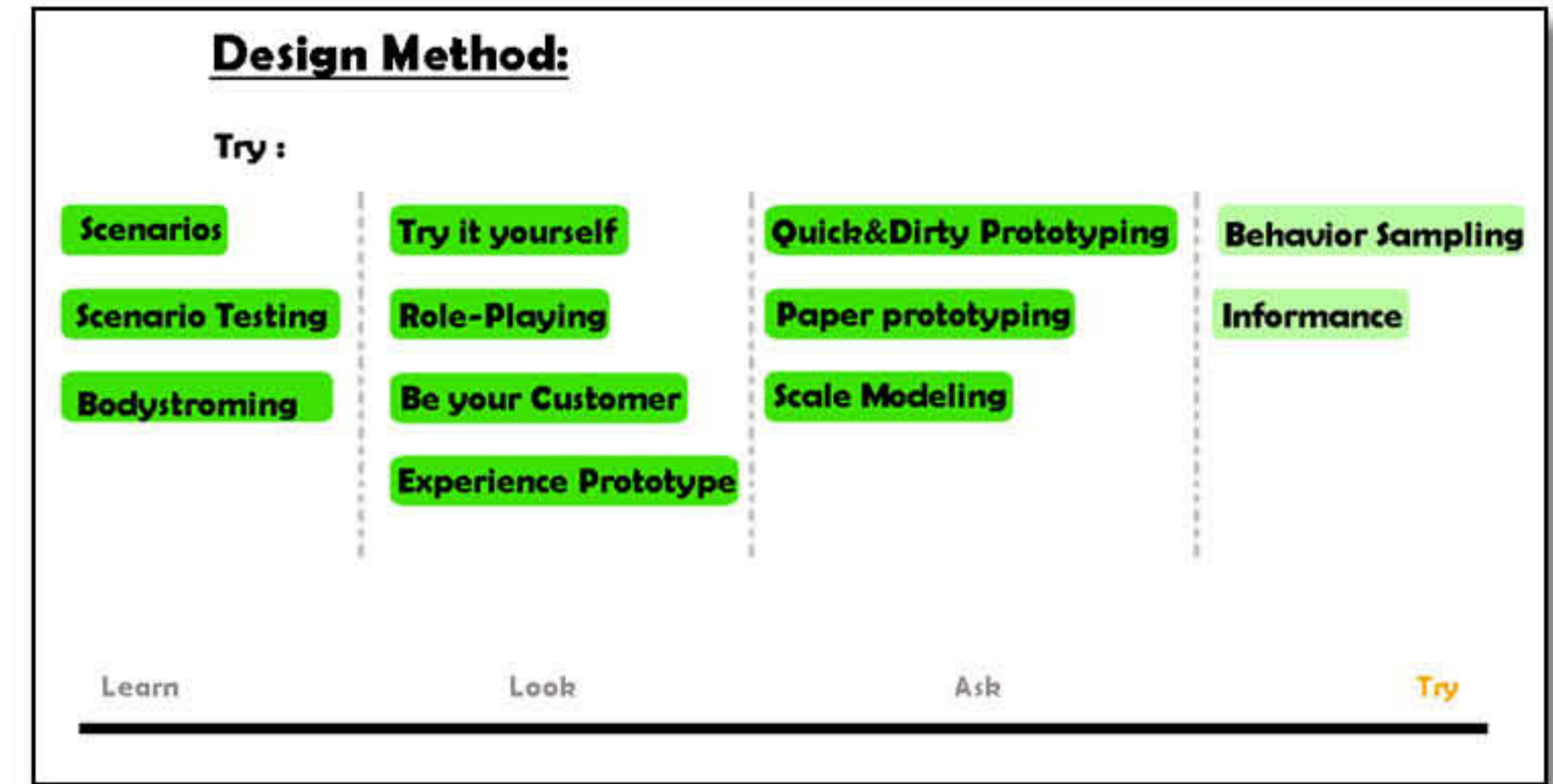


Figure20 the 'Try' methods

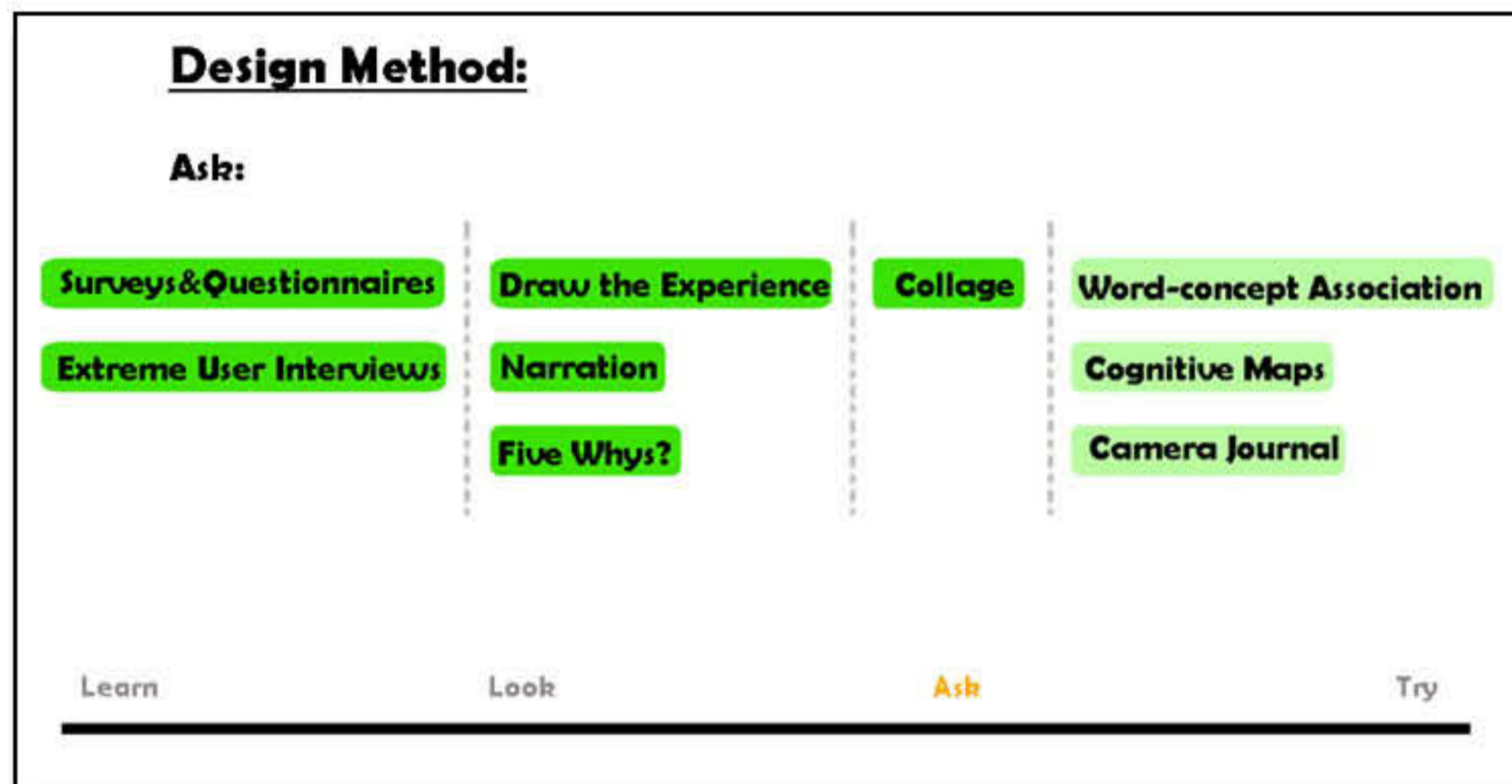


Figure19 the 'Ask' methods

With the limitation of the study, I pick out some of the methods in figure17-20 using in this study.

As it shows in the Figure16 , many of the methods are belongs to the visual part. The visual part is a part of non-verbal. Those non-verbal behaviors are very important to user communication. As early as 1601, gesture as a medium of communication coordinate with vocal and written language was recognized by Francis Bacon (1884-1947). He suggested that 'as the tongue speaketh to the ear, so the hand speaketh to eye' (quoted in Kendon, 1981, p155). The non-verbal behavior may release the real problems.<sup>11</sup>(The handbook of communication skills, Owen Hargle, p75)

11. The handbook of communication skills, Owen Hargle, p75





### 4.3 The balances between some corresponding aspects

There are 3 balance relationships in 3 pairs of corresponding aspects:

The balance between quantity resources and quality resources

The balance between “listen to the users” and “designer’s opinion”

The balance between “let the user imagine” and “give them a physical image”

- **The balance between quantity resources and quality resources:**

This relation between quantity and quality is occurred in many situations. In this project, it also is one important relationship has to balance. Diversity by different contexts and situations, the balance may incline to one side. It doesn’t have to equal in proportion. Different proportion may result even better result.

- **The balance between “listen to the users” and “designer’s opinion”**

This is actually a reflection between two design theories: user-centered theory and genius design theory. As it is stated in previously chapter, the user-centered theory and genius design theory are both utilized in this project. It is bound to have this balance problem.

- **The balance between “let the user imagine” and “give them a physical image”**

Since the number of the users what I can reached is limited. So it has to careful to handle the user. ‘Give them a physical image’ help to contact some time. However it may also limited the imagination of the user.





## Chapter 5 Product Development through user

### Communication

As stated in chapter four, according to the IDEO method card, the research methods were divided into four categories: 'learn', 'look', 'ask' and 'try'. In this chapter, the analysis of using these methods will be documented. In the first section of this chapter, the overall communication condition was elaborated to give a detail.

### 5.1 The overall communication state of affairs

#### 5.1.1 The users involved in this study

- 18 postgraduate students of nursing who are meanwhile professional nurses

The students are already nurses with minimum 2 years of practical work with patients who are critically ill with heart diseases. In the study this year there are 18 students. The students work in their main job as nurses while they are studying and the study is part time. They have now had the lessons about patho –physiology, nursing, research methodology, critically reading research articles, CPR.

- Three of them are especially involved in many design methods.



Sylvi Nesheim Hagen



Iris Hasle



Kåtrine Søbstad Einan

Figure 21 the three especially involved nursing students





- The nursing teachers in Hiak, nursing department, Faculty of health, nutrition and management

Heidi Jerpseth: my external supervisor in nursing department, assistant professor, Faculty of health, nutrition and management.

Gry Flingtorp: teacher in nursing department, teaching CPR course, also working in the cardiology department of Ahus hospital.



Heidi Jerpseth



Gry Flingtorp

Figure 22 the teachers in nursing department

- The doctors and nurses in cardiology department in China
- This contact provided me different country background information about the CPR board design. The number of users including this kind of communication is about 15.

### 5.1.2 The hospital involved in this study

Aarhus University Hospital

Vestre Viken HS Sykehuset Asker og Bærum



Aarhus University Hospital



Vestre Viken HS Sykehuset Asker og Bærum

Figure 23 the involved hospital

The cardiology department of Aarhus University Hospital and Vestre Viken HS Sykehuset Asker og Bærum are the communication places during study.





### 5.1.3 The manufacture involved in this study

(Ying Kang) Guangzhou LinBi Medical Devices Co.Ltd

Ying Kang is founded in 1996, and it has been paying attention to researching and developing in China medical products. Ying Kang has rich experience in operating medical products in China and owns many patent products which have been widely used in medical institutes. At present Ying Kang has two subsidiaries in China as follows

- Guangzhou LinBi Medical Device Co.Ltd: Taking charge of sales and marketing of full lines of Ying Kang products as well as the sole agent of famous products for several international medical device, in China.
- Zhongshan Ying Kang Medical Device Co. Ltd: Specially developing and manufacturing of products, providing constantly Chinese characteristic products to partners of Ying Kang.

CPR board is a product of them producing now, so the advice from them is valuable.

Mr. Xie Yuan: The person I contact, the marketing director of the Ying Kang who used to be a doctor.





#### 5.1.4 Choosing the using surrounding

In this study, the hospital (ward bed) is the choosing surrounding for design.

As stated in chapter 3, there are several possible using surrounding. Table 4 shows some of typical using surrounding classified by man-made surrounding, and nature surrounding.

Each of them has some features. In Table 4, some condition the using surrounding can provide, including the 'hard degree of the surface', 'in time save degree', 'professional lifesaver' and 'equipments condition'. In the 'hard degree of the surface' column, the 'Hospital (ward bed)' and the 'In mountain' is the worst situation. The 'In mountain' got the worst situation is because it was bumpy with a lots of gravel and stone. For the 'Hospital (ward bed)', the worst scored is because of the soft mattress of the ward bed. Usually the patients are always lying on ward bed. So the most possible of using the CPR board in hospital is the on ward bed. Since wherever the CPR takes place, it has to follow the principle that the surface where place the patient should be flat and hard enough. In addition, one of the most important functions of CPR board is to provide the patients a hard and flat surface. So the hospital is the using surrounding I choose for this study.

		Hard degree of the surface	In time save degree	Professional lifesaver	Equipments condition
Man-made surrounding	On board	○ ○ ○	○ ○	○ ○	○ ○
	Home	○	○	○	
	Office	○ ○	○ ○	○	○
	Swimming pool	○ ○ ○	○ ○	○ ○	○ ○
	Factory	○ ○ ○	○ ○	○	
	On highway	○ ○ ○	○	○ ○	○ ○
	Hospital(wardbed)		○ ○ ○	○ ○ ○	○ ○ ○
Nature surrounding	On beach	○	○	○ ○	○
	In mountain		○	○	

Table 4 the compare of different using surrounding





## 5.2 The ‘learn’ methods results and discussion

In the ‘learn’ part, the following methods results are discussed in this section:

Activity analysis

Error analysis

Character profiles

Anthropometric analysis

Among these methods, the ‘Activity analysis’ and ‘Error analysis’ are based on the activity-centered theory. The ‘Character profiles’ is the result of combination of user-centered theory and activity-centered theory. Because it had to be based on the observation of the real users and communicates with them. However, what we want to result is the typical behavior or lifestyle which is relative to the activity-centered theory. The ‘Anthropometric analysis’ is based on the user-centered theory.

### 5.2.1 Activity analysis

‘Activity analysis’

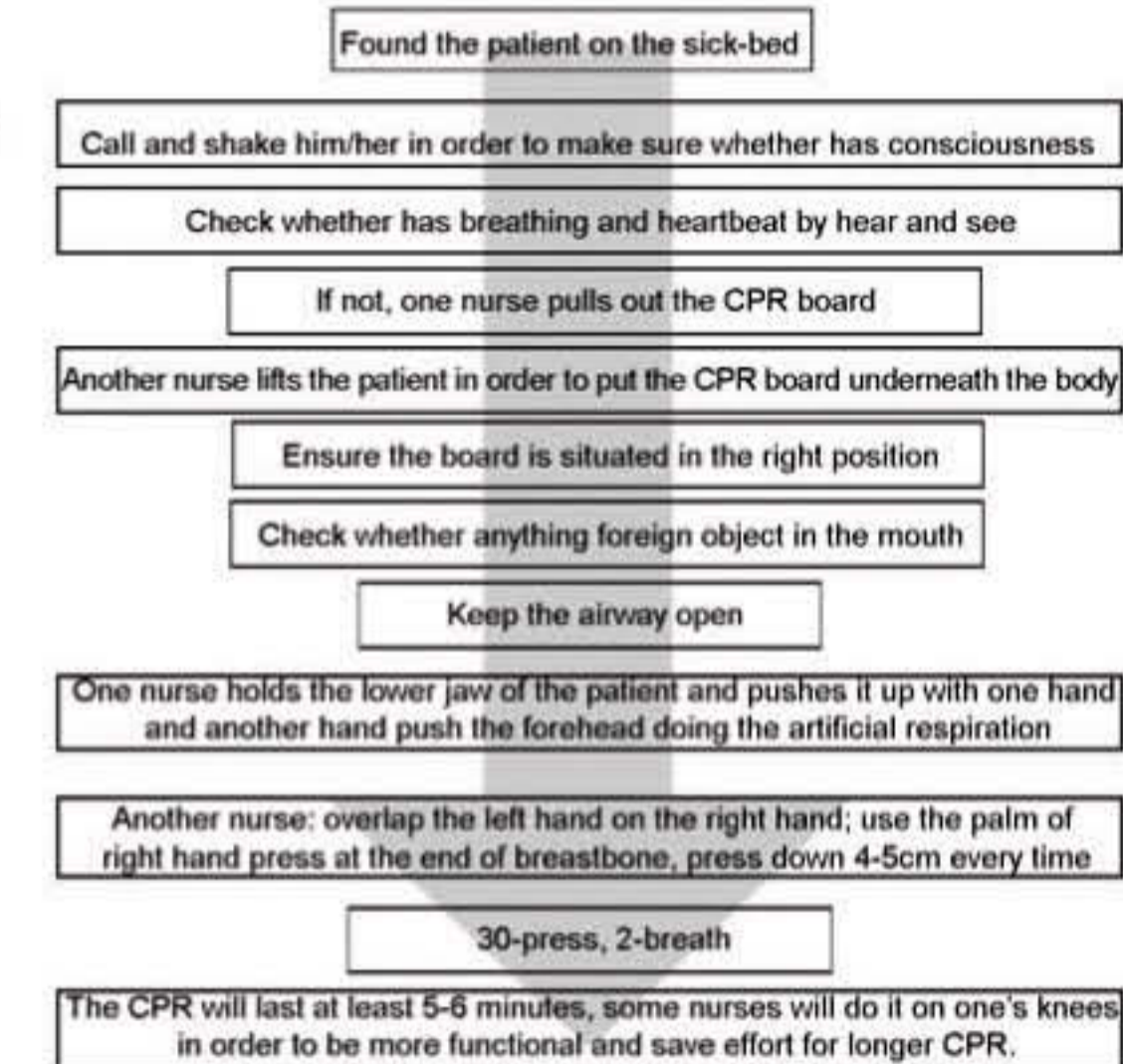
How	Why
List or represent in detail all tasks, actions, objects, performers and interaction involved in a process.	This is a useful way to identify and prioritize with stakeholders to interview as well as which issues to address.

Table 5: Activity analysis

As the figure shows in chapter 3, the activities during the CPR were executed have to be clear and step by step. However, in emergency, a lot of problems might be happened. In this section, each step of activity was analyzed in details to help understand the activities and help the analysis of error analysis.

**Situation:**

hospital sick ward,  
2 nurses





Step 1: found the patient on the ward bed  
 Aim: check the condition of the patient  
 Movement: walk, look,

Step 2: Call and shake him/her in order to make sure whether has consciousness  
 Aim: in order to make sure whether consciousness has  
 Movement: push/pull lightly, call

Step 3: Check whether has breathing and heartbeat by hear and see  
 Aim: check breath  
 Movement: stoop down, put one side of cheek near the nose of patient, and watch the chest of patient to feel whether breath

Step 4: If not, one nurse pulls out the CPR board  
 Aim: get ready for CPR  
 Movement: stand up, move oneself near the CPR board, raise hands, pull hard of the board from the ward bed

Step 5: Another nurse lifts the patient in order to put the CPR board underneath the body  
 Aim: get ready for CPR  
 Movement: there are two way of lift patient on ward bed: which also the direction problems to put the CPR board.

Way1: one hand holds the head/neck of the patient, lift up the patient into a sit position. Put the CPR board from any direction from head or one side with another nurse

Way2: hold one side of patient's buttock and shoulder; roll the patient to another side. Put the CPR board from one side of the patient with another nurse, then roll the patient to the opposite direction and pull the CPR board

Step 6: Ensure the board is situated in the right position  
 Aim: get ready for CPR  
 Movement: move the patient by pull or push

Step 7: Check whether anything foreign object in the mouth  
 Aim: get ready for CPR  
 Movement: open the mouth, see, lift the tongue, check

Step 8: Keep the airway open  
 Aim: get ready for CPR  
 Movement: hold the jaw, push the forehead

Step 9: One nurse holds the lower jaw of the patient and pushes it up with one hand and another hand push the forehead doing the artificial respiration  
 Aim: execute the CPR  
 Movement: hold the jaw, push the forehead, and hold the nose, breath with one joint mouth to mouth





Step 10: Another nurse: overlap the left hand on the right hand; use the palm of right hand press at the end of breastbone, press down 4-5cm every time

Aim: execute the CPR

Movement: intertwine two hand/ overlap the left hand on the right hand, press the at the end of breastbone of the patient

Step 11: 30-press, 2-breath

Aim: execute the CPR

Movement: repeat the movement of step9,10

Step 12: The CPR will last at least 5-6 minutes; some nurses will do it on one's knees in order to be more functional and save effort for longer CPR.

Aim: in order to execute the CPR for a longer time

Movement: knee on the bed

### 5.2.2 Error analysis:

'Error analysis'

How	Why
List all the things that can go wrong when using a product and determine the various possible causes.	This is a good way to understand how design features mitigate or contribute to inevitable human errors and other failures.

Table 6: Error analysis

By observation of the nurses while working and teaching the students how to execute CPR, base on the activity analysis, many possible errors were listed in this section and analyzed.





## Possible errors:

### Situation:

hospital sick ward,  
2 nurses

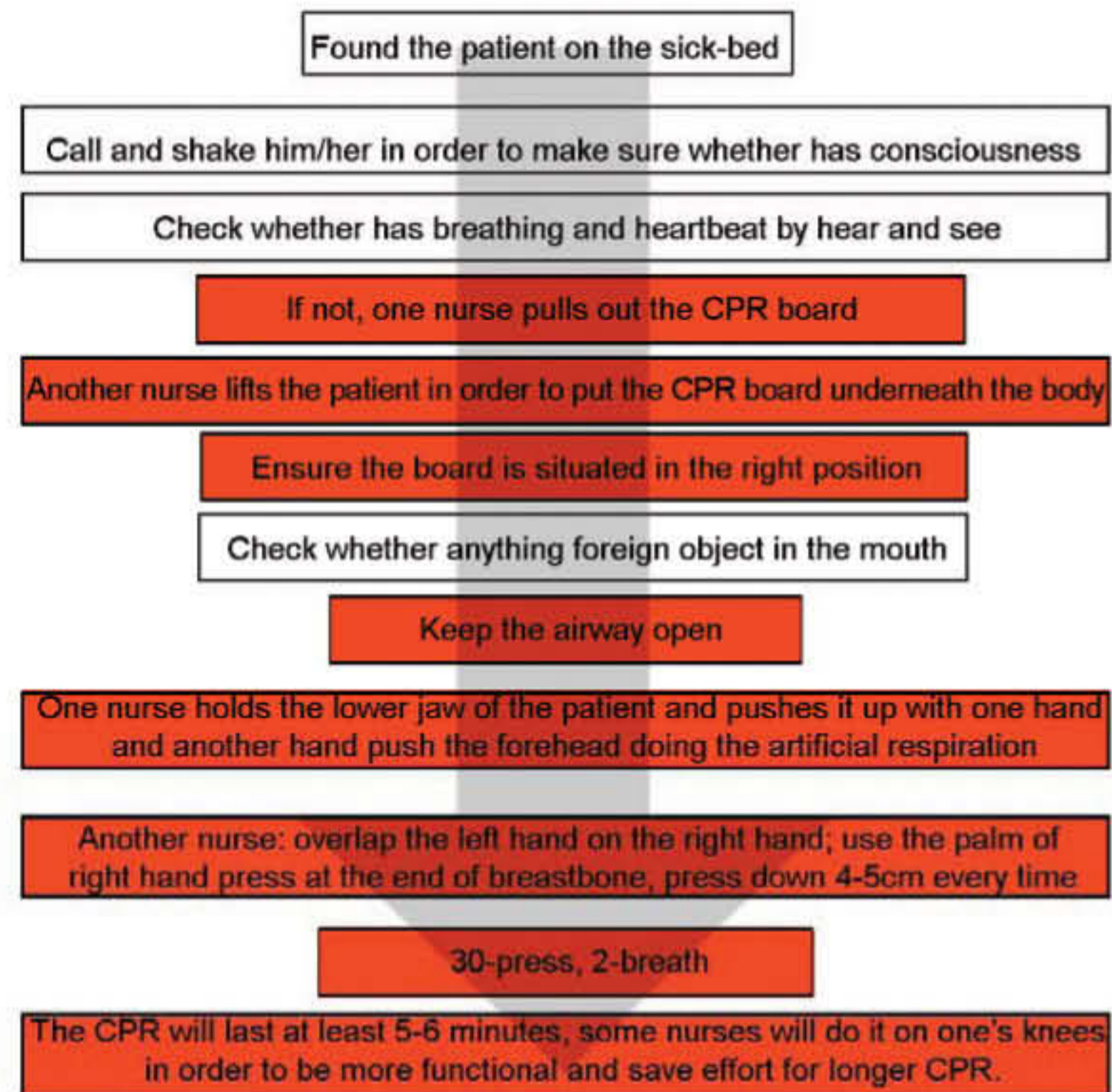


Figure 24 the possible errors

In figure24, the red parts are the steps possible have errors.  
In the coming ,it will have analysis step by step.





# Errors analysis:

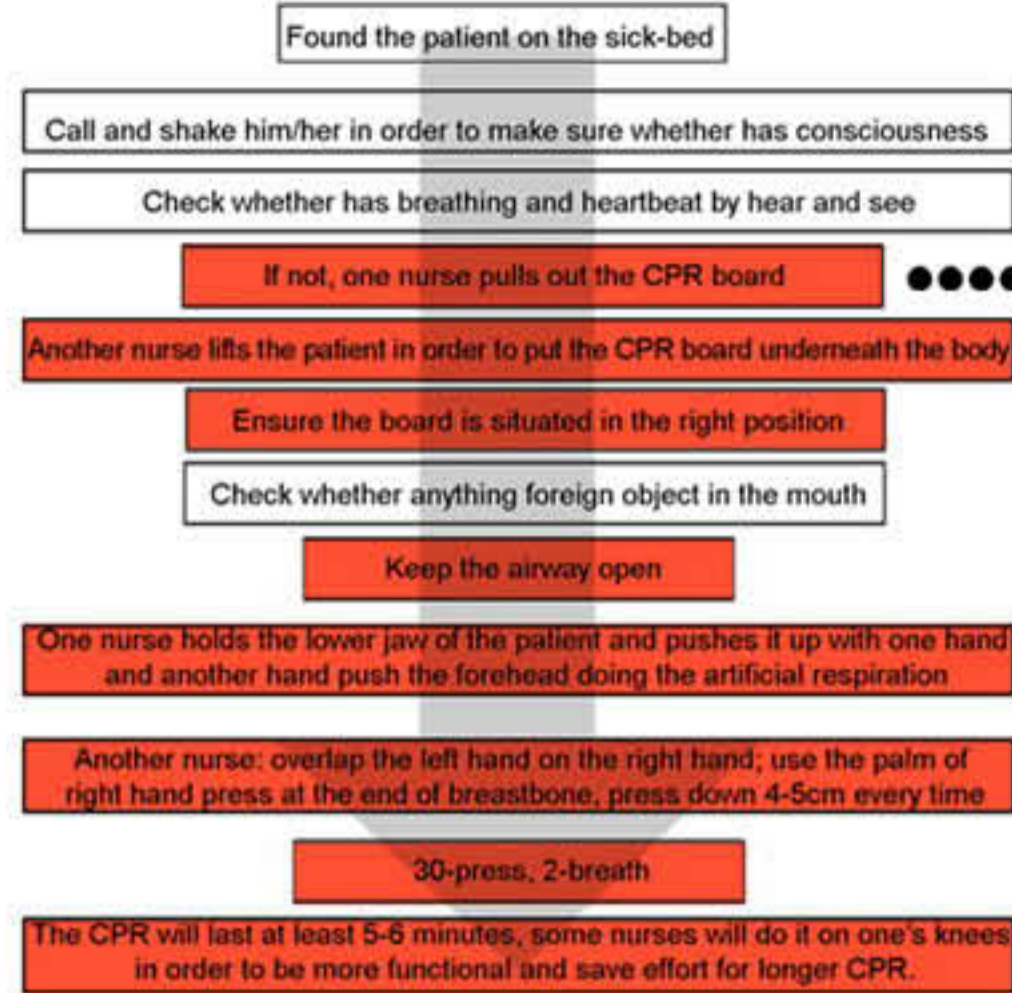


Figure 25 the possible errors 1

## Pulls out the CPR board:



The CPR board was locked or difficult to fetch sometimes.



Sometime, it will be forget to use CPR board when in the hurry.

## Lift the patient and put the CPR board underneath:



Sometimes the patient is a big person which is very heavy to lift. So the putting direction of the CPR board is decided by how to lift the patient. In addition, just because of the different weight of the patient, sometimes the putting underneath the CPR board will have problems. It may get stick.





# Errors analysis:

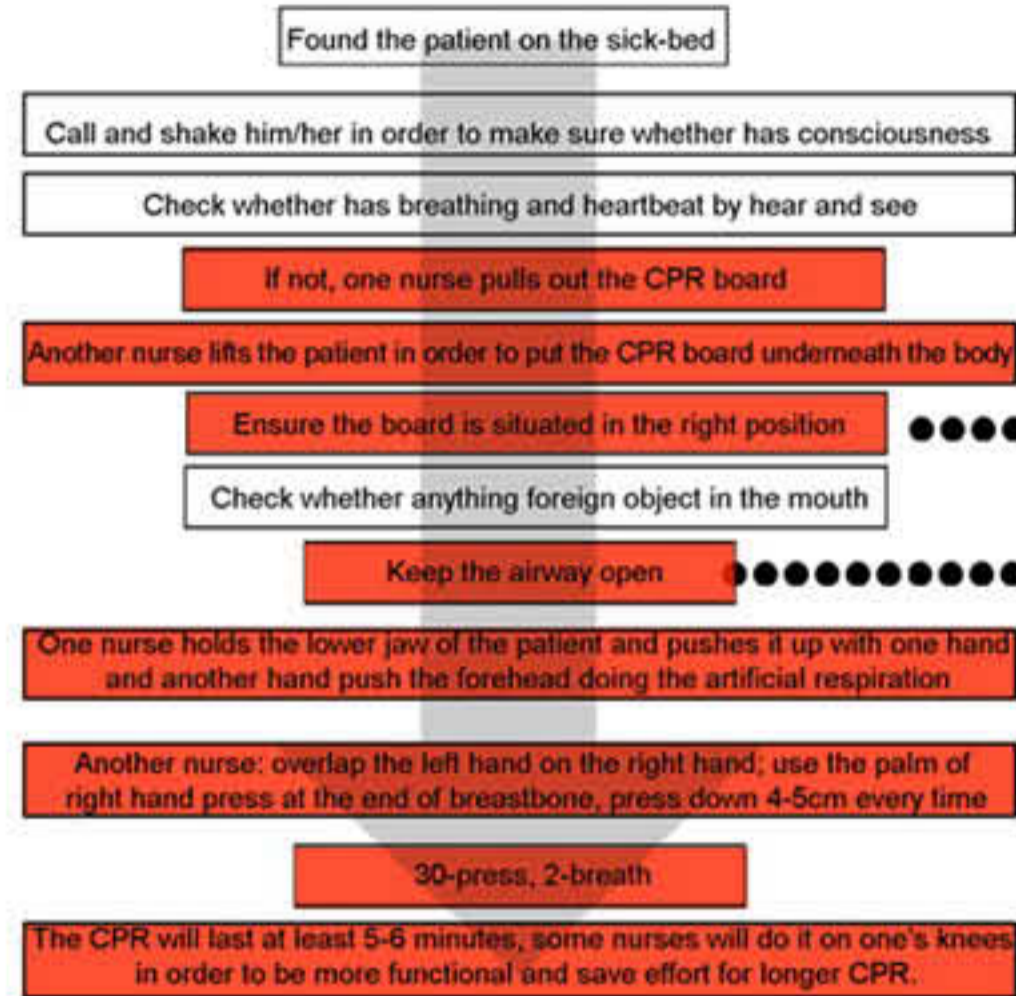


Figure 26 the possible errors 2

## Ensure the board in right place:



The patient sweats in most cases, so the CPR board may slide or hard to put the right place and very unstable.



## Keep the airway open:



The same height of the CPR board and mattress is hard to make the airway open.

Sometimes the patient is very weak; the strong push of the head may hurt them.



# Errors analysis:

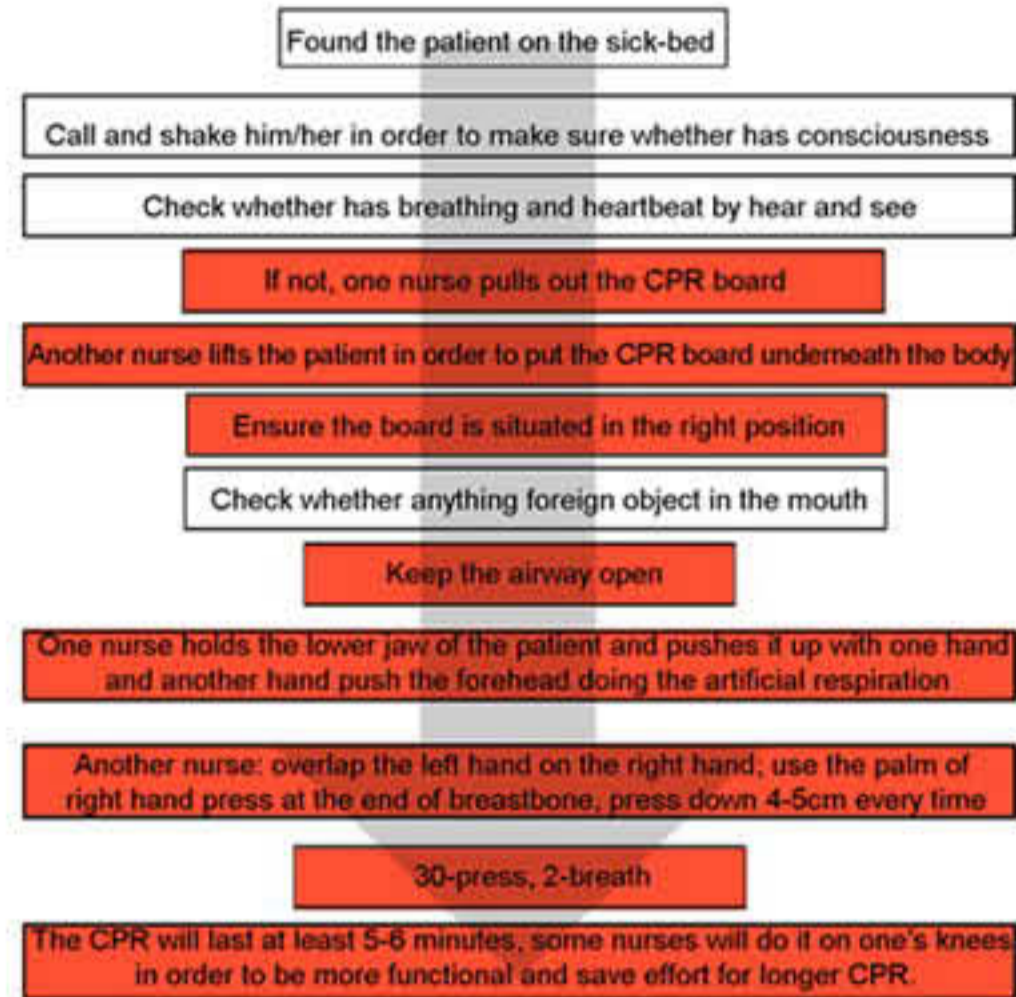
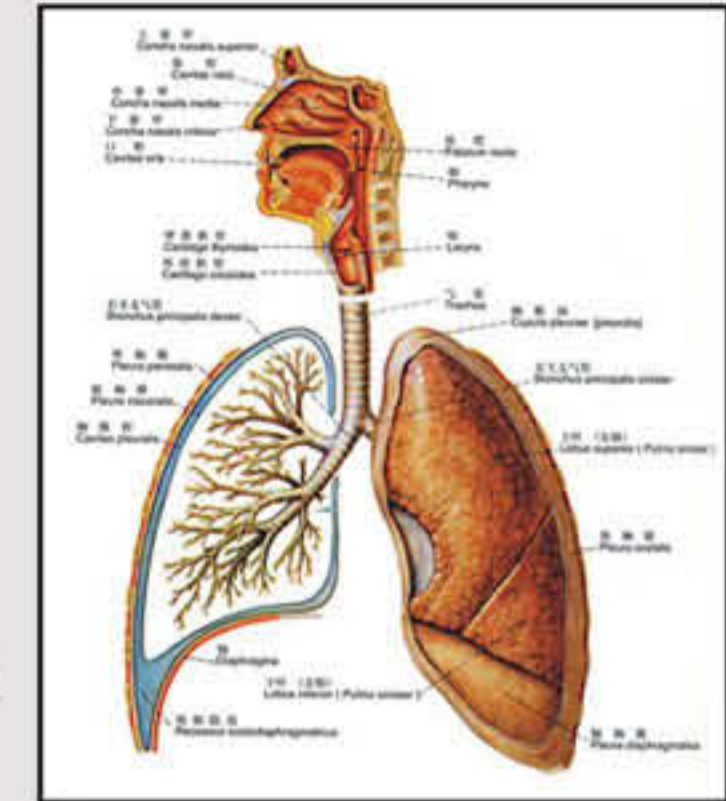


Figure 27 the possible errors 3

## Artificial respiration:



The strong push of the head may hurt patient.



Difficult to check whether the artificial respiration works or deep enough

## Heart massage:



- May press the wrong place
- The press may not strong enough
- The press may too strong to hurt the patient



# Errors analysis:

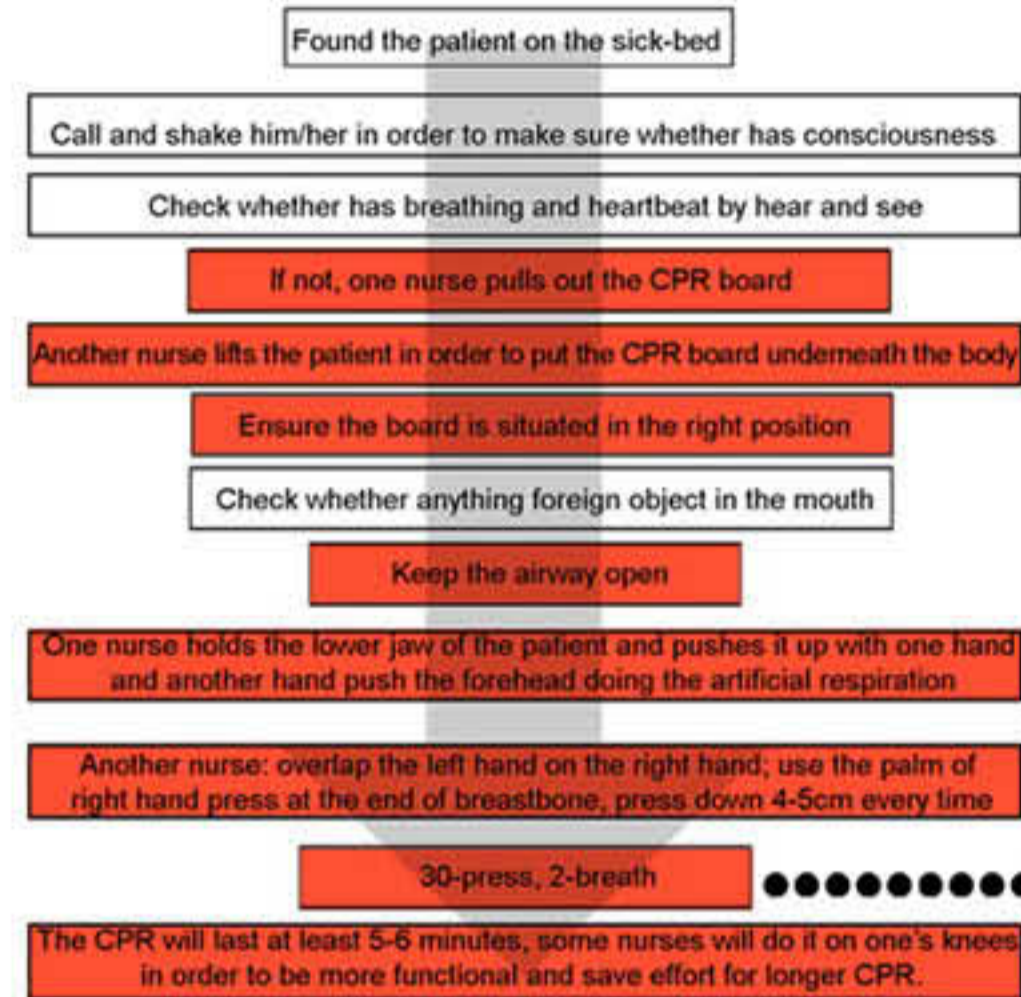


Figure 28 the possible errors 4

## The lasting process:



The heart massage may go weak over time lasting

## Knee on the ward bed:



The nurses' knee may hurt caused by the wrong shape of CPR board





### 5.2.3 Character profiles:

By communication and observe the working condition, I found that their work is a kind of routine. By changing the working timetable, they went to work in a nervous condition. Although there was time for them to rest, however once something happened, the working condition was very intensity. So actually, working as a nurse is a very tired. So the character profile I made is the common condition of their working.

How	Why
Based on observations of real people, develop character profiles to represent archetypes and the details of their behavior or lifestyles.	This is a useful way to bring a typical customer to life and to communicate the value of different concepts to various target groups.

Table 7: Character profiles

**Ann** is a nurse working in the cardiology department of one big hospital. There are a lot of patients coming to see doctor everyday. Ann's job is taking care of the inpatients.



She went to work every second day, since sometime she has to on the night shift. The longest day time for working is from 7:30 am to 8:00 pm, and for the night shift is 8:00 pm to next day 7:30 am. Meanwhile she is also a mother of two kids. She has to take care of them herself

For the normal nurses working in the in-patients department, the works they have to do general treatment including injections, writing nursing records, observe the condition of patients, record the change of patients' condition and use of drugs for critically ill patients, assist the doctors to do everything they can and work as doctor in hurry or doctor-absent. Take the injection work as an example, there is commonly 50 patients need to treat everyday, and each of patients has 4-5 bottles of injection. So it is a huge job to do. Sometimes they even do not have time to eat. Of course, there are a lot of detain jobs like meet the new patients and explain the usage of drugs.



Figure 29 the character profiles

So after the character profiles analysis, I found how to less the hard degree of working condition is very important. For this project, it is how to save the strength of compression and let the CPR board use easier.



#### 5.2.4 Anthropometric analysis

##### 'Anthropometric analysis'

How	Why
Use human population measurement data to check the coverage and suitability of the design solution for target user group.	This helps to identify a representative group of people for testing design concepts and evaluating the general usability of product details.

Table 8: Anthropometric analysis

In this project, the related human population measurement data is the mainly about the size of upper part of the body and the weight.<sup>12</sup>

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12.Human factors design handbook, second edition, Wesley E. Woodson





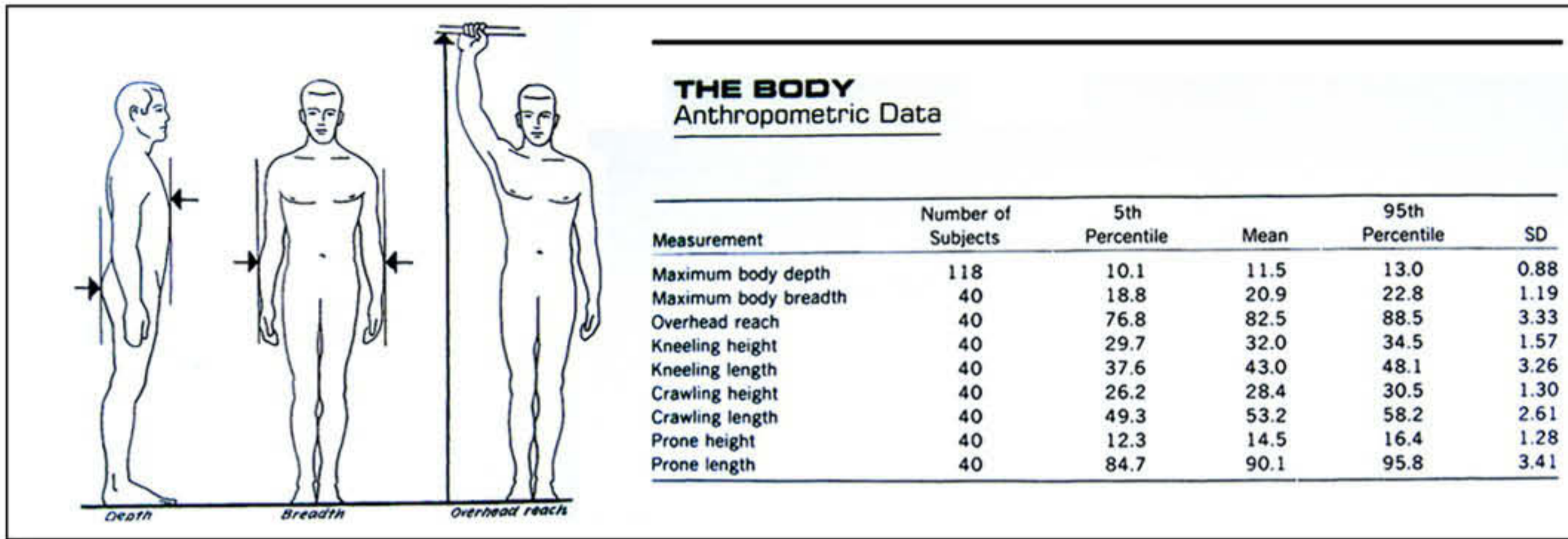


Figure 30 Anthropometric analysis: width

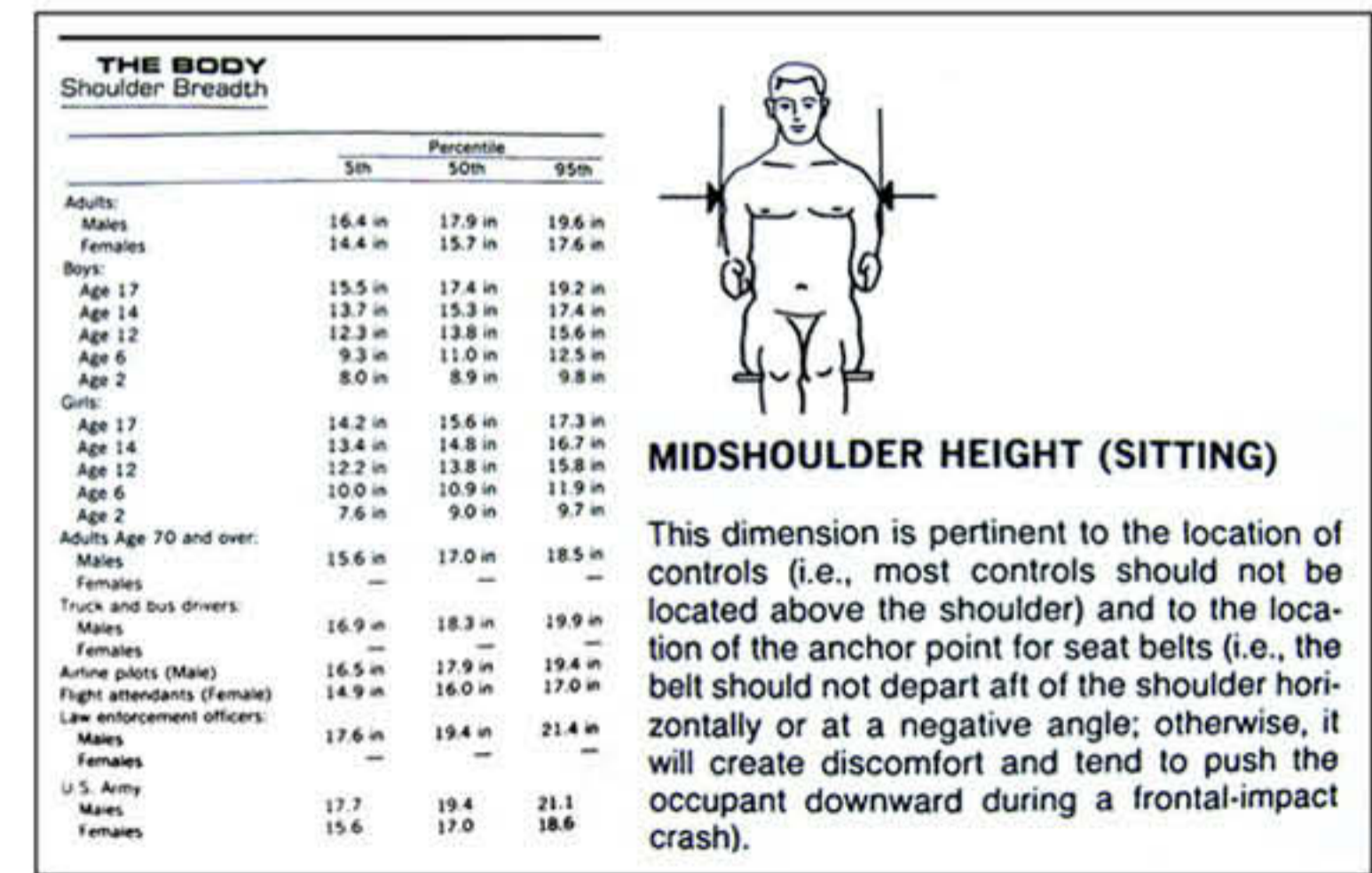
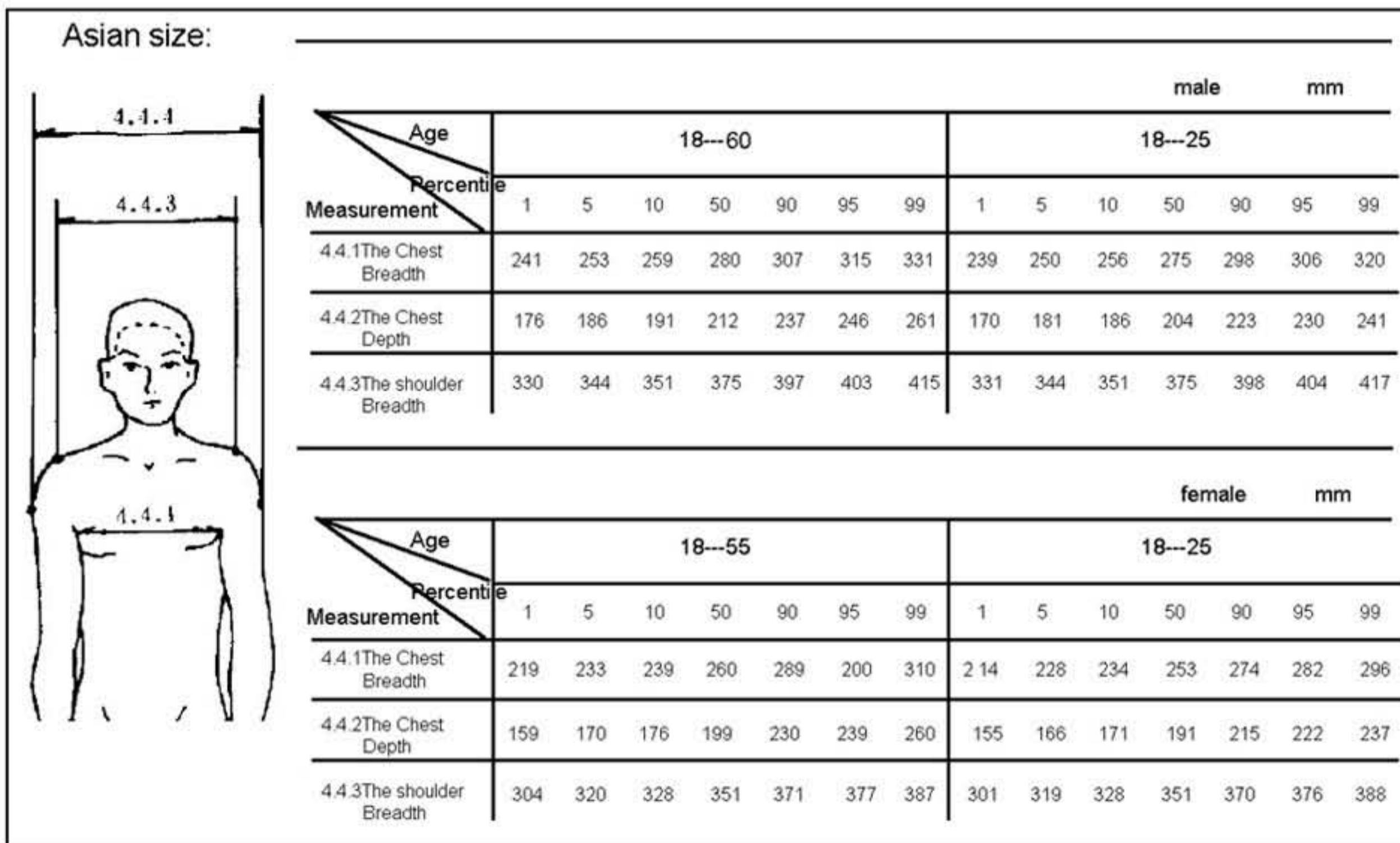
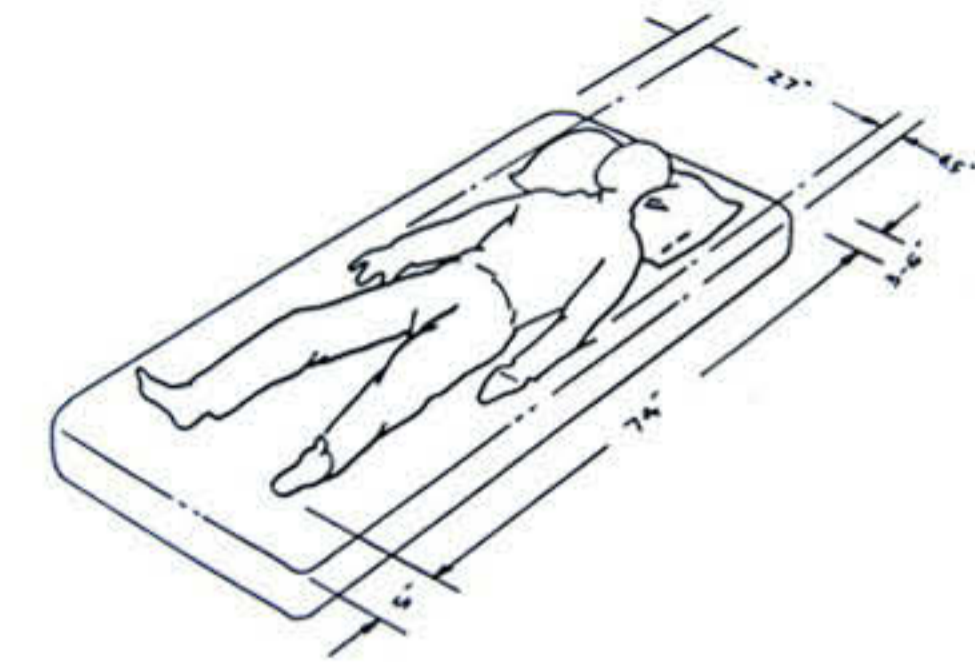
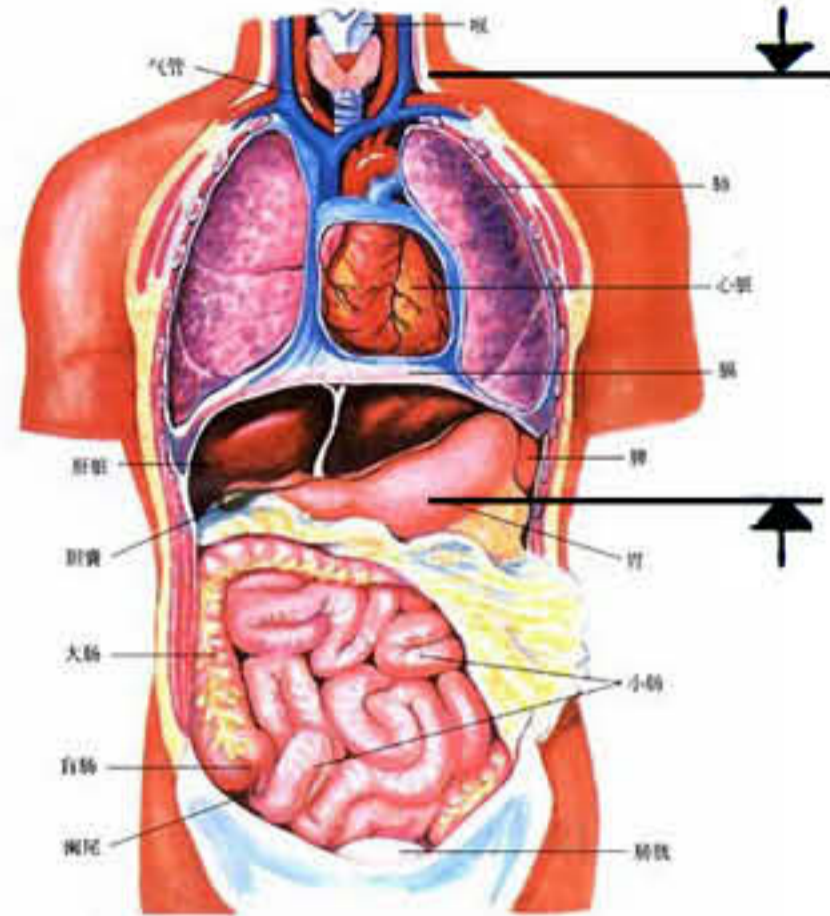
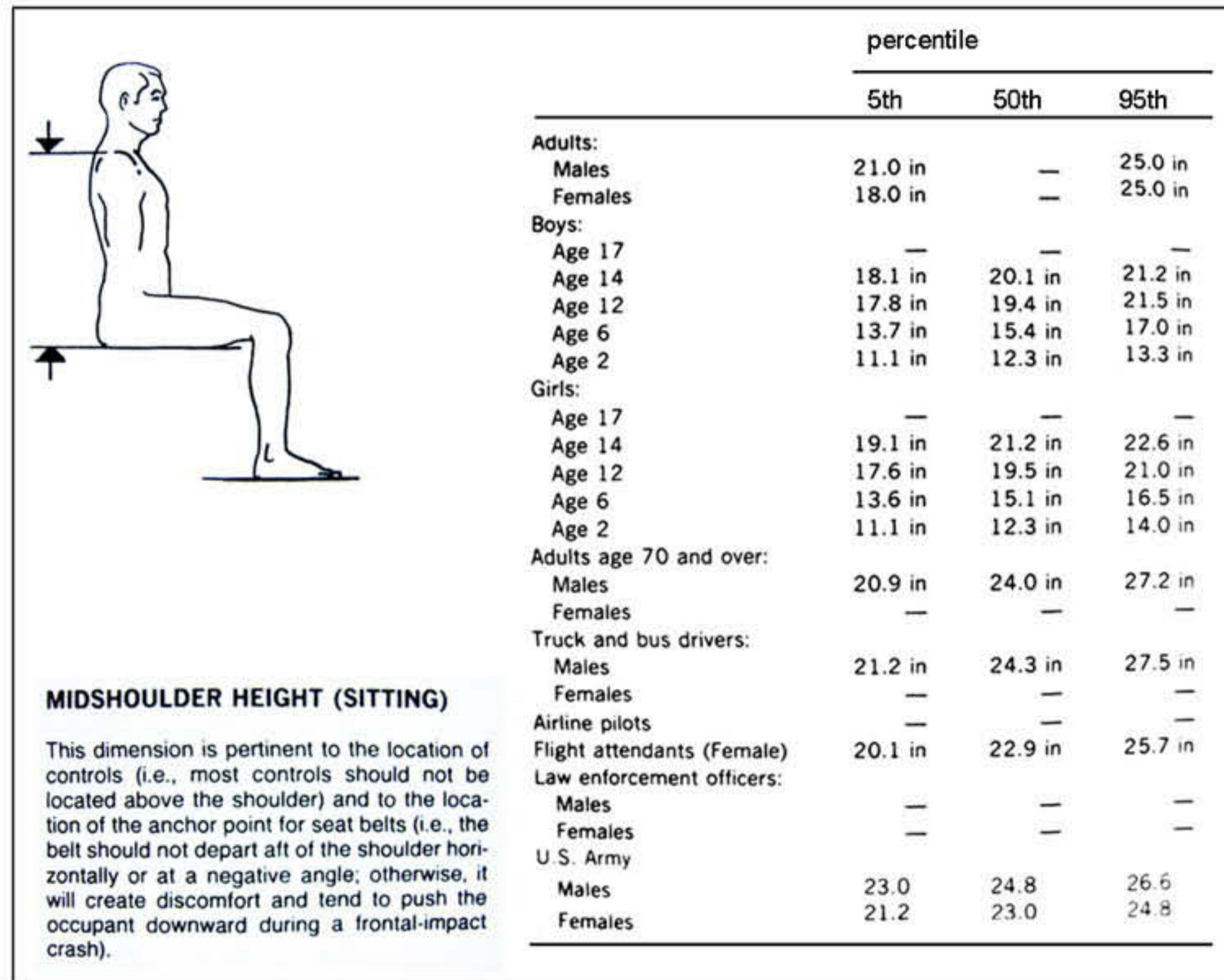
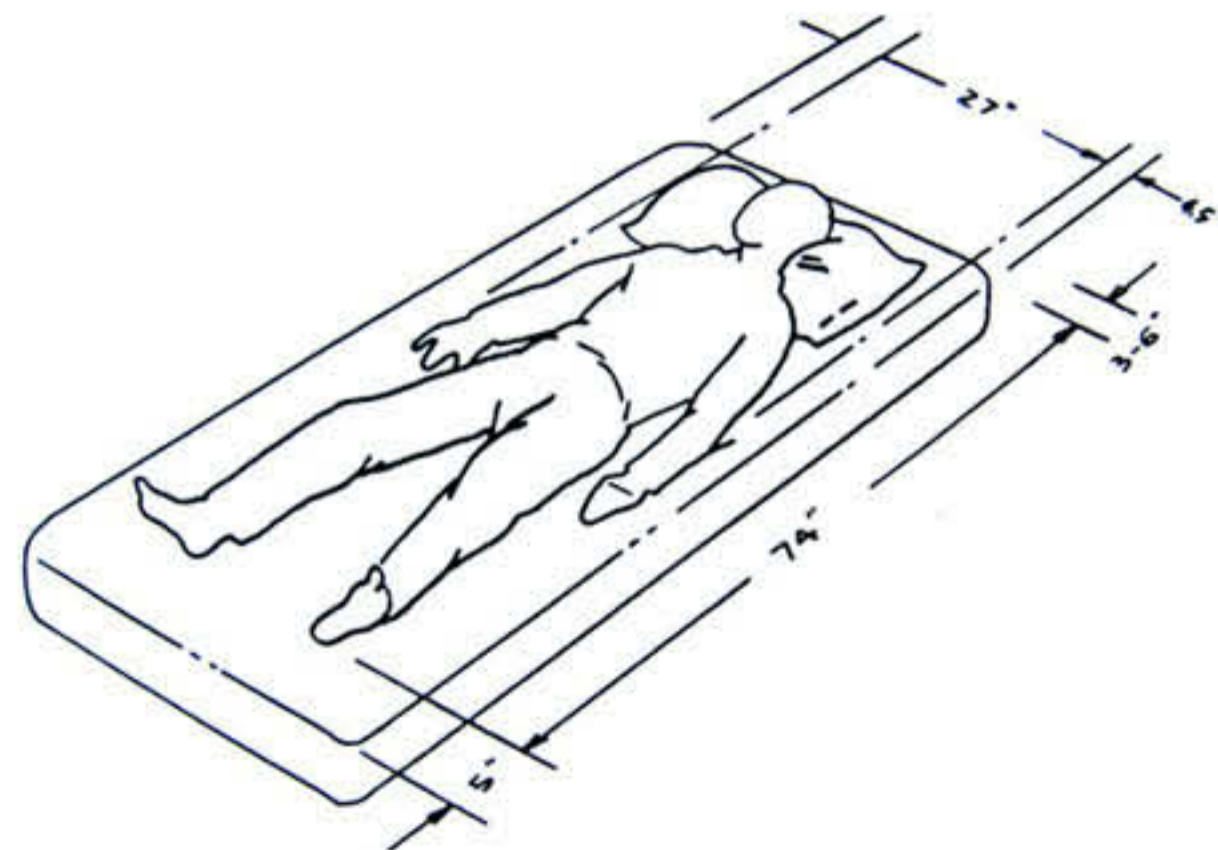




Figure 31 Anthropometric analysis: length



Nowadays the size of CPR board is according to the size of bed head. So it is too large for the body. This distance should be the real length the CPR board need.







According to the principle of CPR, the right angle of head should let the lower jaw perpendicular to the horizontal plane

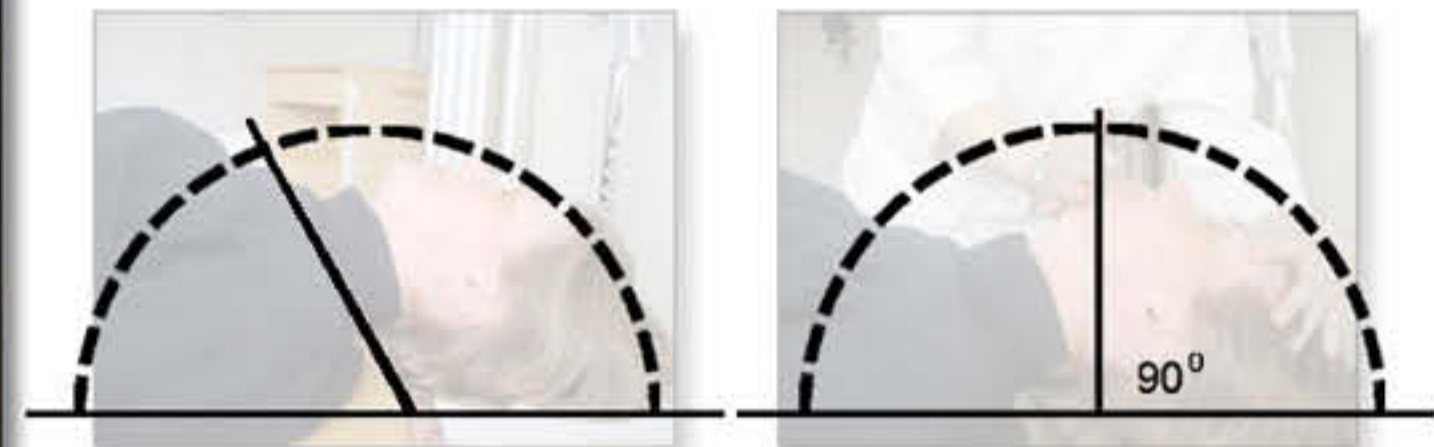


Figure 32 Anthropometric analysis: the head angle of elevation

Head length

	Percentile		
	5th	50th	95th
Adults:			
Males	7.3 in	7.7 in	8.2 in
Females	7.0 in	7.4 in	7.7 in
Boys:			
Age 17	7.2 in	7.7 in	8.0 in
Age 14	7.2 in	7.6 in	8.1 in
Age 12	6.9 in	7.5 in	7.7 in
Age 6	6.6 in	7.2 in	7.6 in
Age 2	6.5 in	6.9 in	7.3 in
Girls:			
Age 17	6.9 in	7.4 in	7.8 in
Age 14	7.0 in	7.4 in	7.9 in
Age 12	6.8 in	7.3 in	7.8 in
Age 6	6.6 in	7.1 in	7.4 in
Age 2	6.1 in	6.7 in	6.9 in
Adults age 70 and over:			
Males	7.3 in	7.7 in	8.1 in
Females	—	—	—
Truck and bus drivers:			
Males	7.2 in	7.6 in	8.1 in
Females	—	—	—
Airline pilots (Male)	7.2 in	7.8 in	8.6 in
Flight attendants (Female)	6.9 in	7.3 in	7.7 in
Law enforcement officers:			
Males	7.3 in	7.8 in	8.2 in
Females	—	—	—
U.S. Army			
Males	7.3	7.8	8.2
Females	6.9	7.4	7.8



NECK FLEXION, DORSAL (A), VENTRAL (B)

	Average	SD
Ventral flexion	60°	12
Dorsal flexion	61°	27
Right-left flexion	41°	7
Right-left rotation	79°	14

**RANGE OF MOVEMENT AT THE NECK JOINT\***





After analysis the human population measurement data, the size of CPR board should be:

Minimal breadth: 35 cm

Minimal length: 40 cm

**The weight data:**

The reason I did the human weight analysis is because of the human weight of the aspect which influent the speed of execute CPR. What's more, to some degree that the direction / speed of putting the CPR board underneath the patient is decided by the human weigh.

Although all the information from nurses and medial persons shows that there is no regulation of which direction is the right way to putting the CPR board, the most important thing is it has to be fast. Concerning to fast, the fastest direction of putting the CPR board should be the lightest direction to lift patients.

There are two directions of lifting patients: from head to lift the patient to a half-sit position; from one side to turn the patient to another side.

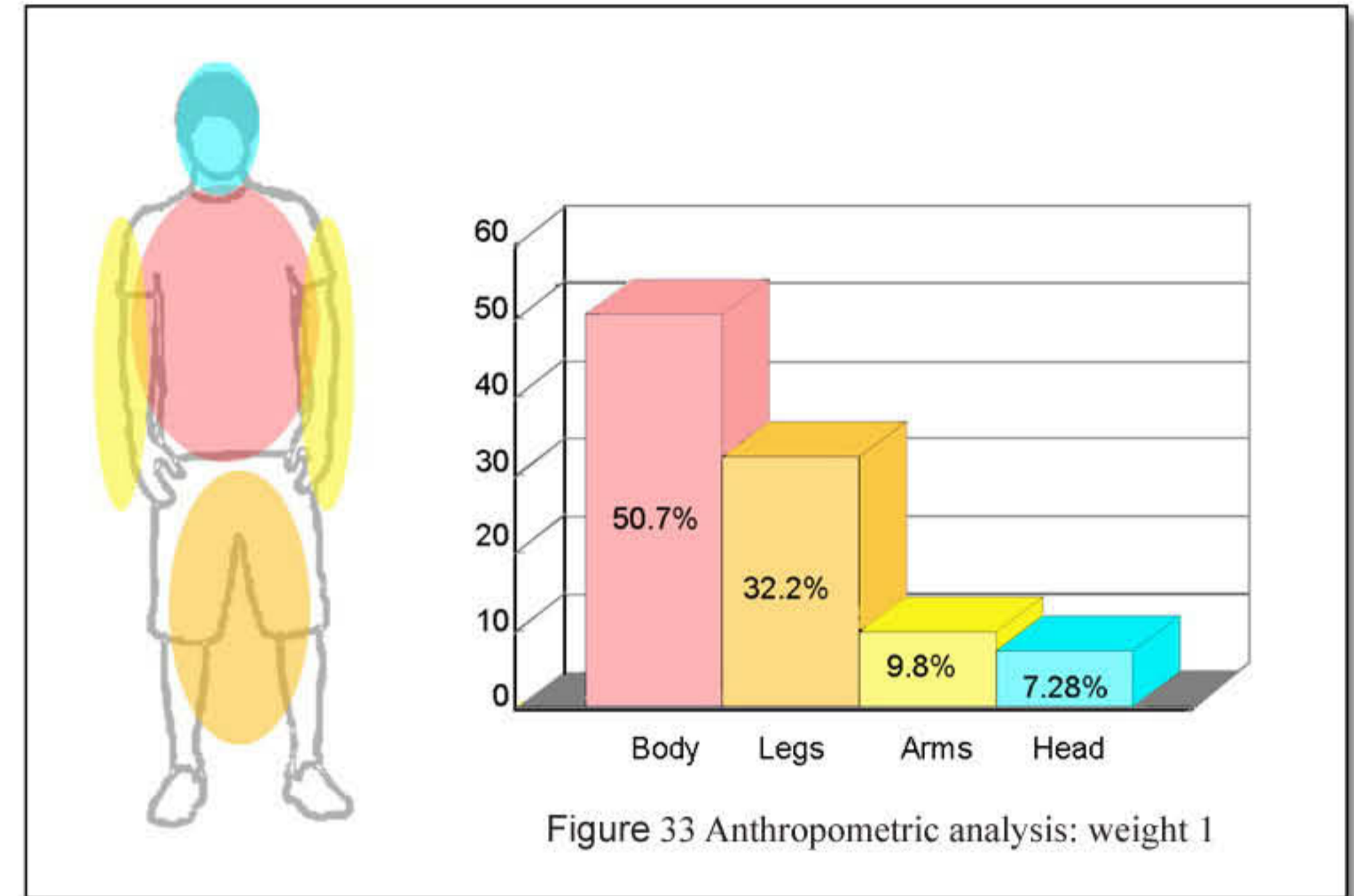


Figure 33 Anthropometric analysis: weight 1

**The weight of each part of the body**

Part of the body	Weight percentile (%)	Deviation
Head	7.28	0.16
Body	50.70	0.57
Hand	0.65	0.02
Forearm	1.62	0.04
Forearm+hand	2.27	0.06
Upper arm	2.63	0.06
One arm	4.9	0.09
Both arms	9.8	
Foot	1.47	0.03
Crus	4.36	0.10
Thigh	10.27	0.23
One leg	16.10	0.26
Both legs	32.20	

Figure 34 Anthropometric analysis: weight 2





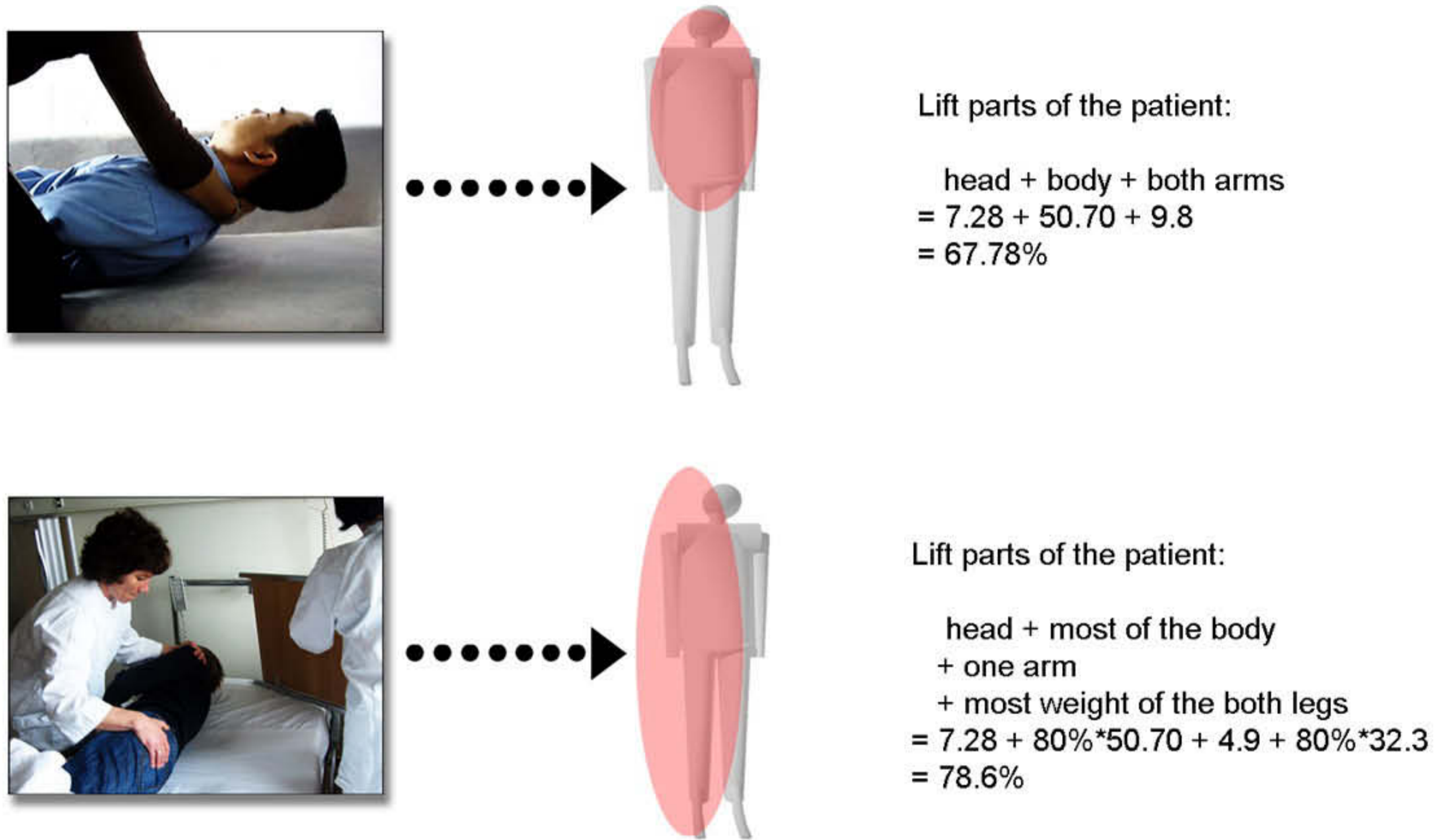


Figure 35 Anthropometric analysis: weight 3

So after analysis, the lighter way of is to lift the patient to a half-sit position from head.





### 5.3 The ‘look’ methods results and discussion

In the ‘look’ part, the following methods results are discussed in this section:

Fly on the wall

Shadowing

These two methods are based on the user-centered theory.

#### 5.3.1 Fly on the wall

‘Fly on the wall’

How	Why
Observe and record behavior within its context, without interfering with people’s activities.	It is useful to see what people actually do within real contexts and time frames, rather than accept what they say they did after fact.

Table 9: Fly on the wall

#### 5.3.2 Shadowing

‘Shadowing’

How	Why
Tag along with people to observe and understand their day-to-day routines, interactions, and contexts.	This is a valuable way to reveal design opportunities and show how a product might affect or complement users’ behavior.

Table 10: Shadowing

‘Fly on the wall’ and ‘Shadowing’ are similar observation methods. What I had done was to go to the training rooms where the cardiac department teachers teaching the students to execute CPR.

The reason of doing this kind of communication is because the nursing students just like our common people who are not very familiar with CPR. Consequently, they may result a lot of errors when learning. When the errors happen, the teacher would correct them. Therefore, as the observer, I can find where the problems are. In addition, I can know how to avoid them. This process also do a lot of favor for me to do the ‘Activity analysis’ and ‘Error analysis’.







The teacher was teaching the nursing students how to execute CPR.

The students were trying it themselves.



The teachers showed how to execute the advantaged CPR.

<http://www.youtube.com/watch?v=d3RNjjqR1WA>

[http://rapidshare.com/files/377658153/MVI\\_4358.AVI.html](http://rapidshare.com/files/377658153/MVI_4358.AVI.html)

The address to download the video of nursing students learning execute CPR





Another location to fulfill 'look' methods is the hospital. There are two hospitals involved:

Aarhus University Hospital

Vestre Viken HS Sykehuset Asker og Bærum

The hospital observation helped me to understand the routine working condition of the cardiology department. Through the communication with the nurses working there, it helped me to do the 'Character profiles' analysis.

There are several hospitals in Xi'an, China also involved into the communication. Although there is no chance to do the communication like 'Fly on the wall' and 'Shadowing', it still helped me to understand the CPR board design suiting different background by telephone interview and email with the doctors and nurses working in cardiology department.





## 5.4 The ‘Ask’ methods results and discussion

In the ‘ask’ part, the following methods results are discussed in this section:

### Survey & Questionnaires

#### Extreme user interview

In this section, these two communication methods are typical methods based on user-centered theory.

## 5.4.1 Survey & Questionnaires

### ‘ Survey & Questionnaires’

How	Why
Ask a series of targeted questions in order to ascertain particular characteristics and perceptions of users.	This is a quick way to elicit answers from a large number of people.

Table 11: Survey & Questionnaires

In the ‘Survey & Questionnaires’ part, it was begin from the worst and best question.

From the human nature, people would like to describe their dream because they can imagine without limitation, to add all the stuff they like inside the dream. Some questions like: How would the situation be if everything was perfect, or what would they ask for if they could get one thing to happen? This gave me more information about the situation now (what is missing), than to ask directly. It is very easy and fun for people to answers such a question, ask people to describe one little thing that could do the product better.

Some question like, what are your best experience and the worse? , is also the same principle. In the study of CPR board, these kinds of questions were utilized.

The reason to ask worst situation questions is because from people psychological reason, most people like to complain, which is also a way to blow off repressed emotion.





## Information from Communication:

Problems: while using
<p>“Difficult to get the board under the patient”</p> <p>“The patient tend to ‘roll off’ the board while doing the CPR”</p> <p>“The board got stuck”</p> <p>“The bad thing was that this was too big in size to get under the patient, but the weight on the CPR was easy”</p> <p>“The bed is too small and the patient too big”</p> <p>“I find it hard to put it under the patient in bed”</p> <p>“The important time to go away”</p> <p>“It hurt my knees when I stand on my knees doing CPR”</p> <p>“A big (fat) man, not easy to turn him over to left or right side.”</p> <p>“It is not easy to get when I need it”</p> <p>“We also have to be very carefully if he has some special equipment to take care of.”</p> <p>“It can be more difficult if the mattress is soft”</p> <p>“All beds (the old) we have a tree board we can used, but its difficult to take this away, and its take time.”</p>

Table 12: the answers from survey & questionnaire 1





<b>Problems: after using</b>
<p>“It’s difficult to clean afterward”                      “Some time it was stuck be the rust”                      “It’s difficult to do my work and I have to climb upon the bed”                      “It is not easy to get when I need it”</p>

Table 13: the answers from survey & questionnaire 2

<b>Function:</b>
<p>“The board must also have a handle giving a good grip.”                      “It would also be nice if it could be hanging several places on the wall.”                      “Maybe it could be decorated with some graffiti or art, then it would be decorative when it isn’t in use.”                      “it has to be easy to get when you need it”                      “It was easy to transport and carry and place under the patients.”                      “helps my to get my compressions more effective”                      “My worst experience is that i can create more hands- off - time during till CPR, especially if there are inexperienced cure involved”                      “The board is used in CPR- situations where the resuscitation is long and complicated”                      “The boards must have handles”                      “That its easy too used and we remember to used it. In these situations we have to run quickly to the patient and its important that the CRP is there.”                      “That board is comfortable and easy too used.”                      “may make the board easier to slide under the patient.”                      “Can be folded when losing some of its important function to be a hard and stable surface.”                      “Maybe it should have another “surface”, which could be better since the patients often are ‘clammy’.”                      “it should be designed so that it lies steady in the bed and the patient lies steady on it. ”</p>

Table 14: the answers from survey & questionnaire 3





Size:	Weight:	Surface:
<p>“A big (fat) man, not easy to turn him over to left or right side.”</p> <p>“The bad thing was that this was too big in size to get under the patient. But the weight on the CRP was easy.”</p> <p>“One problem is that the bed is too small and the patient too big.”</p> <p>“may make the board smaller”</p> <p>“Perhaps it should be thinner”</p>	<p>“I want the CPR board with light weight”</p> <p>“I wish for the board to be lighter”</p>	<p>“I want the CPR board with smooth surface”</p> <p>“Made with a fabric that decrease friction.”</p>

Table 15: the answers from survey &amp; questionnaire 4

Shape:	Material:
<p>“I want the CPR board more round and less square”</p> <p>“It would be nice if it had a shape that allows you to stand on your knees in the bed without hurt your knees”</p> <p>“I would like it to have an anatomic shape that allows you to stand on your knees”</p> <p>“It has to be easy to clean.”</p>	<p>“It should be in a material that isn’t heavy, easy to clean and easy to put under the patient”</p> <p>“It has to be easy to clean.”</p> <p>“Made with a fabric that decrease friction.”</p>

Table 16: the answers from survey &amp; questionnaire 5





Compare to interview, the questionnaires is way targeted to groups. As one principle 'social proof' in the book *Influence, science and practice*<sup>13</sup> (Influence, Robert B. Cialdini) said: 'we view a behavior as correct in a given situation to the degree that we see others performing it.' Towards group, there is the risk to face silence at all. This is because people always have the feeling of uncertainty & social confirmation. The way to reduce it is to make it have a clear direction---point it out. Therefore instead of further detailed questionnaires, I chose to do personal interview individually. Because of in this project, it is easier to get useful information in the way of having personal interaction.

#### 5.4.2 Extreme user interview

##### ' Extreme user interview'

How	Why
Identify individuals who are extremely familiar or completely unfamiliar with the product and ask them to evaluate their experience using it.	These individuals are often able to highlight key issues of the design problem and provide insights for design improvements.

Table 17: Extreme user interview

The extreme user interview is the embodiment of the balance of quantity and quality. It is a way to involving some persons very much instead of involving many just a little bit.

In this case, three of the Hiak postgraduate students list in first section of this chapter is very often interviewed. Since the special medical background design, the people who are extremely familiar with the CPR board were chosen to be the interviewee. The interview took several rounds, at the very beginning, in the middle of design process, concepts evaluation, etc.

13. Influence, science and practice, Robert B. Cialdini





## 5.5 The 'Try' methods results and discussion

In the 'try' part, the following methods results are discussed in this section:

Scenarios

Role-playing

Paper-prototyping

Scale modeling

These kinds of methods are the way trying to develop the image of the products.

### 5.5.1 Scenarios

' Scenarios'

How	Why
<p><b>Illustrate a character-rich story line describing the context of use for a product or service.</b></p>	<p><b>This process helps to communicate and test the essence of a design idea within its probable context of use. It is especially useful for the evaluation of service concepts.</b></p>

Table 18: Scenarios

Base on the analysis of 'Character profiles', 'Activity analysis', 'Extreme user interview' and other way of communication, the scenarios give a probable using context.





## Scenarios:

**Ann** is a nurse working in the cardiology department of one big hospital. There are a lot of patients coming to see doctor everyday. Ann's job is taking care of the inpatients.



It was a normal Tuesday evening, around 7 o' clock pm. Ann started work that day 8 o' clock am, and was going to off duty 8:30 pm. After almost the whole day working, she was very tired and just hoped the time of off-duty coming soon.





## Scenarios:

**Suddenly** the beeper screamed. It was bed No.7. It is Charles, a tall and heavy guy. He used to be very strong, but the heart disease ruined his health totally. Now he is a weak old man with bad heart disease.

Only Ann noticed this. She ran to the bed No.7 finding Charles already unconscious. It was the patient beside him who rang the beeper. After a check, Ann knew she should execute CPR immediately. However, Charles lay on the soft mattress. So she had to use the CPR board. She wanted to fetch the CPR board and found it was locked by the shelf, without thinking she had to pull it out by brute force. Fortunately, it came out. Then she tried first to see whether she could turn him to one side. But she found it was impossible. So she climbed upon the bed to try her best to lift him. Because it was only Ann herself and Charles is very heavy, after several tries, Ann finally put the CPR board under Charles. But the board wasn't very steady underneath the body and sliding, which made it even more difficult to do the CPR. The CPR lasted for a long time. Because of the desperate struggle and professional knowledge, Charles was saved. However, for Ann, it was a totally terrible experience. Ann felt herself exhausted and just about to drop.

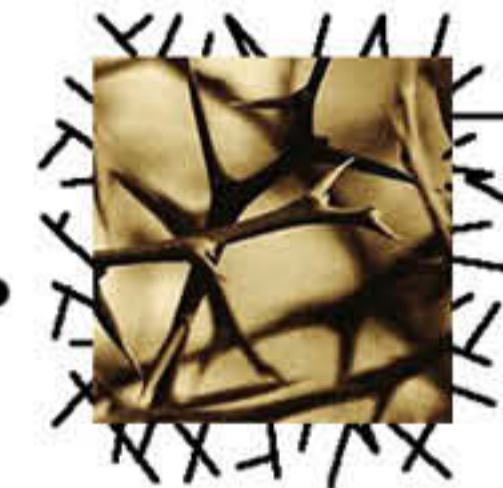




Figure 36 the role-play

### 5.5.2 Role-playing

#### 'Role-playing'

<b>How</b>
<b>Identify the stakeholders involved in the design problems and assign those roles to members of the team.</b>
<b>Why</b>
<b>By enacting the activities within a real or imagined context, the team can trigger empathy for a actual users and raise other relevant issues.</b>

Table 19: Role-playing

The postgraduate students and some of the bachelor students in Hiak, nursing department involved in the role-play. One of them played as the patient who has badly heart disease and need to have first aid immediately. The others played as the nurses who find her in emergency. The serious actions were taken by picture in continuous capture modes, 2 pictures /1second. They executed 2 rounds of heart CPR, each time 30 compressions, respirations. There are 237 photos during the whole process. So it was last totally around 2 minutes.





### 5.5.3 Paper-prototyping

#### ' Paper-prototyping'

How	Why
Rapidly sketch, layout, and evaluate interaction design concepts for basic usability.	This is good way to quickly organize, articulate, and visualize interaction design concepts.

Table 20: Paper-prototyping

### 5.5.4 Scale modeling

#### ' Scale modeling'

How	Why
Use scaled, generic architectural model components to design spaces with the client, team, and/or users.	This spatial prototyping tool provides a way to raise issues and respond to the underlying needs of different stakeholders.

Table 21: Scale-modeling

The two methods are the way to communicate between the product and the users, the product and the designer, also the way communicate between the users and the designer.

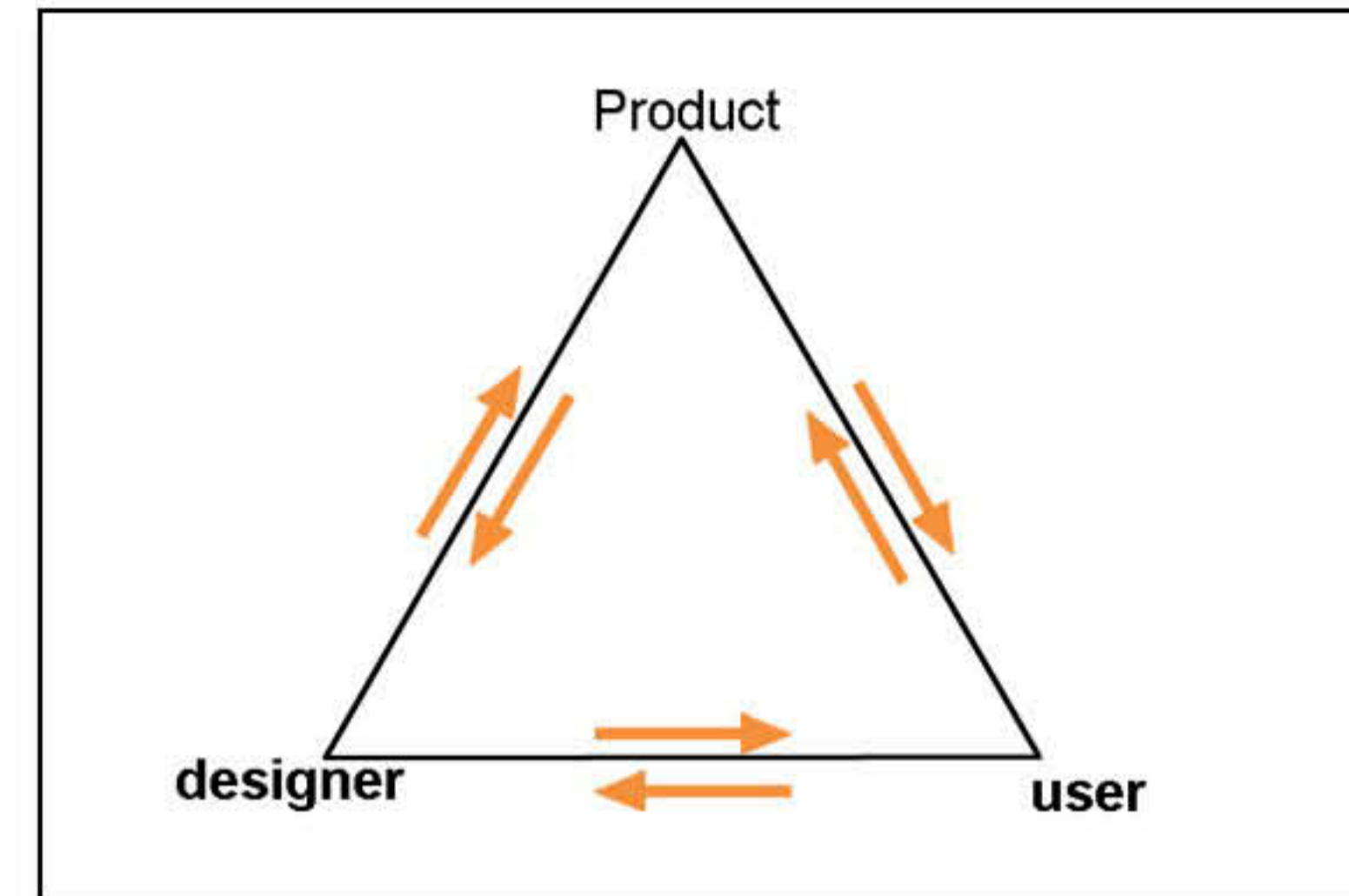


Figure 37 the relation between product (Model) , user and designer







Figure 38 the paper-prototype and scale modeling





**Conclusion:**

The process of practice the above communication methods is the way of product develop. From learn to look, than to ask, finally try, it is a logically way.

Only after you have the acquaintance of the context, you can ask some useful questions which may help you to have a further understand. Then, you can have some possible try about the product. During the communication, I find the verbal part of communication is very useful.

A lot of existing methods (including what I have used in this project) is based on words, but not all the information is to be shared by words. During the communication, I find the verbal part of communication is just takes a small percentage of the communication. A lot of the information is collected by the non-verbal methods. In table 22, I classified the research methods relative to my study into verbal, non-verbal, and other. It doesn't mean that the methods listed in the 'other' part are neither verbal nor non-verbal. Those methods doesn't have so obvious feature whether they belong to verbal methods or non-verbal methods. To a certain degree, It is decided by how the designer will execute.

After all the practice of the above research methods, a general product image has already emerged. The detailed concepts development and final concept will be showing in the next chapter.

<b>Verbal communication (including writing language)</b>	
Extreme user interview	---ask
Questionnaire	---ask
Scenario testing	---try
Role-play	---try
<b>Non-verbal communication:</b>	
Error analysis (base on observation)	---learn
Activity analysis (base on observation)	---learn
Character profiles (base on observation)	---learn
Shadowing	---look
Fly on the wall	---look
Scenario	---try
Try it yourself	---try
Role-play	---try
Experience prototype	---try
<b>The others:</b>	
Anthropometric analysis	---learn
Quick-dirty prototype	---try
Paper prototype	---try
Scale modeling	---try

Table 22: the classification of verbal and non-verbal research methods





## Chapter 6

### Product Concepts Development and Final

#### Product

This chapter is the part of concepts development after the communication. In this chapter, different concepts will be analysis and compare. The final concept and final product will be presented as the result in the end of this chapter.

In the very beginning of the chapter, some conclusion information from communication will be presented.

#### 6.1 The overall conclusion information from communication

In this section, the following information will be analysis:

Different user analysis

Hospital mood board

The requirements list

##### 6.1.1 Different user analysis

There are three kinds of users in the CPR board project:

The patients: the users which the CPR board used for

Using condition: unconsciousness

The nurses: the users who really execute the CPR board

Using condition: emergency, usually two nurses working together

The cleaner: the nurses for sometimes are also act as the cleaners.

##### 6.1.2 Hospital mood board

This analysis helped to understand the hospital environment feeling. It helps design regarding to the emotional feeling.





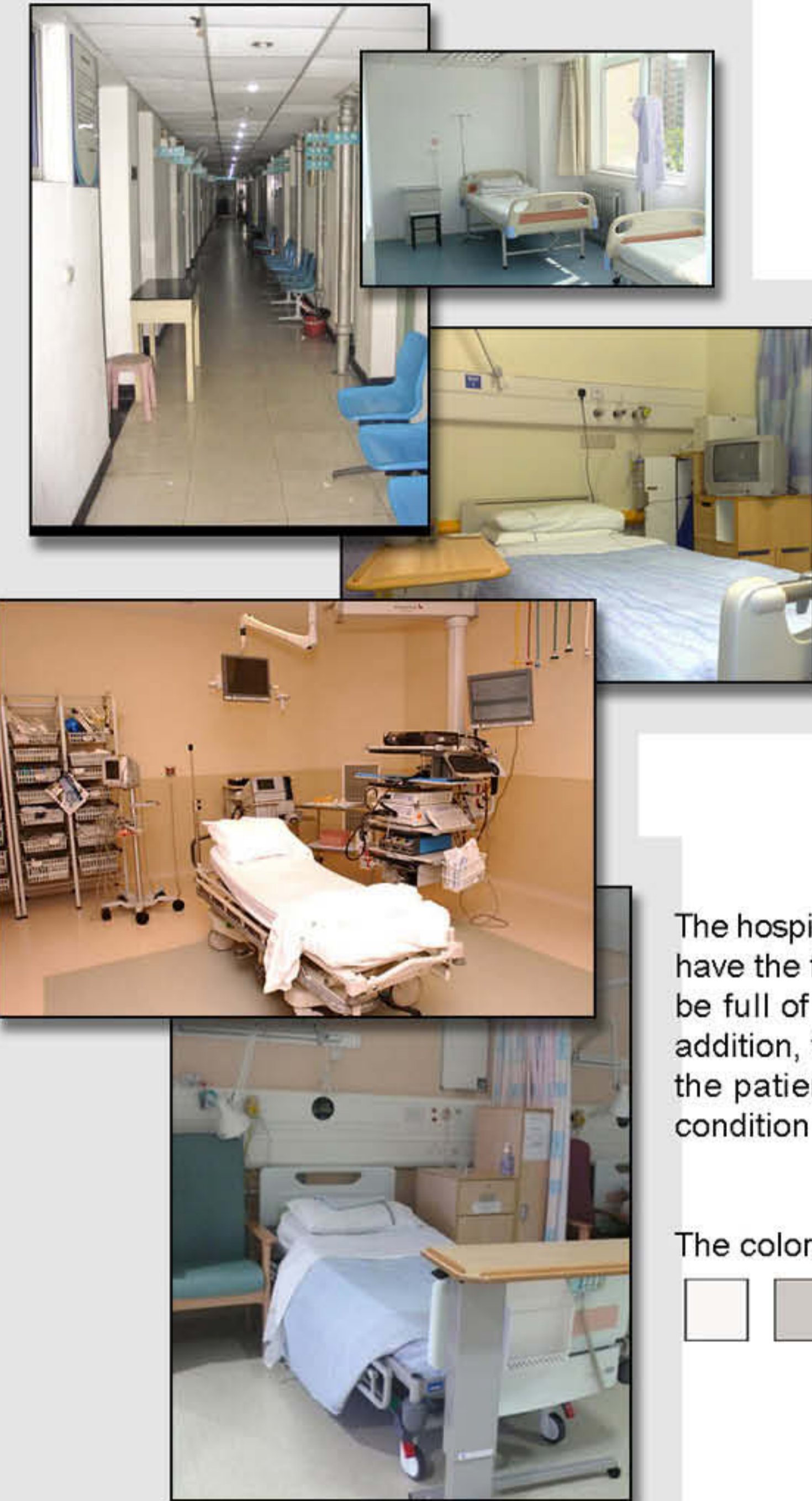


Figure 39 the hospital mood board (1)





Hospital want to give people **clean, bright, spacious** feeling.  
Some of the hospital are trying to create a **home/family** atmosphere.



The hospitals usually are places have the feeling of boring, and be full of a lot of devices. In addition, the stuffs belongs to the patients will make the condition even more serious.

The colors using in the hospital:



Figure 40 the hospital mood board (2)





### 6.1.3 The requirements list

The requirements got through user communication can be classified into 7 parts by different users and aspects:

The requirements from patient

The requirements from nurse

The requirements from cleaner

The requirements from psychological aspect

The requirements from environment aspect

The requirements from economic aspect

The requirements from manufacture aspect

#### The requirements from patient:

1. hard enough to hold body when compression
2. flat to lay the patient on a horizontal position
3. keep the airway open
4. lay the patient in a stable condition
5. protect the nerves inside the cervical vertebra from hurt when unconsciousness
6. do not have to consider the skin hurt
7. meet the ergonomics requirements

#### The requirements from nurse:

1. can be used fast and functional (very important)
2. strong enough to hold the compression efficiency
3. can keep the patient in a stable position when compression even when the patient sweats

4. help to keep airway open
5. lighter than the existing CPR board
6. easy to fetch
7. easy to hold
8. smooth enough to put underneath the patient fast
9. portable
10. fit the using surrounding
11. easy to understand how to use (semantics)
12. easy to keep the CPR board in a good condition

#### The requirements from cleaner:

1. easy to clean
2. easy to keep clean

#### The requirements from psychological aspect:

1. easy to let the nurse understand how to use
2. give the nurses help to clam down when emergency by shape, color

#### The requirements from environment aspect:

For big environment:

1. no toxic
2. the material can last for long time
3. no influence to the nature
4. less material





For small environment:

Fit for the using surrounding

**The requirements from economic aspect:**

1. cheap material
2. less material
3. no long distance transportation

**The requirements from manufacture aspect:**

1. easy to mold with existing technology
2. less components
3. less material
4. less kinds of martial

**6.2 The concepts**

The concept part is the embodiment of the 'Genius design theory'. Base on the requirements got from the communication and all kinds of research methods analysis in previously chapter, all the details which will analysis in this section and next section are decided by the designer in the way of test, observation, data collect and brainstorm, etc.

In order to fulfill the requirements list above, there are several concepts:



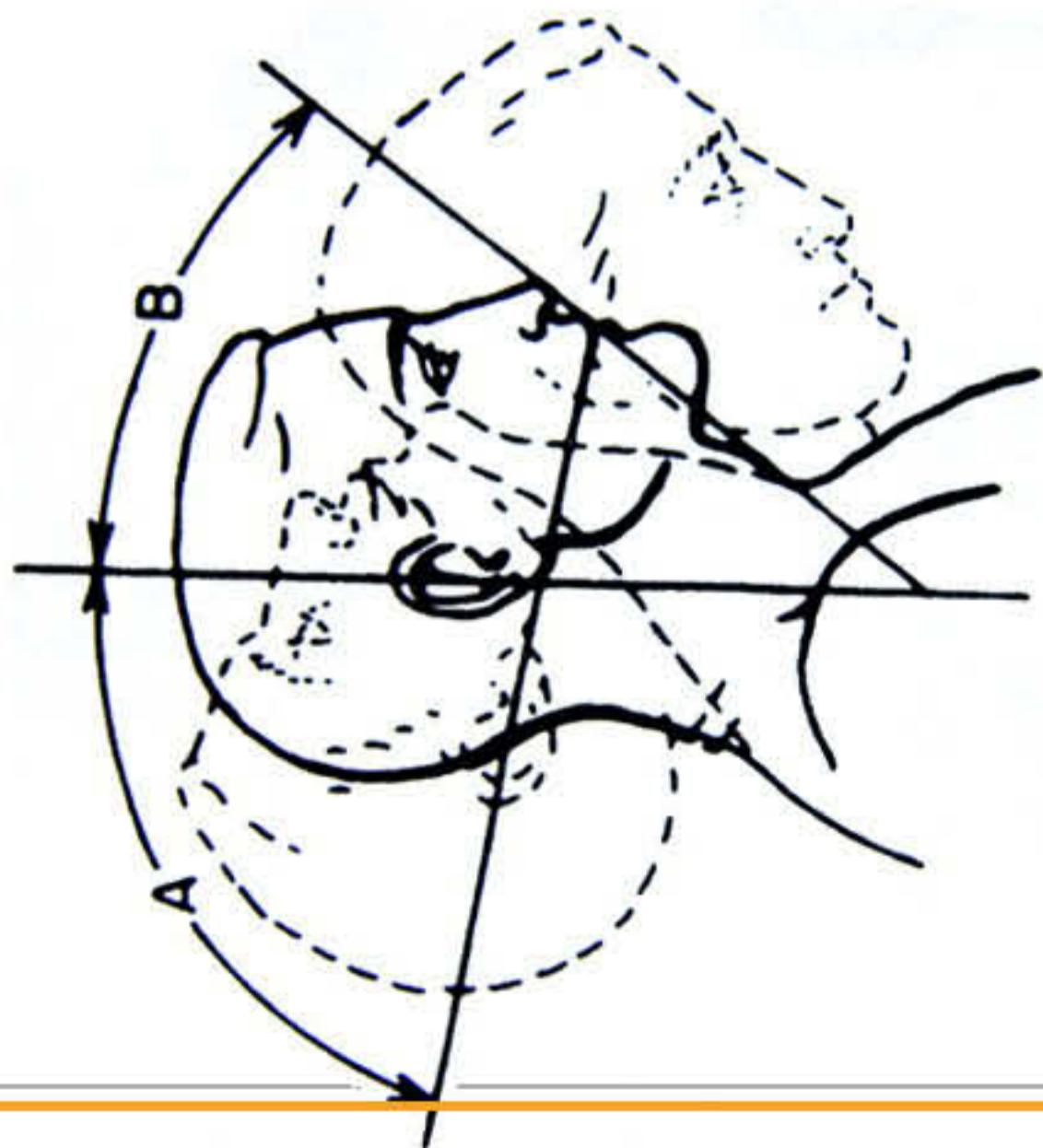


# Concept 1:

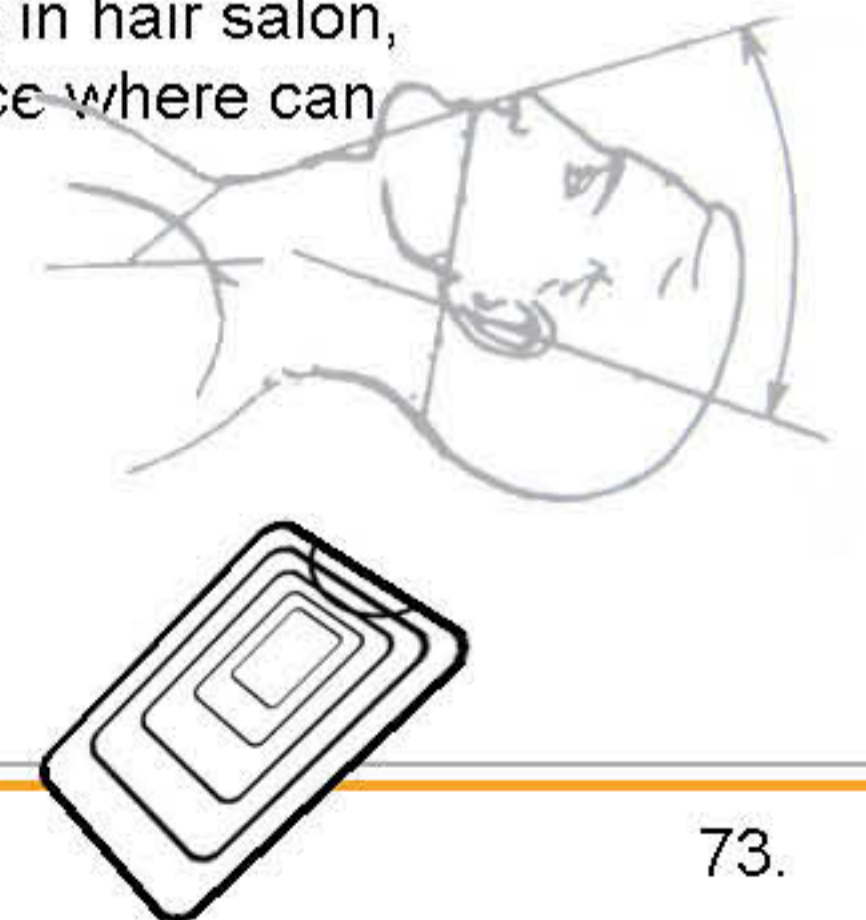
## Inspiration:



Figure 41 the inspiration of concept 1



Inspired by the head position of washing bed using in hair salon, and some posture of yoga, this concept shape a space where can let head lean back in order to keep the airway open





## Concept 1:

### Sketch:



Figure 42 the concept 1

Inspired by the head position of washing bed using in hair salon, and some posture of yoga, this concept shape a space where can let head lean back in order to keep the airway open



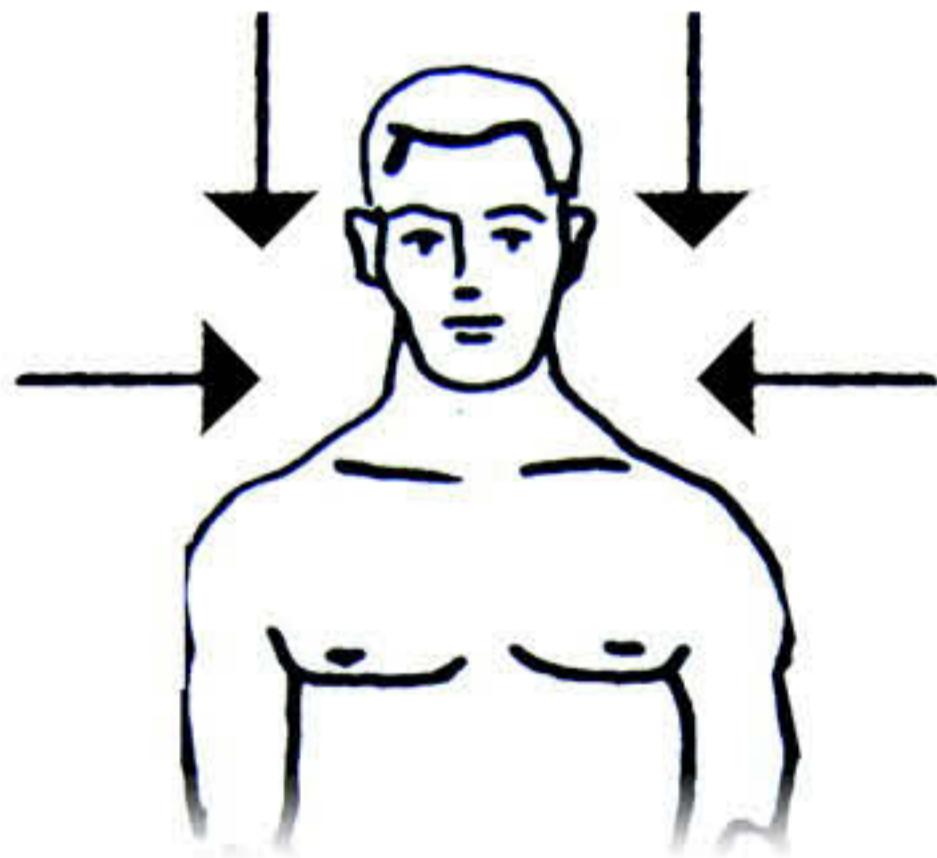


## Concept 2:

### Inspiration:



Figure 43 the inspiration of concept 2



Since fast, functional, stable are the three words appears most frequently from the answer of questionnaire, so the instead of piece of plywood, I got the inspiration (Genius design theory) from the seats of roller coaster. Using the shape of shoulder and neck to fix the right position of patient, it can result stable and functional consequently.





## Concept 2:

### Sketch:

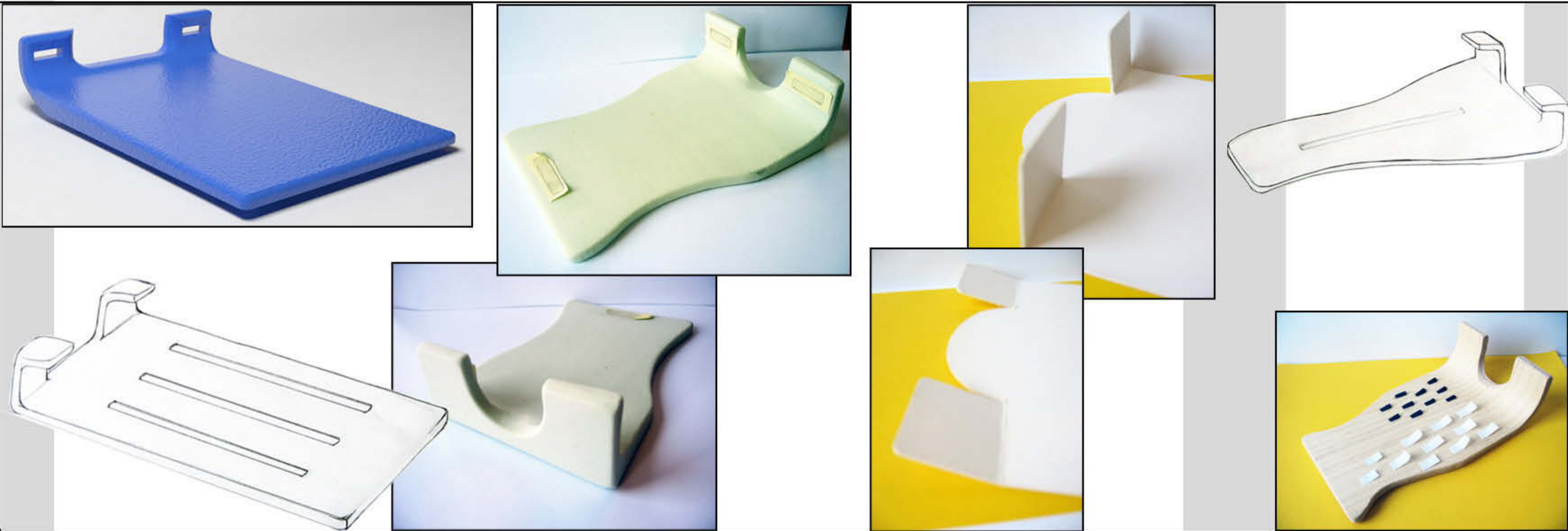


Figure 44 the concept 2

Since fast, functional, stable are the three words appears most frequently from the answer of questionnaire, so the instead of piece of plywood, I got the inspiration (Genius design theory) from the seats of roller coaster. Using the shape of shoulder and neck to fix the right position of patient, it can result stable and functional consequently.



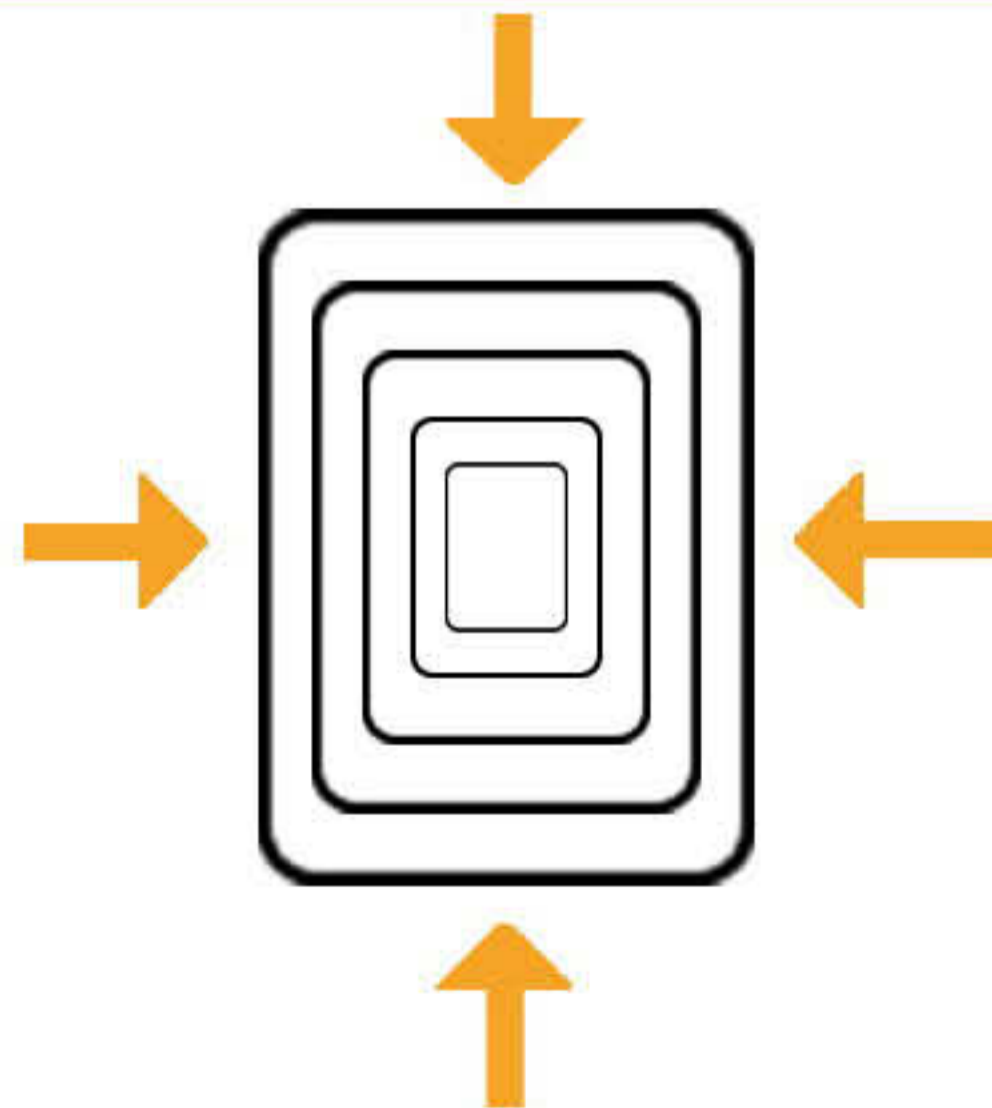


### Concept 3:

#### Inspiration:



Figure 45 the inspiration of concept 3



Inspired by the principle of skifelle and the shape of concentric circle, concept 3 takes use these two principles to hold patients in the right place in a fast and stable way.





## Concept 3:

### Sketch:



Figure 46 the concept 3

Inspired by the principle of skifelle and the shape of concentric circle, concept 3 takes use these two principles to hold patients in the right place in a fast and stable way.





## Other Concepts:

### Inspiration:

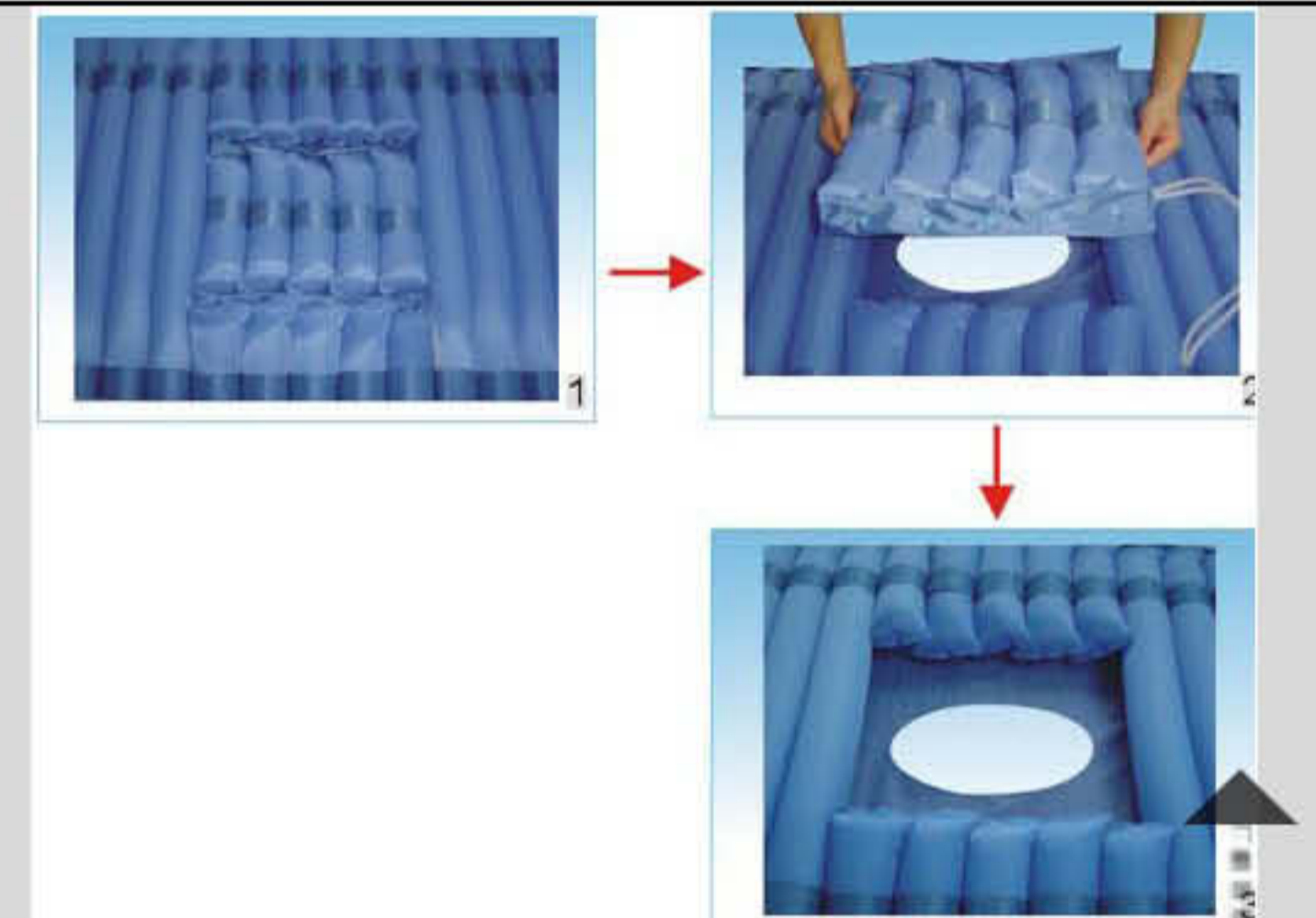


Figure 47 the other concept

In order to slide smooth underneath the patient and stable afterwards, this concept applies powder principle. The surface of the board is be powdered with special powder. However the powder may is not safe for patients. Therefore this concept is not applied.

In this concept, a smooth removable sheet outside the CPR board can provide smooth slide, and this sheet should be removed quickly after put the board underneath. It is complex to operate when emergent.

This concept applied some mechanic device to help meet the requirements. The disadvantage is it may cost a lot and can not portable.





## Concepts compare:

Functional

Fast

Stable



✓  
Hard enough to hold the compression of CPR

✓  
No expanded part to block put fast

✓  
The smooth surface may slip



✓  
Hard enough to hold the compression of CPR

✓  
The expanded part may block to put fast

✓  
The shoulder and neck part both guarantee enough stable



✓  
Hard enough to hold the compression of CPR

✓  
No expanded part to block put fast

✓  
The special surface principle guarantee enough stable

Figure 48 the compare of different concepts

After compare, the concept 3 meets all the three basic requirements. Therefore it is the final concept.





## 6.3 The detail of final concept

### 6.3.1 The length and width:

In order to confirm the length and width of the CPR board, there are two methods used.

Method 1: the figure from the 'Anthropometric analysis' from chapter 5.2.4, the 95% percentile was chose for the distance used.

Minimal width: 35 cm

Minimal length: 40 cm

Method 2: the extremely persons test

#### ■ Length test

For length test: an extremely tall man, 201cm

a short girl 151cm

These two heights are the two ends for common adult people.

A piece of board made by cardboard in size 35cm width, 40cm length is used for test. Each expanded distance is 5cm for length.

From the followed figure, we can see that length: 40cm+5cm, is appropriate for the tall man. In order to avoid extraordinary, it added 1 cm for the length. The final length of the CPR board is 46cm.

#### ■ Width test:

For length test: a strong man, 187cm, >100kg

a slim girl, 165cm, 44kg

These two persons are the two ends for common adult people on width.

There are two figure of distance used for width test: 35cm, 40cm. the inner width is 35cm, the outer distance is 40cm.

From the followed figure, we can see that width: 35cm, is appropriate for the strong man. In order to avoid extraordinary, it added 1 cm for the width. The final width of the CPR board is 36cm.

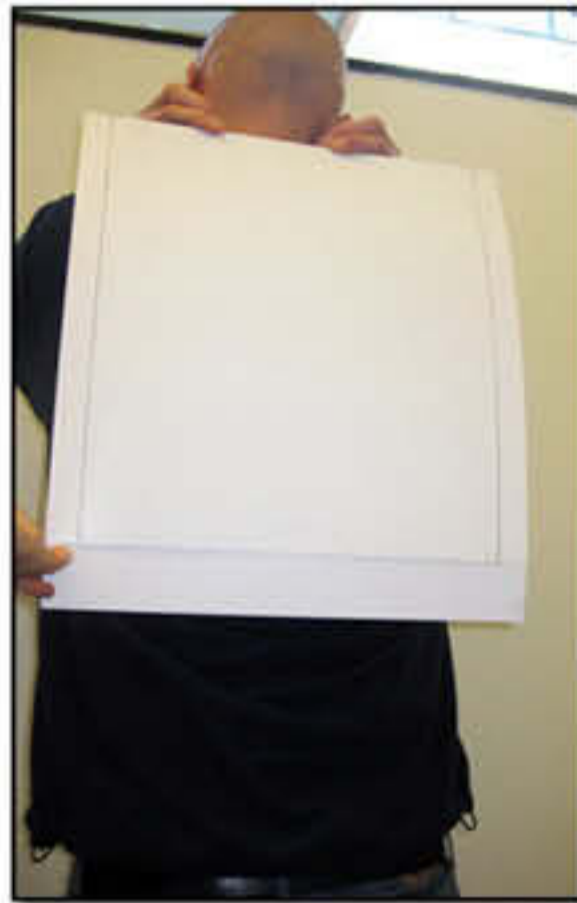




Figure 49 the length test

5 cm expanded

10 cm expanded



Name: Hans- Jørgen  
Thoresen  
Job: IT support, HIAK  
Height: 201cm



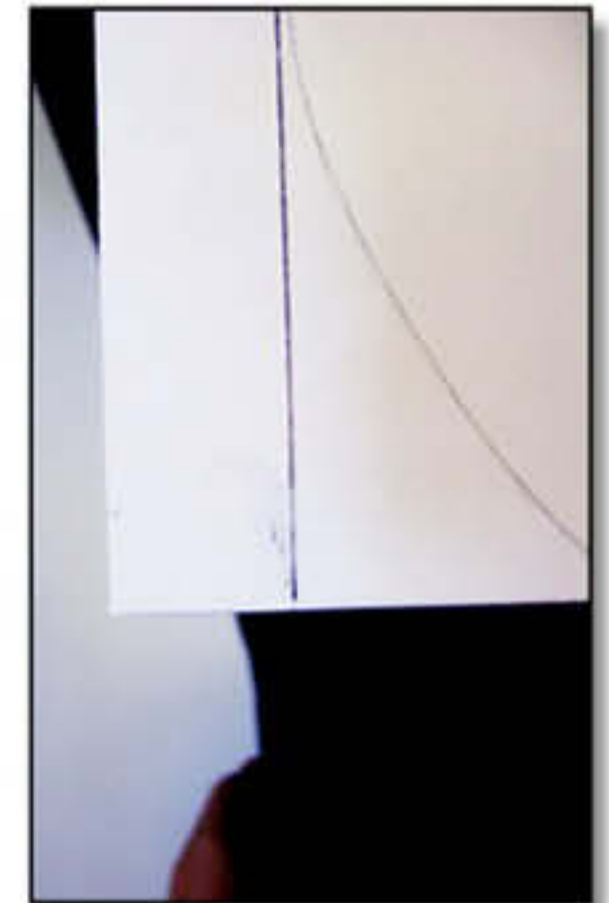
do not to test

Name: Siri Beate  
Persen  
Job: Student,  
Klasse-2007H-PDB,HIAK  
Height: 151cm

Figure 50 the width test



Name: Pål-Anders  
Grøva  
Job: Student,  
Klasse-2007H-PDB,HIAK  
Height: 187cm  
Weight: >100kg



Name: Zeng, Yi  
Job: Student,  
Klasse-2009H-PDB,HIAK  
Height: 165cm  
Weight: 44kg





### 6.3.2 The shape:

There are three basic shapes for the CPR board design from brainstorm. In table 23, it compared those three shapes from 'save material', 'stable' and 'less possible to hurt patient' aspects.

After the compare, the shape no.1 was chosen to be the final basic shape because compare between 'save material' and 'less possible to hurt patient', the 'less possible to hurt patient' is more important.

	Save material	Stable	Less possible to hurt patient
1. 		✓	✓
2. 	✓	✓	
3. 		✓	

Table 23: the comparison of the shape of CPR board

### 6.3.3 The lower corner shape

From communication with nurses, I found a lot of them knee on the ward bed when execute CPR. Some of the nursed were also say that the wrong shape and size of existing CPR board may hurt their knees. Therefore the lower corner shape of CPR board is also a point I have to consider.



There are 4 possible shapes for the lower corner shape:

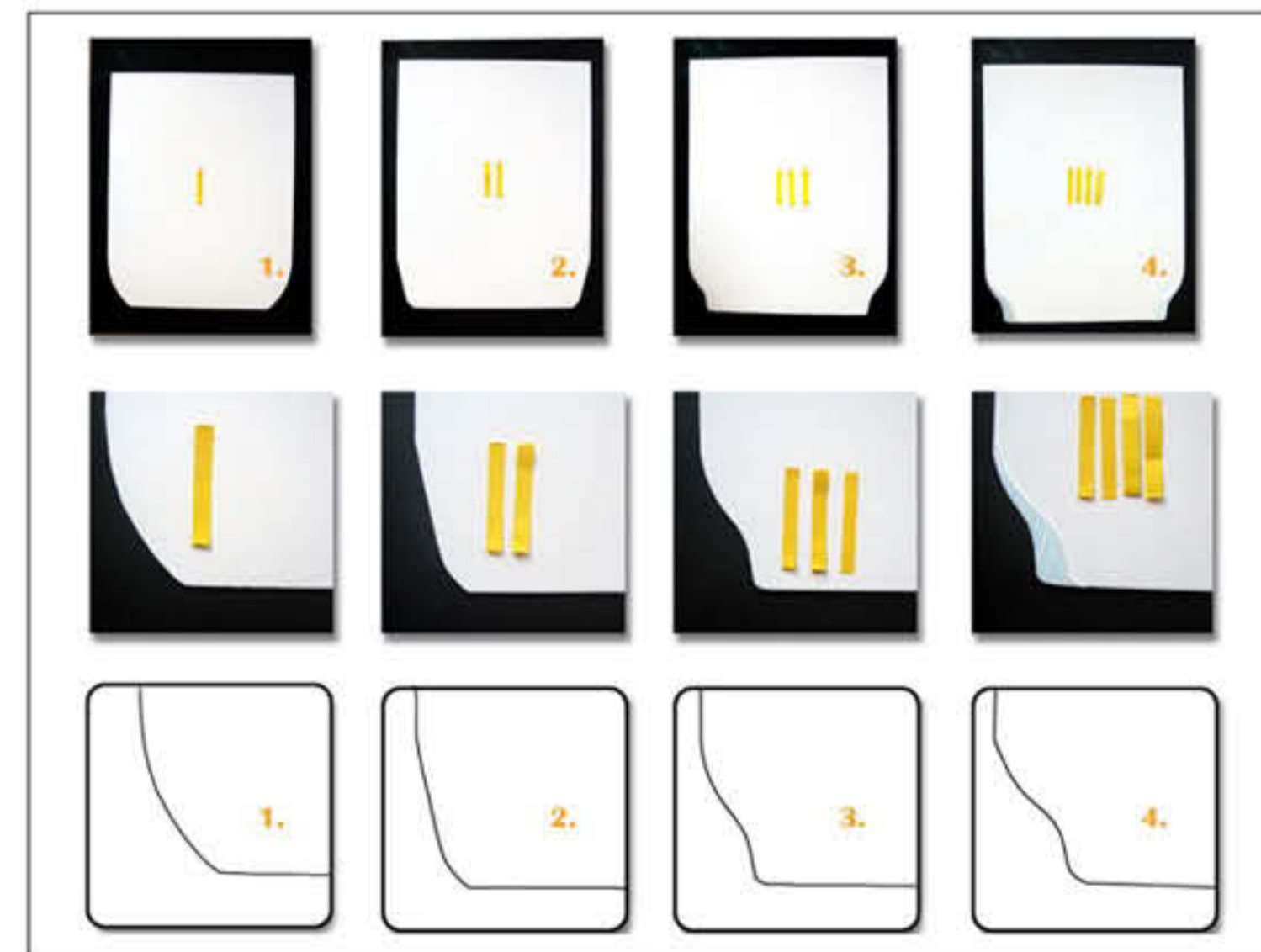


Figure 51 the lower corner shape 1





For strong man this shape will be underneath the patient. So it only has to consider the situation of a slim person, the stable and saving material aspects.

Shape 1, the most stable shape to hold the patient, but it may hurt the knee of nurse by the curve outwards.

Shape 2, this shape can provide better protection for the knees.

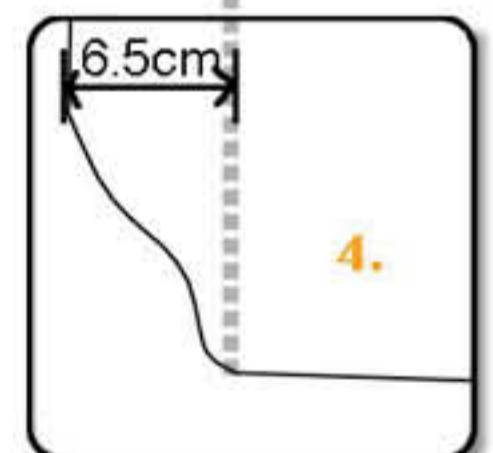
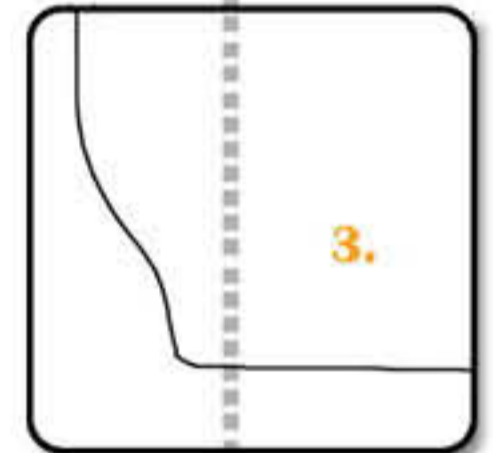
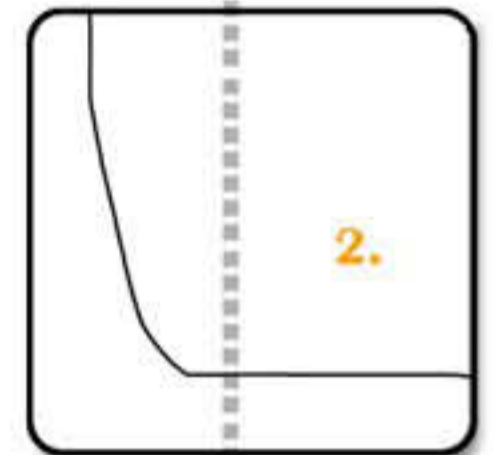
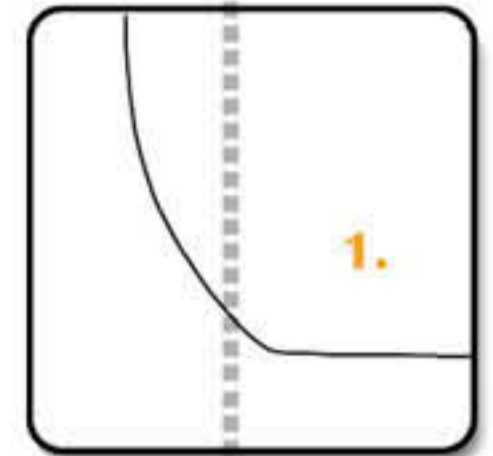
Shape 3, follow the shape what the knee might be.

Shape 4, the most 'saving material' shape, and the further recessed shape may satisfy more slim people

In general, all 4 shapes can provide stable position for patient. However by the reason of protect knees of nurses and saving material, the shape 4 meet all requirement.

The end of the shape

The end of the shape is decided by the human body data. The minimal width of the body is 35cm. therefore in order to hold the body functional, the end of the shape is 6.5cm from aside.



The start of the shape

By observation, I found that the nurses always knee at the near place beside where elbow is. In addition from the height test with the tall man, the beginning point of the curve shape should be maximal 9cm from the end.

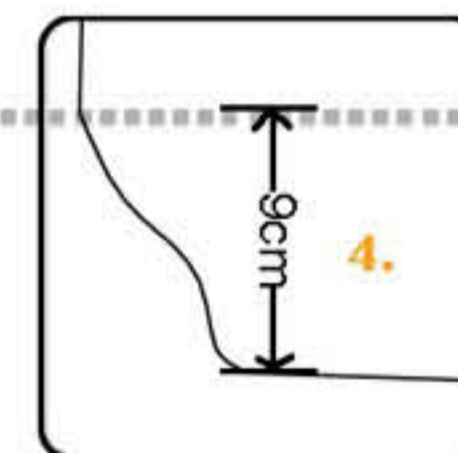
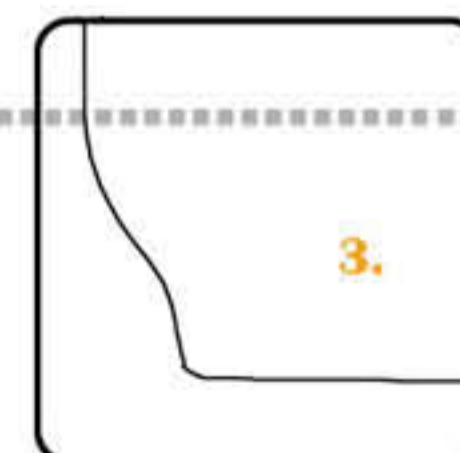
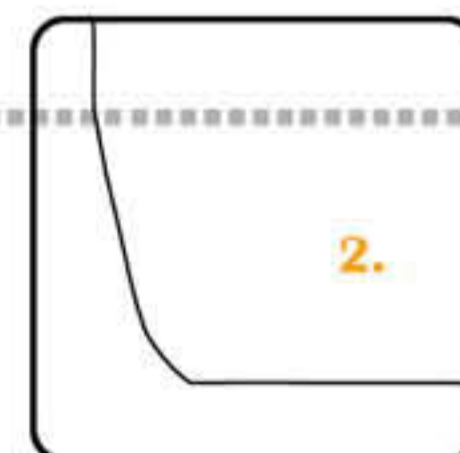
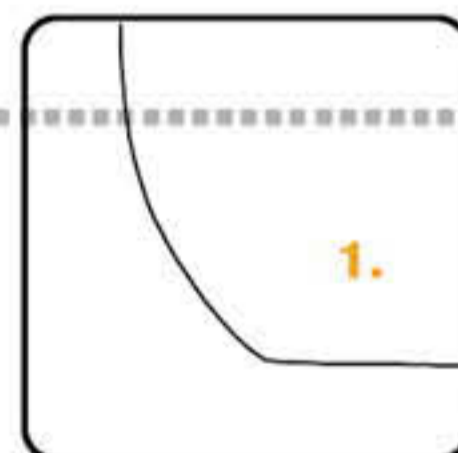


Figure 52 the lower corner shape 2





### 6.3.4 The lock pattern on the front surface:

The final concept applies the principle of skifelle as it was showed previously. Referring to the specific surface, there are two possibilities.

Saw tooth

Step

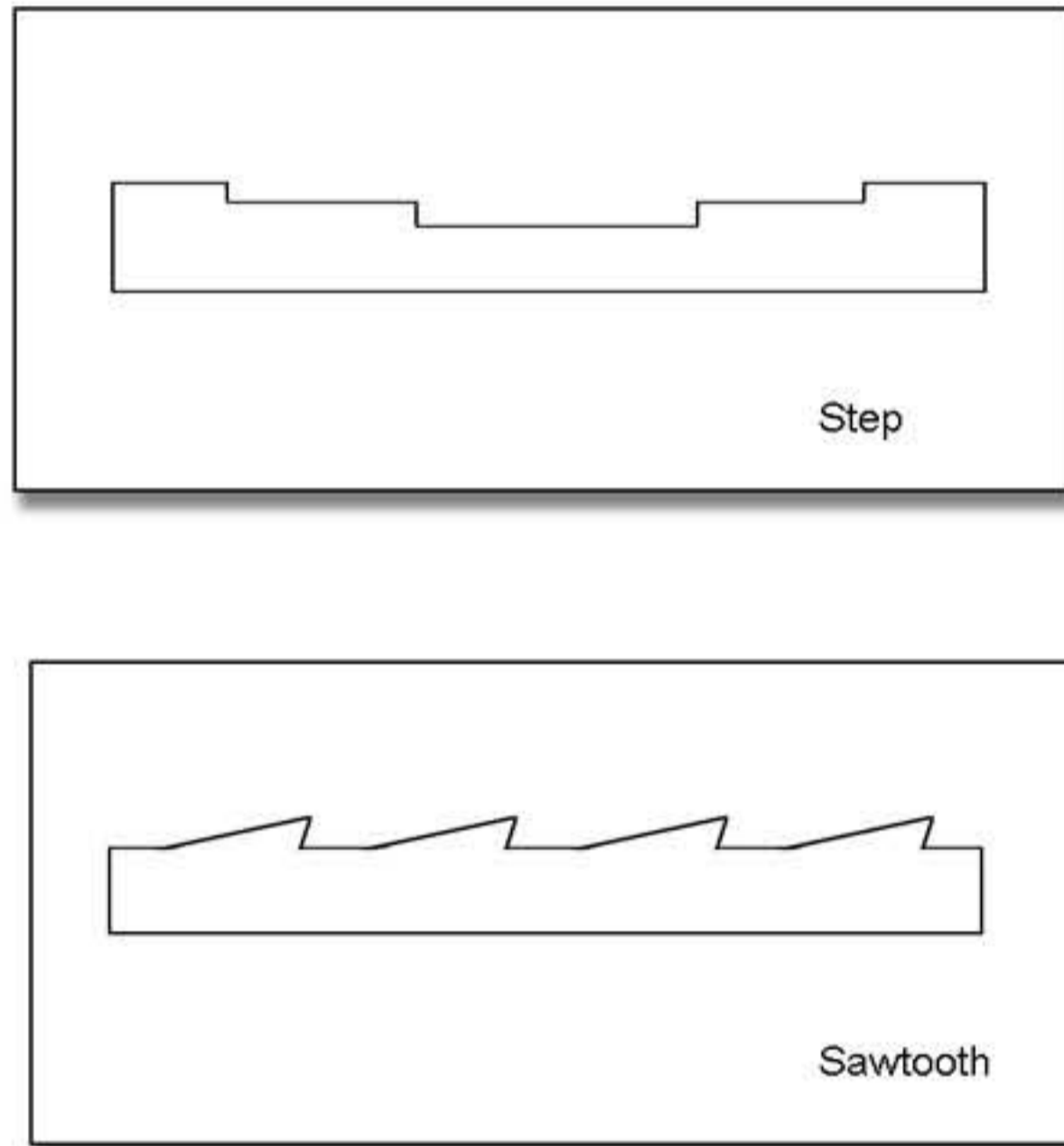


Figure 53 the different pattern of front surface

Compare between these two possibilities, the 'step' is more suitable because it is 'less possible to hurt patient'.

### 6.3.5 The center of the surface lock pattern

Because of the feature of the 'step' surface is smooth slide for downwards, but locked for the reverse direction. So whenever put the CPR board from head direction or one side, the first half of the slide into will be very smooth, but the second half way will meet the reverse steps. However, it is impossible to put the CPR board

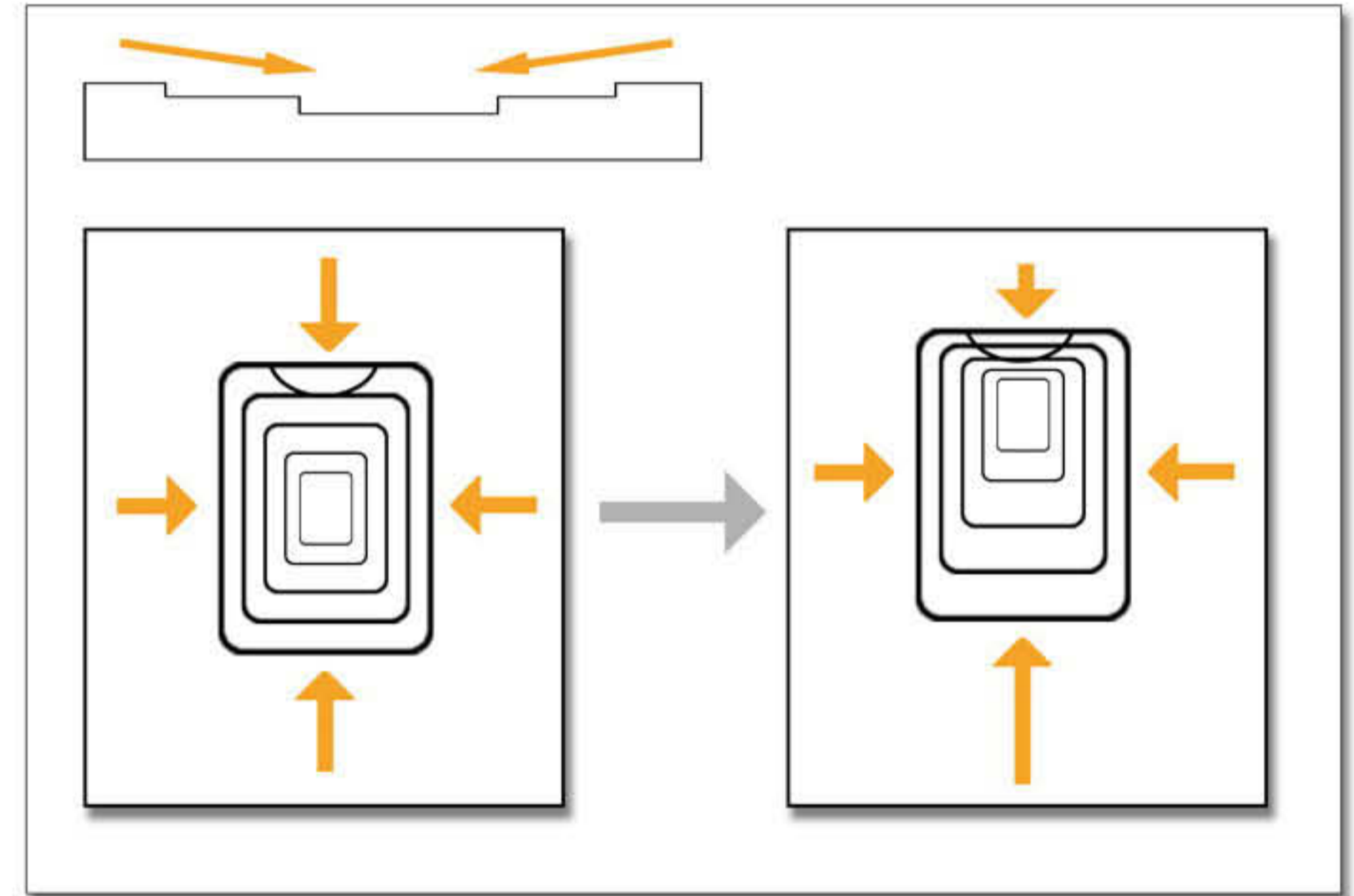


Figure 54 the position of center lock pattern

without lift patients. Therefore, the second half way is also easy to slide underneath.

But the remove of the center of lock pattern will help to lengthen the smooth downwards part and form a thicker thickness in neck part which provide bigger possibility to open the airway.





### 6.3.6 The edges:

The edge is an important part which may influence the ‘fast’ of using the CPR board.

There are 8 possibilities of different edged for test. After test number 7 is the best solution for this project since it can has the smallest touching surface to the mattress because the touching surface is an arc when it touching another flat surface, the touching surface is just a line theoretically and there is a space for the nurses to hold when emergent after place.

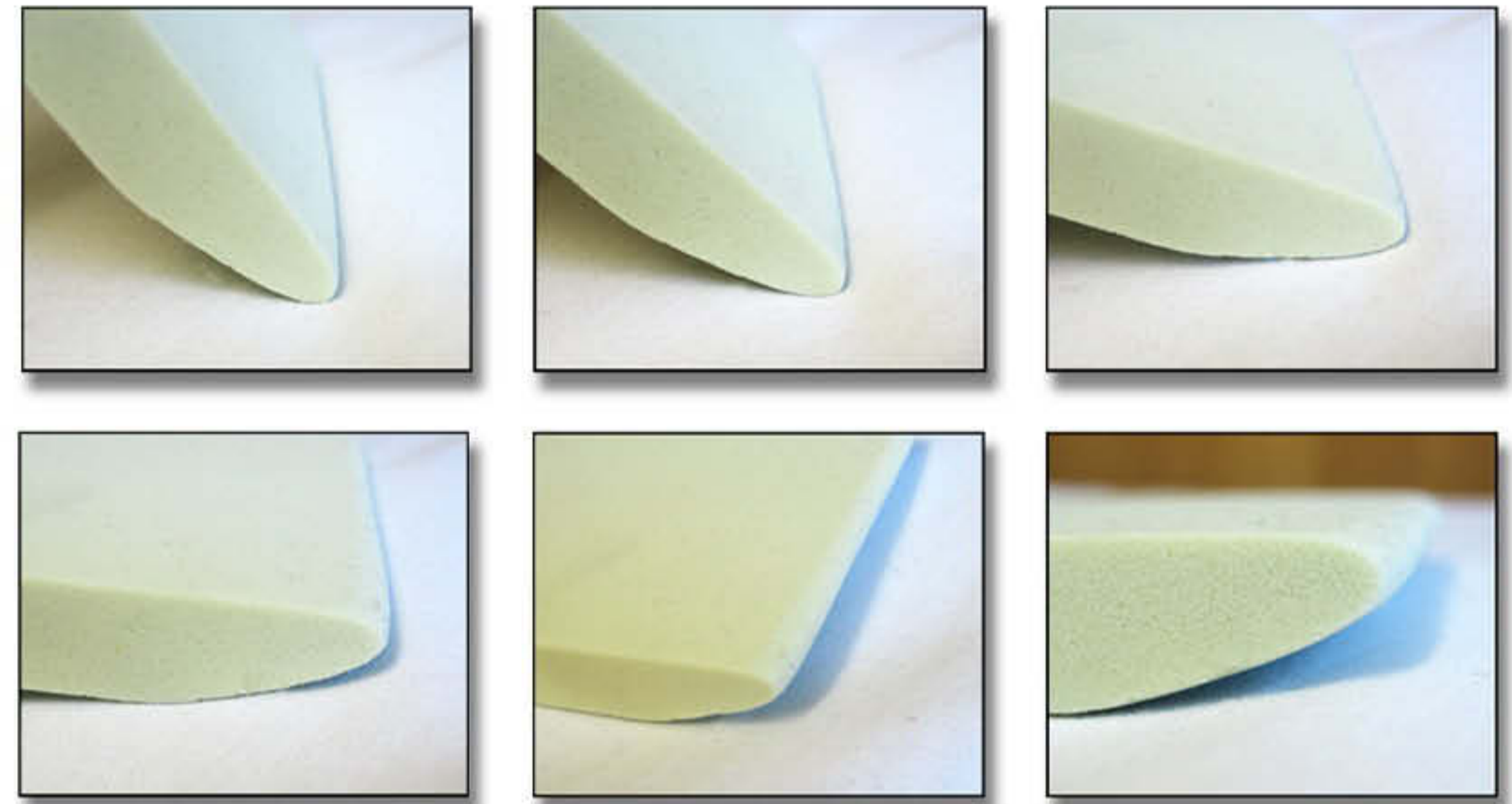
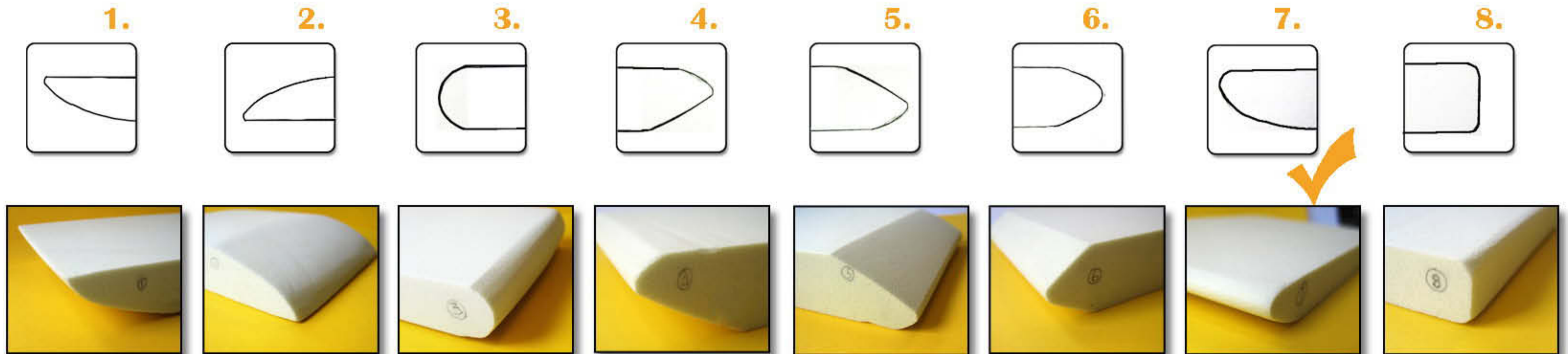


Figure 56 the test of edge no.7

Figure 55 the different shape of edges





### 6.3.7 The area of center space of surface lock pattern

As it is analysis in previous chapter 5.2.4, the lighter direction to lift patient is from the head. However the complex and full of devices situation in hospital sick ward also require that the CPR board can put underneath from one side.

Whenever which direction the CPR board will use, the smooth part should be as bigger as possible in order to meet the 'fast' requirement.

The area of center space is the area shows in figure 57. The size of this area should be satisfying the human data. After observation and test myself, it is found that half of the body will be lift whenever from head or from one side. So the size about 10cm length and 5cm width is alright.

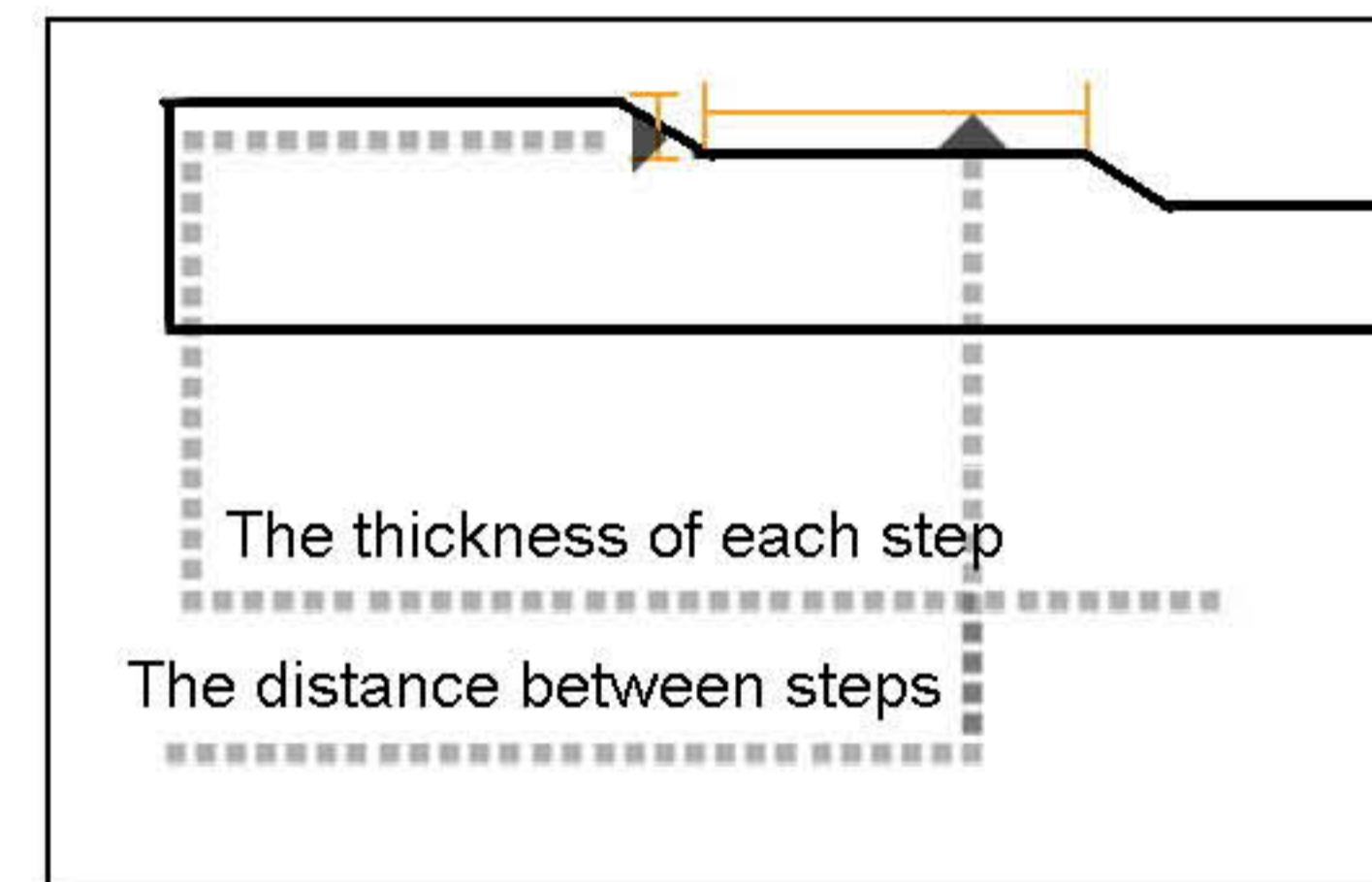


Figure 57 the area of center space

### 6.3.8 The thickness of each step The distance between steps How many steps

These three aspects are mutual interacted. As it is already decided that the center area is located in the upper part of the CPR board (6.3.6) in a size of 10cm length, 6cm width (6.3.7), and the basic size of the CPR board is 46cm length, 36cm width (6.3.1), the CPR board has use the 'step' principle to provide stable and fast result.

In figure 58, it shows two different thicknesses: 1mm, and 2mm, of each step in cardboard prototype. In addition, a test with two thicknesses was done by designer with the help of nurses.



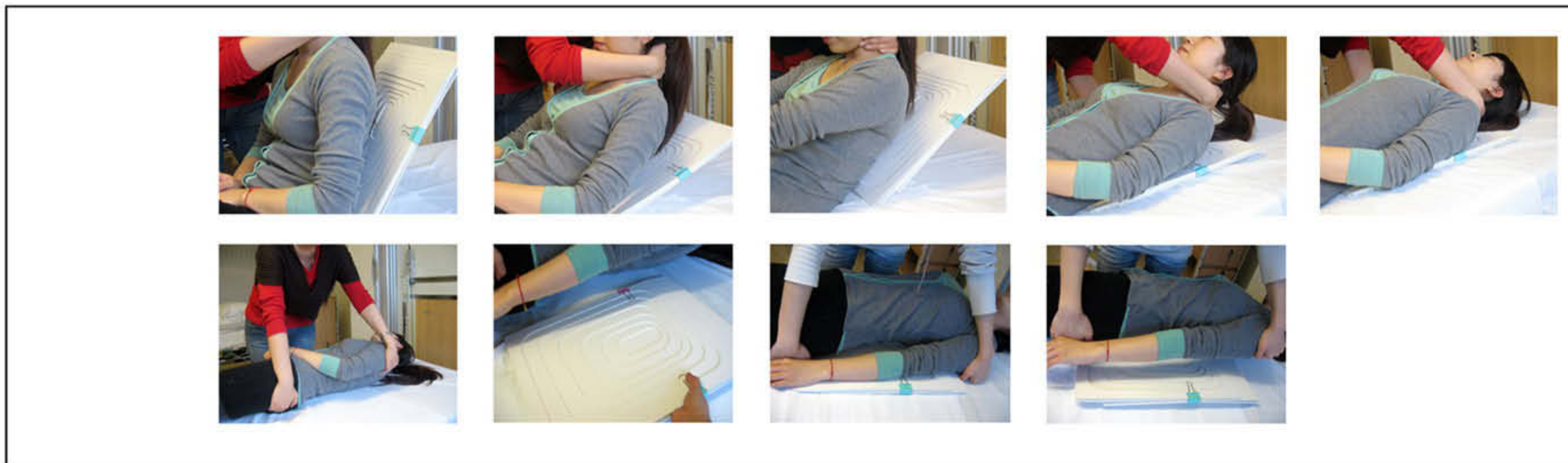


According to the test and cardboard prototype, the 2cm thickness is better for the project because the long distance of the bigger smooth part B showing in figure 58 need bigger attitude difference.

The distance between steps shouldn't more than 4cm, which also decided how many steps it is. As a result by the fixed detail list above, the number of steps is 7 which can provide a distance between steps less than 4 cm.



Figure 58 the thickness of each step





### 6.3.9 The thickness of the CPR board

In order to provide a space for the head go backward to open the airway, the principle of concept 1 is applied in the product: leave some space for the head go backwards and take use the thickness to give the backwards space. Although there will be a lower round shape to hold the head, the thickness of the board still play the predominant part to give a space to open the airway.

The thickness of the CPR board is higher at the head end than the other end, because the thicker head end can provide more distance to let the head lean backward.

From the information got from (Ying Kang) Guangzhou LinBi Medical Devices Co.Ltd, the thickness of the CPR board they produce is varying in 3-5cm.

By analysis, the length of the head is 20cm (95<sup>th</sup> percentile for adult mails) and the chest depth is 30cm (95<sup>th</sup> percentile for adult mails). As it showed in figure 59, the head is turn about 20 degree to let the lower jaw into the vertical position. By mathematics calculation of triangle law of sines, and it should subtract the chest depth; the thickness of the head end is 5 cm. For another end of the board, because the thickness of upper 7 steps is 1.4cm, so it should not less than 1.4 cm, therefore 1.5 cm is applied.

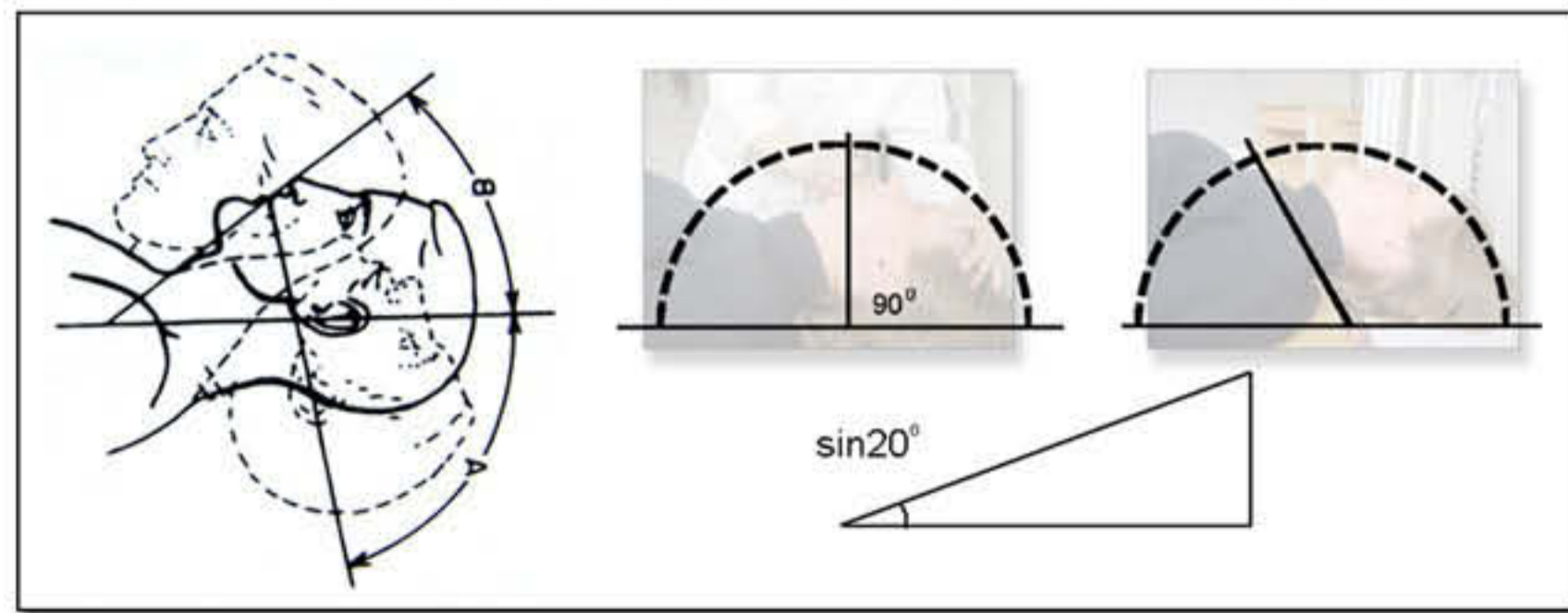


Figure 59 the thickness of CPR board

### 6.3.10 The position and the size of the handle

The normal shape of handle is applied in this project because it is easy to manufacture and can save some material by the shape of handle.

In figure 60, it shows the position and size of the handle.

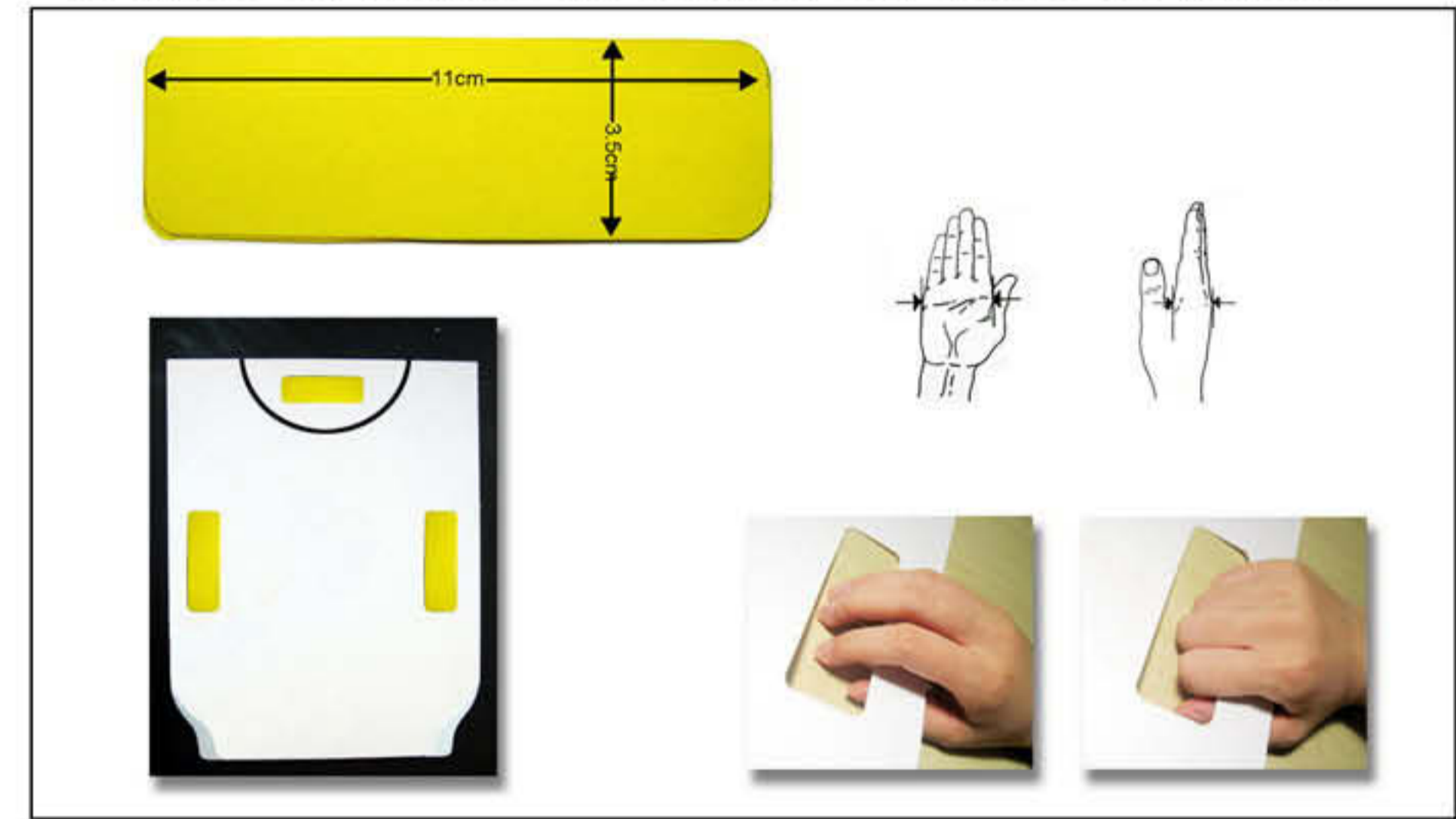


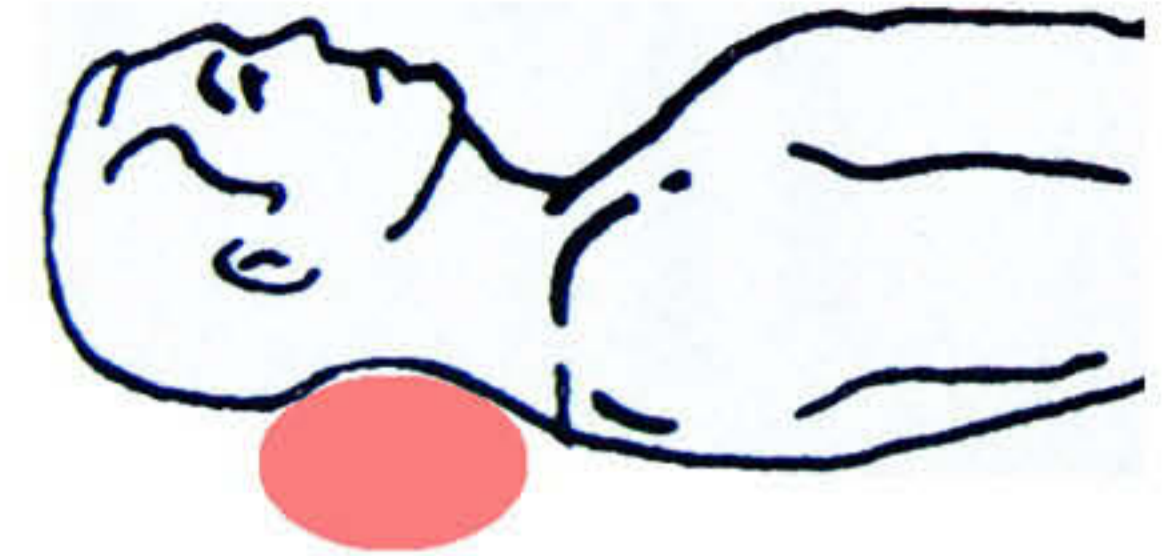
Figure 60 the position and the size of the handle

The hand breadth at metacarpal (95<sup>th</sup> percentile for adult mails) is 9.6cm. In order to leave some space for the using, the length of the handle is 11cm. the hand thickness at metacarpal (95<sup>th</sup> percentile for adult mails) is 3.2cm. In order to leave some space for the using, the width of the handle is 3.5cm

For the position, the each side of the CPR board has one handle. The third one is situated at the head end inside the round shape which holding head. What it has to emphasize is that all these three handles should situated in the middle of each side which can result balance in weight.







### 6.3.11 The curve of head holding part

The principle of concept 1 was applied in this project also. So the curve of the head holding part should relatively follow the human head-neck curve. A test was done to see how the curve should be.

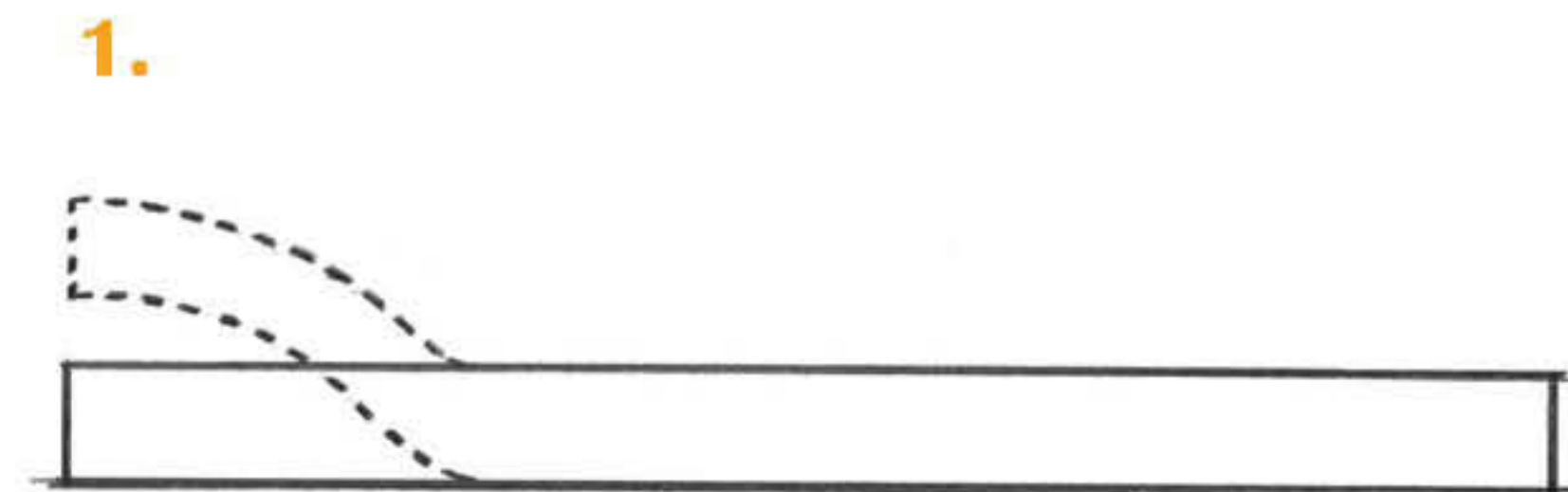
After test, there are two ways to design the curve here:

1. lift the horizontal level to follow the curve of the human neck part
2. leave space to satisfied all the people's different curve



Figure 61 the curve of head holding part

The second solution is applied in this project which can have more space for the different shape and size of heads.





### 6.3.12 The slope between adjacent two steps

The reason to have slope is because the cleaning reason. If two steps just one above another one, the angle is 90 degree, which is easy to store dust there and not easy to clean.

As it showed in figure 62, 3 different degree of slope were applied to consider the different joining part between two adjacent steps:  $30^{\circ}$ ,  $45^{\circ}$ ,  $60^{\circ}$ .

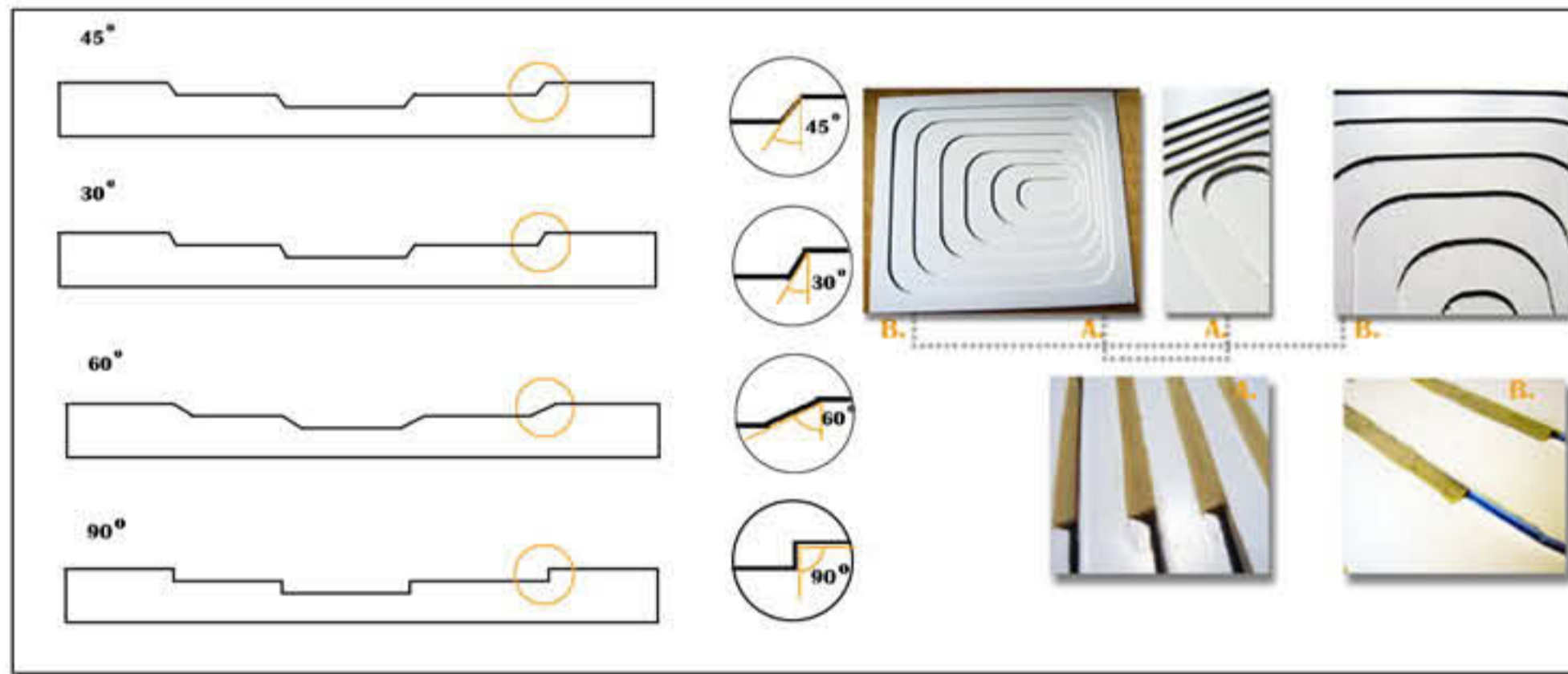


Figure 62 the slope between adjacent two steps

The slope between steps is influenced by the thickness of each step and the distance between steps. These two aspects had already be settled down in previously analysis: the thickness of each step: 2mm, the distance between steps: <4cm

After analysis and test, the degree 45 is suitable. For 60 degree, it will loose the function to guarantee stable in part B as it showed in figure 62. In addition, for 30 degree, there have relative sharp edges between steps.

### 6.3.13 The material of product

By the consultation from the manufactory, (Ying Kang) Guangzhou LinBi Medical Devices Co.Ltd, the material of this project was chosen from plastic which can provide long lifespan of the product and easy to clean. After analysis, the ABS plastic was chosen for its good quality to meet the requirement of CPR board: rigid, tough and good dimensional stability (strong enough to hold the compression), safe (can made food mixer), good low temperature properties (can used in different temperature surrounding), and the price is cheap.

Name	Trade name	Application <sup>14</sup>
Acrylonitrile	Lustran	Telephone handset, rigid luggage,
Butadiene	Magnum	domestic appliance housings(food mixers),
Styrene	Novodur	Electroplated parts, radiator grilles, handles,
ABS	Teluran Ronfalin	Computer housings

#### Properties

Rigid, opaque, glossy, tough, good low-temperature properties, good dimensional stability, easy to electroplate, low creep

#### Physical properties

Tensile modulus	1.8-2.9 N/mm <sup>2</sup>
Notched impact strength	12-30 Kj/ m <sup>2</sup>
Linear coefficient of expansion	70-90 x10 <sup>6</sup>
Max cont use temp	80-95 oc
Specific gravity	1.04-1.07



Figure 63 ABS plastic

14.The plastic handbook, Chris Lefteri





### 6.3.14 The color of product

As the mood board of hospital showed, the normal color used in hospital is white, grey, wood yellow and blue.

Consider the using surround for this project is hospital sick ward, and by the feature of this special medical device, when the CPR board is used, it must be in an emergent situation. By the analysis of color psychology, the blue can help people to calm down and give people an eased feeling.

So the final color for this project is blue.

### 6.3.15 The storage of CPR board

After brainstorm, there are a lot of different ways to store it. It may used for decoration when it free of use (which may influence the speed of using, give up); it may combine with the bed (may cost time to fetch and may ruin the CPR board by some other purpose of using bed); it may use the magnetic force to store (the magnetic force may influence those people with cardiac pacemaker), but finally I found that the most traditional way is the most practical: the drawer. Like the place where the computer keyboard places, this project used the same way to store it. The reason are:

Firstly, it is the fast way to fetch and use the CPR board;

Secondly, in this way, the CPR board can easy to keep in a good condition from dust and others;

There is one more reason to choose this solution. By observation, there is an existing drawer nowadays besides each ward bed. So it just takes use the exiting condition, and do not to occupy others.



Figure 64 the storage of CPR board

### 6.3.16 The manufacture suggestion

By consult with manufactory, blew molding technique will be applied for manufacture.

The blew molding technique is a existing ready and mature technology, which meet the requirement from manufacture aspect listed in the beginning of this chapter.

### 6.3.17 The environment thinking of the product

In this project, the way of environment thinking is:

#### 1. Use less material

By carefully analysis and test, after meeting the requirements, this design uses as less as possible material.

#### 2. Choosing durable material and try to keep the CPR board in good condition in order to lengthen the product life span.





6.3.18 The product image

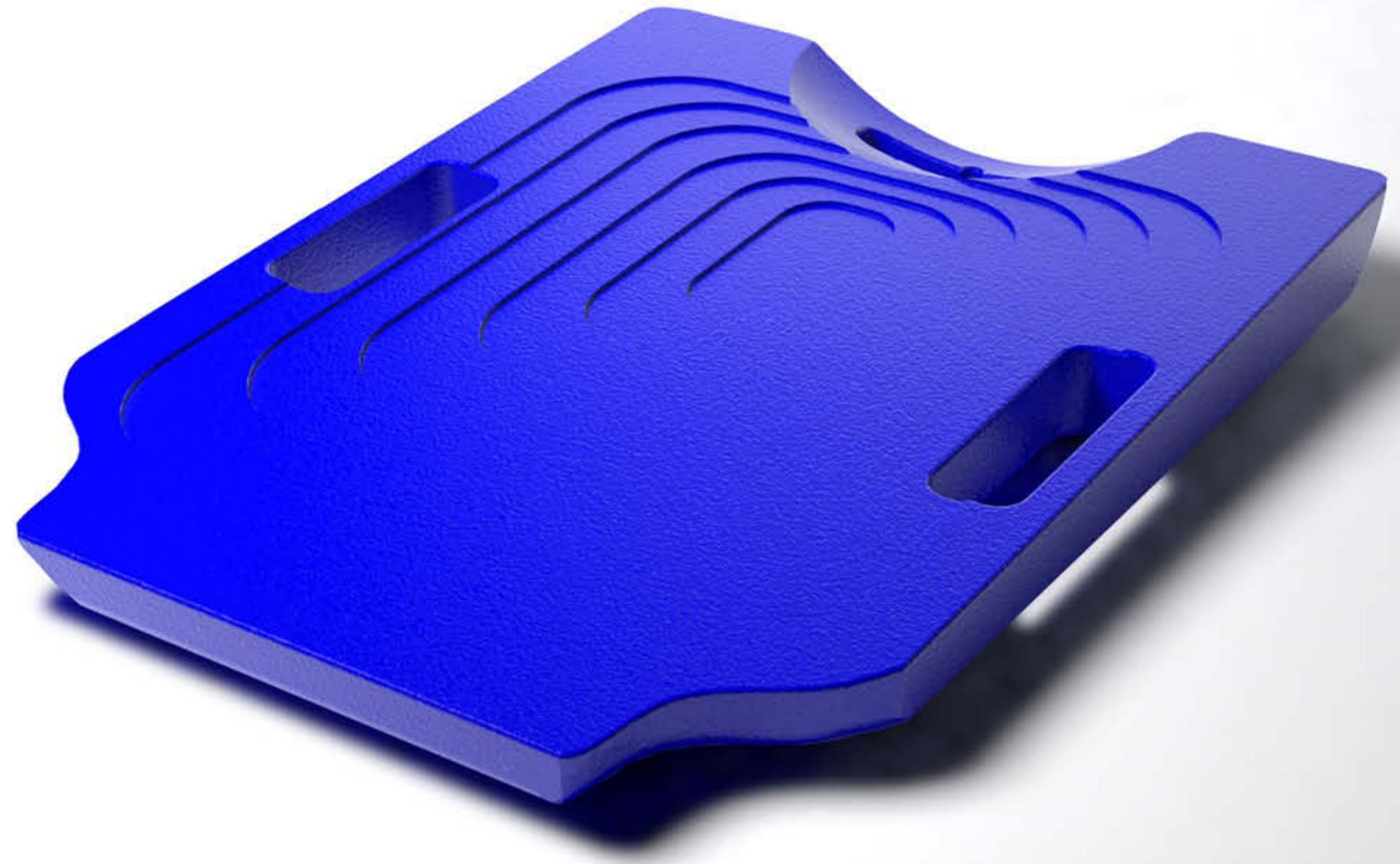
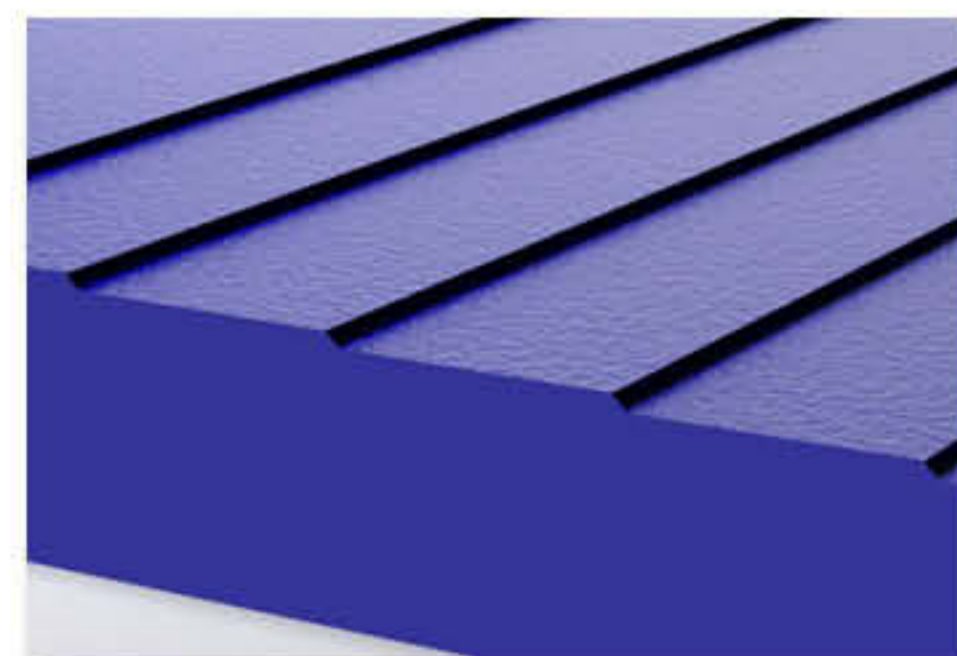


Figure 65 the product image





## 6.4 The model making



Figure 66 the model making

Instead of real material for manufacture, the model was made by wood. In figure 66, it shows the main frame making process of the model.





### 6.4 The model making



Figure 67 the model test

In the process of model making, it shows the test of design details.

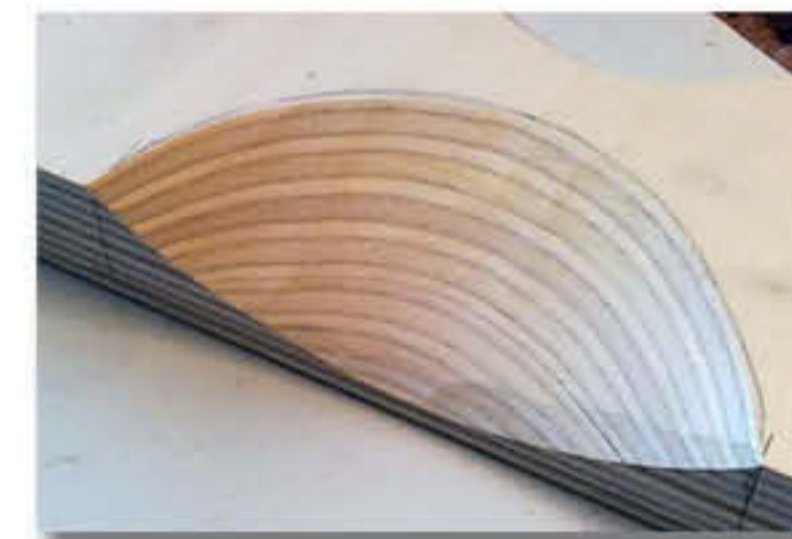
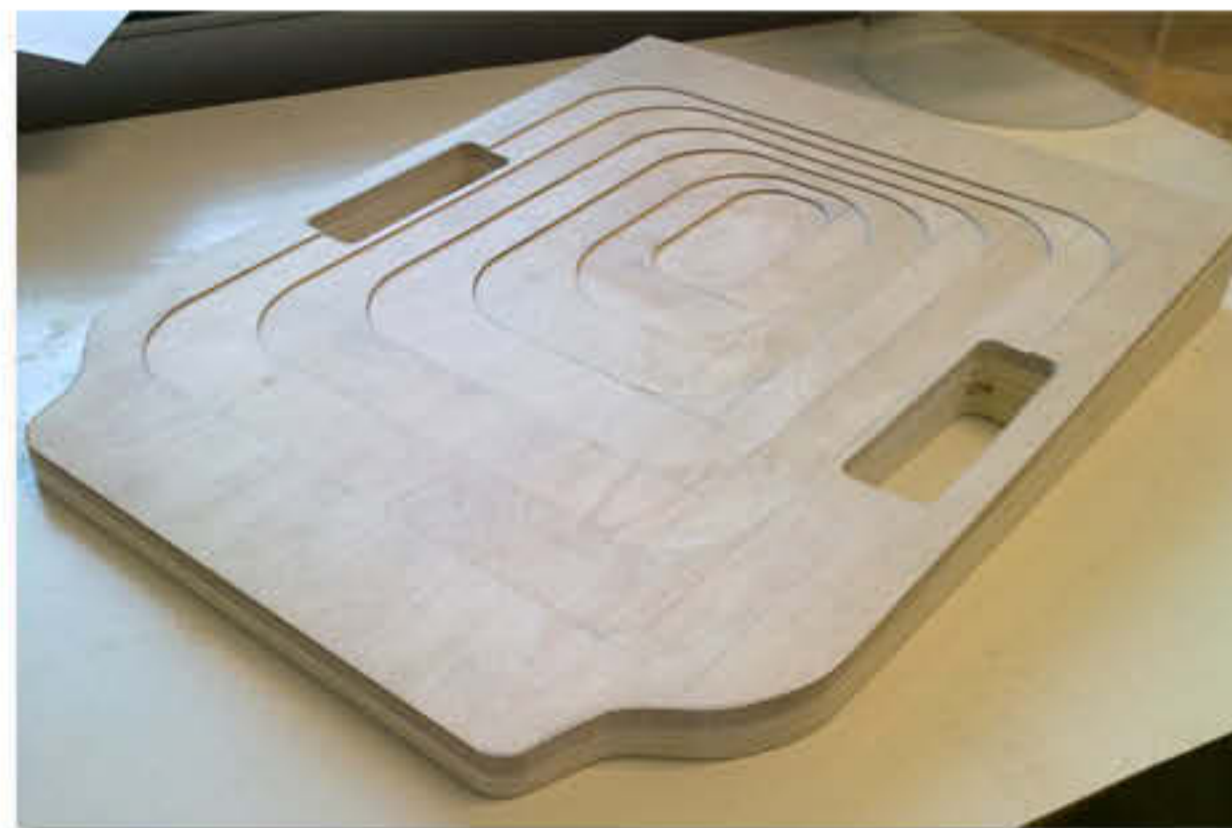


Figure 68 The head curve of the model





## 6.4 The model making



Figure 69 the model making (2)





The detail of the model

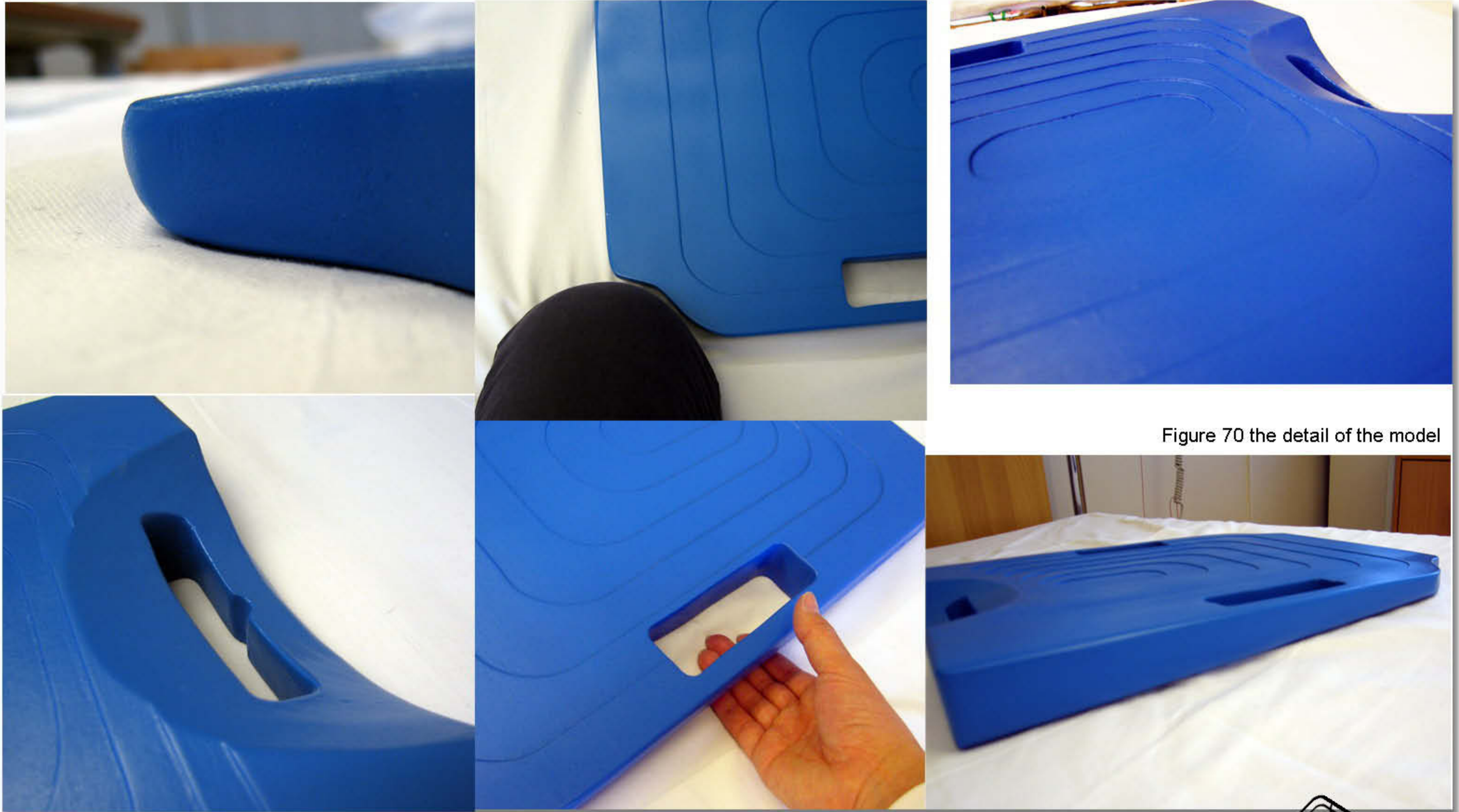


Figure 70 the detail of the model





The presentation of the model



Figure 71 the presentation of the model





### 6.5 The evaluation

After the product development process through user communication, an evaluation was made to see whether the product meet the requirements got from user communication and design methods.

So from the evaluation, this design generally satisfies the requirements from user communication and also indicated that the proposed research program within the central proposition was an appropriate approach to fulfill the aim of this research.

Requirement	agree	neutral	disagree
<i>The requirements from patient:</i>			
1. hard enough to hold body when compression	✓		
2. flat to lay the patient in a horizontal position	✓		
3. keep the airway open	✓		
4. lay the patient in a stable condition	✓		
5. protect the nerves inside the cervical vertebra from hurt when unconsciousness		✓	
6. do not have to consider the skin hurt		✓	
7. meet the ergonomics requirements	✓		
<i>The requirements from nurse:</i>			
1. can be used fast and functional (very important)	✓		
2. strong enough to hold the compression efficiency	✓		
3. can keep the patient in a stable position when compression even when the patient sweats	✓		
4. help to keep airway open	✓		
5. lighter than the existing CPR board		✓	
6. easy to fetch	✓		
7. easy to hold	✓		
8. smooth enough to put underneath the patient fast	✓		
9. portable	✓		
10. fit the using surrounding		✓	
11. easy to understand how to use (semantics)		✓	
12. easy to keep the CPR board in a good condition			
<i>The requirements from cleaner:</i>			
1. easy to clean	✓		
2. easy to keep clean	✓		
<i>The requirements from psychological aspect:</i>			
1. easy to let the nurse understand how to use	✓		
2. give the nurses help to clam down when emergency by shape, color		✓	
<i>The requirements from environment aspect:</i>			
For big environment:			
1. no toxic	✓		
2. the material can last for long time	✓		
3. no influence to the nature		✓	
4. less material	✓		
For small environment:			
Fit for the using surrounding		✓	
<i>The requirements from economic aspect:</i>			
1. cheap material	✓		
2. less material	✓		
3. no long distance transportation			
<i>The requirements from manufacture aspect:</i>			
1. easy to mold with existing technology	✓		
2. less components	✓		
3. less material	✓		
4. less kinds of martial	✓		

Table 24: the evaluation





## Chapter 7 The conclusion to the study and suggestion for future research

### 7.1 The conclusion to the study

This investigation set out with the aim to achieve improvement of design through user communication and design methods, by ways of a study of cardiac compression board (CPR board). In order to achieve this, a series of user communication actions were taken place, meanwhile the research about design methods were also be studied. After the generally research on both sides: the user communication and design method, the criterion which combining three design approaches was generated. Those three design approaches are User-centered design, Activity-centered design, and Genius design. Base on the combination of these three design approaches, the design methods were classified into 4 modes, look, learn, ask, and try. During the whole product development process, there are some findings which can be recommended for future in order to improve the design especially relating to user communication and design methods:

1. The design is based on user communication, however the user design approach always has its' limitation for the recourse scope can reached, so the design project focus on the user communication should not only rely on this design approach. During the process of communication, the designer also plays a very important role to find the problems and get inspiration through their own capacity and acuity.
2. Before the extreme user communication, it should be a

thorough comprehension about that particular fields of knowledge by the designer himself and herself especially for those fields unfamiliar even in daily life. Take this project as an example; the medicine field is not what we familiar with. Base on this advanced research, the latter communication will have a better exchange with the users.

3. For the user communication, it should also combine the quantity and quality. For quantity communication, you can observe the group behavior, to see how they will influence each other. After group communication, it is better to target several people to do the extreme communication verbal or non-verbal. In this project, instead of involving a lot of users a little bit, I choose to involve some persons very much. Because I think in this way I can get more detail resources.
4. The principle what Robert B. Cialdini's work 'Influence, science and practice' analysis: 'Point it out'. It's a good way to conquer group 'social proof' of silence. For example, when you dose an interview with more than one people, the group silence situation may happen. In this situation, it will be better to ask one of them one question. In that way, there is no chance for him/her just waiting for others to be response. Whatever he/she said may arouse the others' agree or disagree which may give the designer more chance to find out something may ignored.
5. The beginning question for the first asks. In order to start the communication, the dream question may be a good start. The rule of people's experience followed a shape of inverted pyramid as it shows in figure 72. (Design and the social





sciences: making connection, Jorge, Frascara, p3) If we go to the dream part, there are a lot of experiences for the users to show and it will be easy for them to exchange their own experience whatever they say, think, do, use, know and feel.

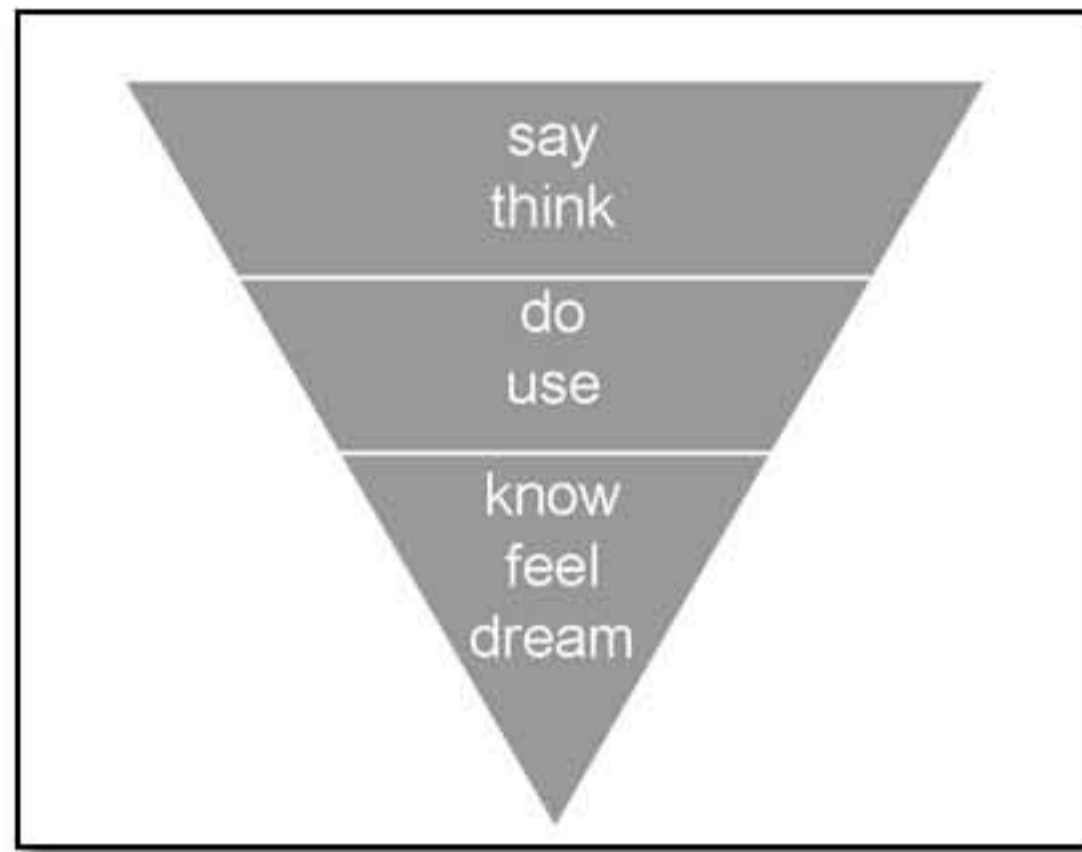


Figure 72 the inverted pyramid of people's experience<sup>15</sup>

6. The non-verbal communication will give more finding. As we all know there is different between what people say and what people do. So compare to what the users said and write, the behavior may be more trustful. Sometime the answers get from the written questionnaire and verbal interview can not give the real answers because when the user doing interview and questionnaire, they probable are not in the real situation. Some detail may take for granted or be forgotten. Moreover although many methods are based on words, but not every information are to be shared by words. You will find a lot of thing by non-verbal ways.

15.Design and the social sciences: making connection, Jorge, Frascara, p3

7. Give the users who are the target of communication a physical image of prototype will be easy to communication. At very beginning of the user communication, there was a confused problem for me: whether should I give the user a concept prototype to have the further communication or let the user thinking without limitation. After a period of thinking and discussion with tutors, I decided to give the users a physical image of prototype to communicate and it worked well. The reason I did this choice is because the users in this case are people may do not have design experience. So the physical image especially works with the non-design background users.
8. Compare to male, the female users are even easier to contact in this case. Base on the feedback from the questionnaire, most of the answers were got from female. Maybe because of the particular career, it was resulted this finding.
9. The user communication is a process of bidirectional. If the designer can give the user more feeling of involvement or sense of participation, and to embody the value of some users', it will even more motivate the further participate of those certain users. When they saw their own contribute which was embodied by way of prototype or some other form before the finished product, it will be an inspiration for them to devote more for the project.

Above all are my findings during the research and study. They are might not suitable for some other situation. However, they can





be a reference for others when they are doing the related research.

### **7.2 The suggestion for future research**

The following are potential areas for further research in future studies:

1. Further test about the compression strength for the CPR board
2. Explore and develop the other combining sub-function, such as, times count, compression sensor.
3. More people test
4. New material which can satisfy light, strong, and functional.





## Appendix 1: The questions from questionnaire

Here are some questions I want to ask refer to the CPR board. It's better that if you can answer them in English. If not, you can either answer them in Norwegian. But English is much more preferred since I can not speak Norwegian and have to find someone else to translate for me. Could you please answer, preferably in some length? It would be deeply appreciated. And sent the answer to my Hiak email address Heng.Yao@stud.hiak.no Thank you very much!

1. What is your best experience with the CPR board?
2. What is your worst experience with the CPR board?
3. What is your normal experience with the CPR board?
4. How would the situation be if everything was perfect?
5. What would you ask for if you could get one thing to happen to the CPR board?  
Can you describe one little thing that could do the CPR board better works?





## Appendix 2: The questionnaire about user communication

**the questionnaire about User Communication**

**1. The gender of you \***

Male

Female

**2. The age of you \***

Less than 20

20-25

25-30

30-40

over 40

**3. How many years have you learn as a product designer? \***

Less than 2 years

2-5 years

Over 5 years

**4. Do you think user communication is important for design? \***

Yes. It's very important

It's a method I will use, but not very important

It's a useful way I can choose, but not necessary

No, it's not important

**5. Will you do user communication in the design process? \***

Yes, I do it every time

Yes, I do it some times

No

**6. Do you think the user communication useful for design? \***

Yes, I think it is very useful

It works sometime

No, I don't think it is useful.

**7. The common methods you will use about user communication \***  
Description: you may choose many options

Interview

Observation

Questionnaire

User scenario

Role-play

Immersion

Behavior-mapping

Paper prototype

**8. How many round of use communication will you usually do? \***

One

two

three

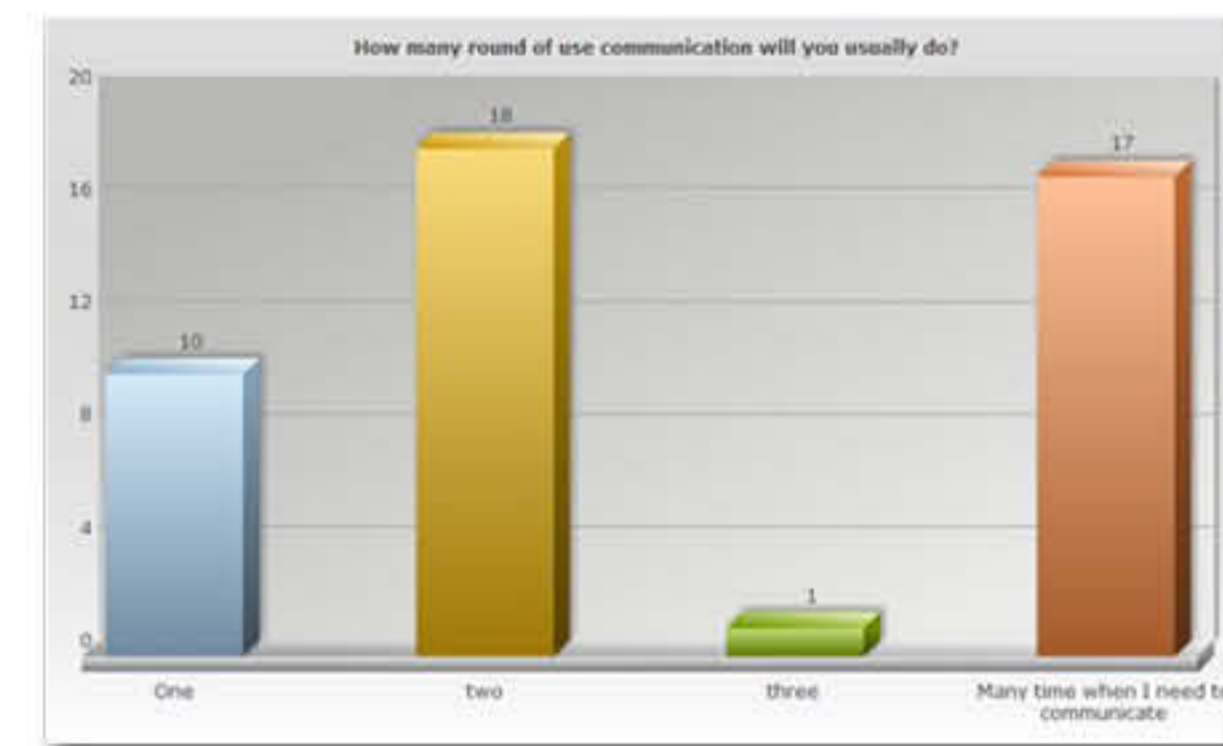
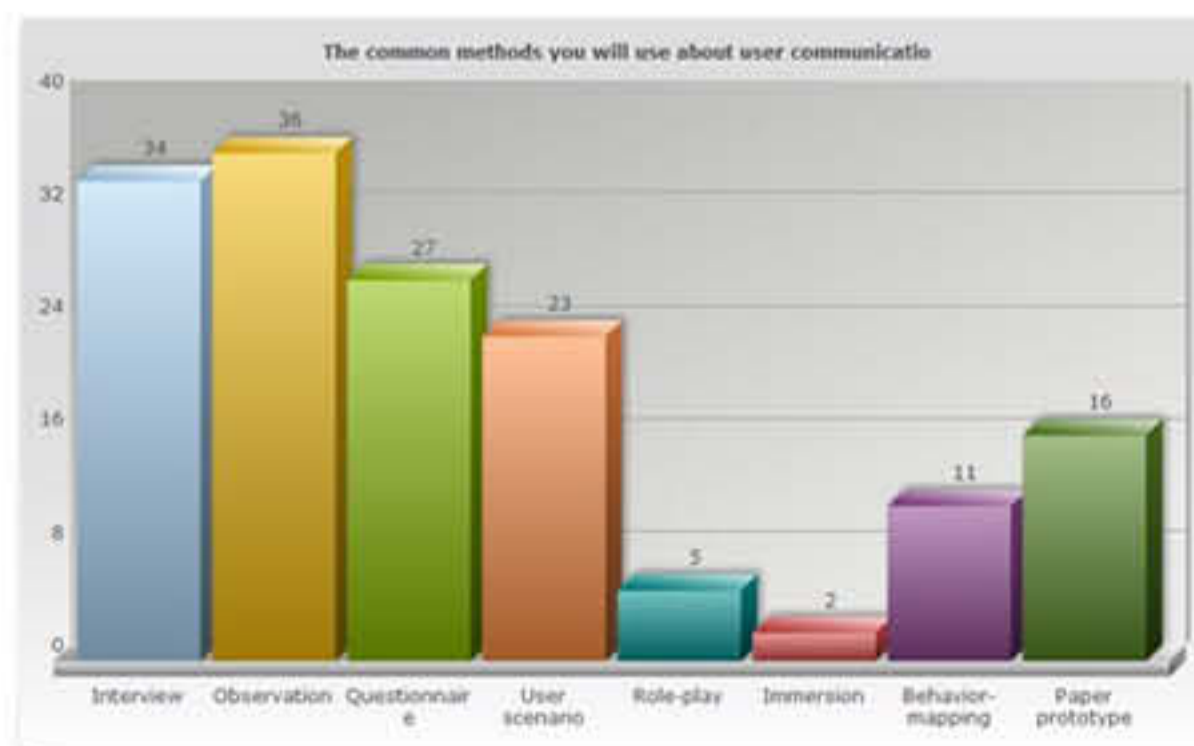
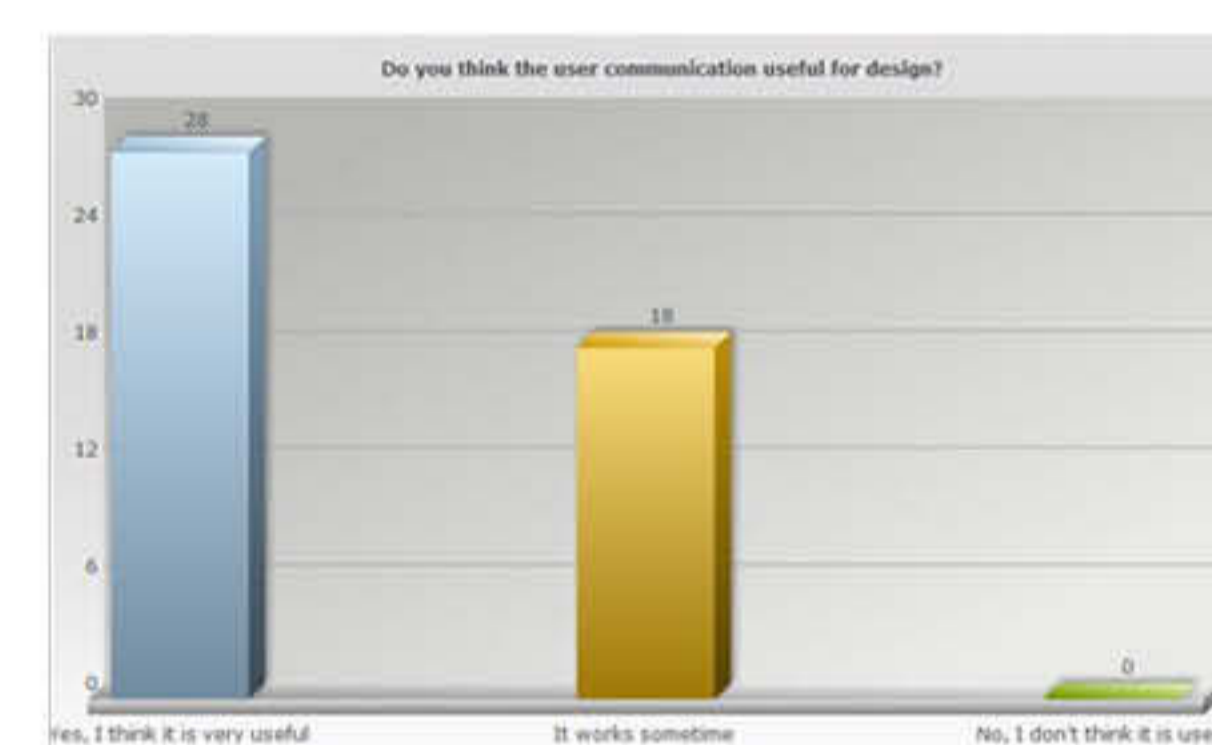
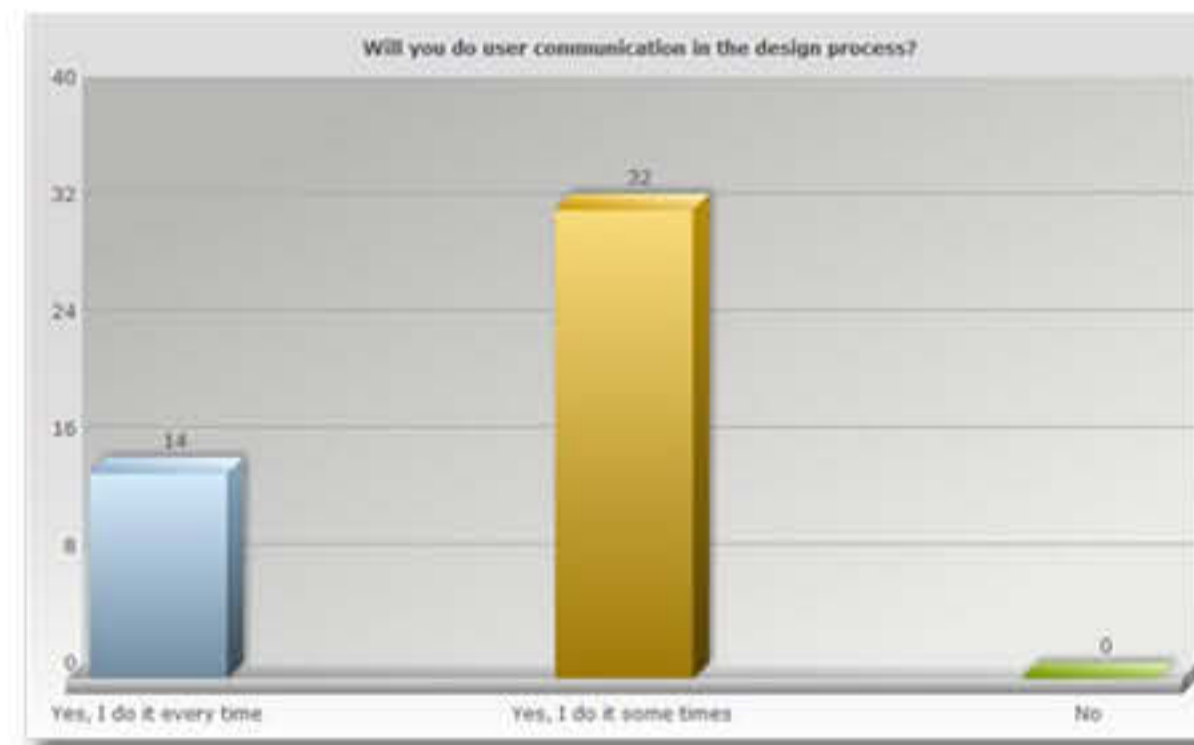
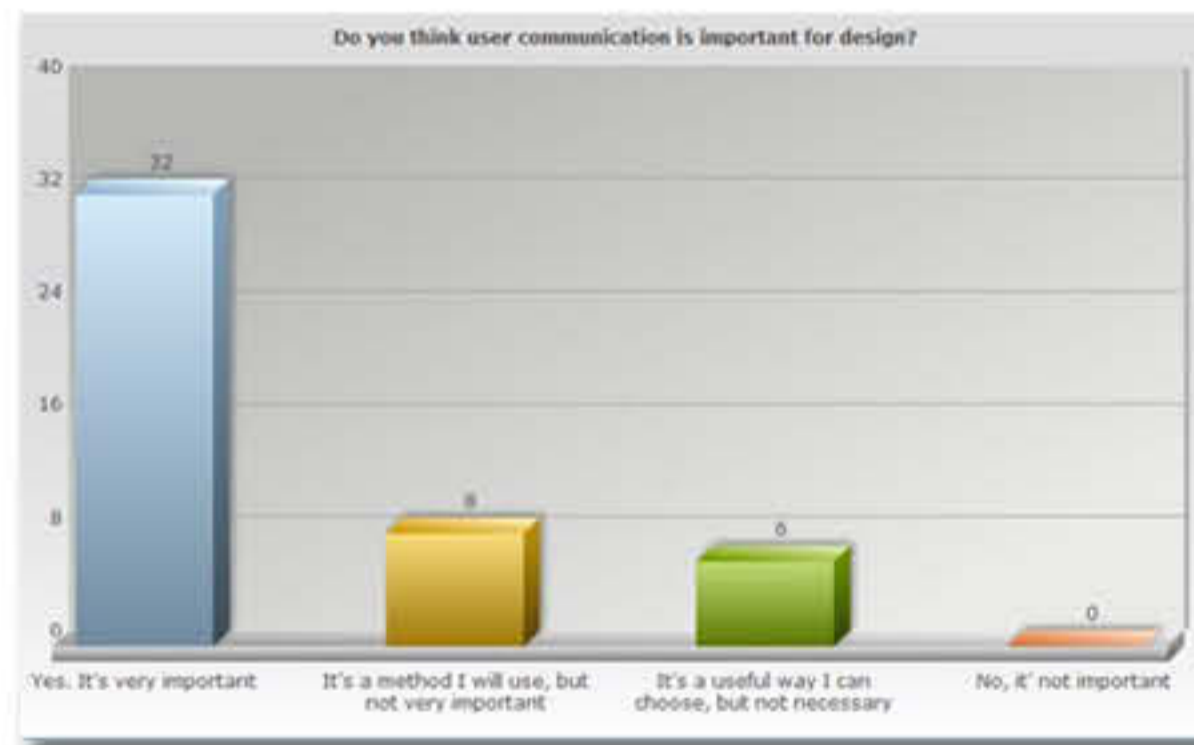
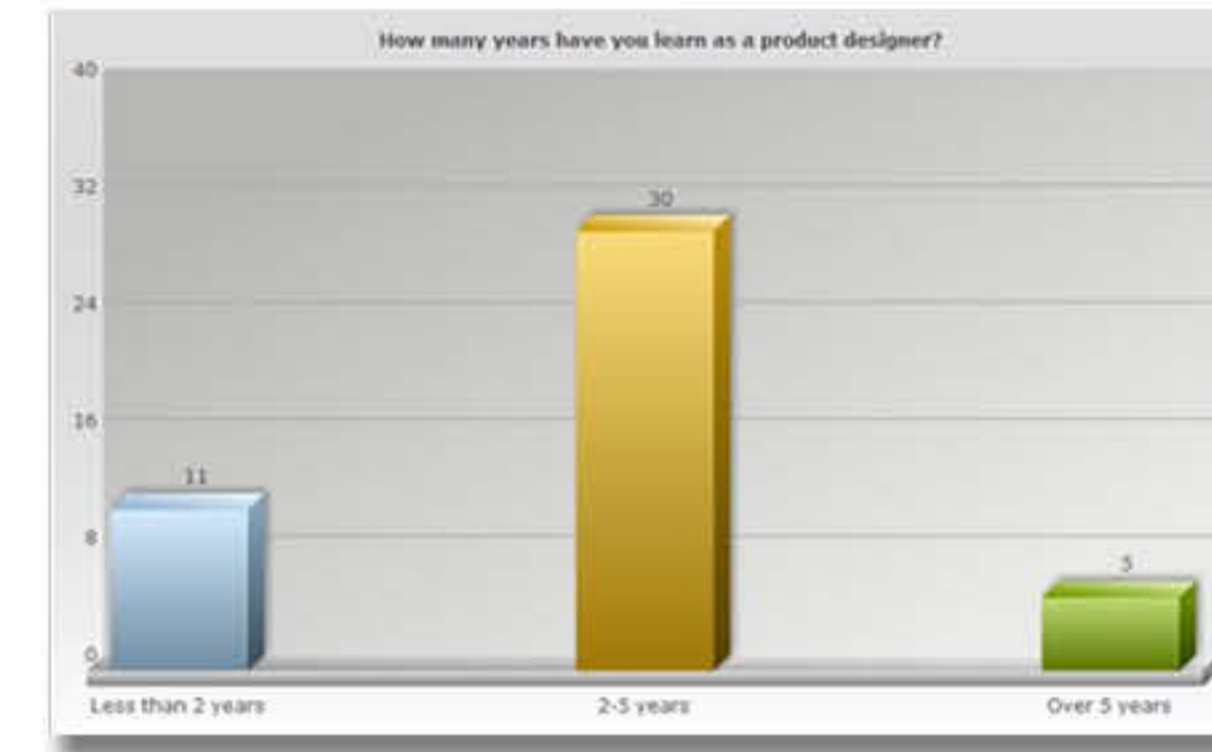
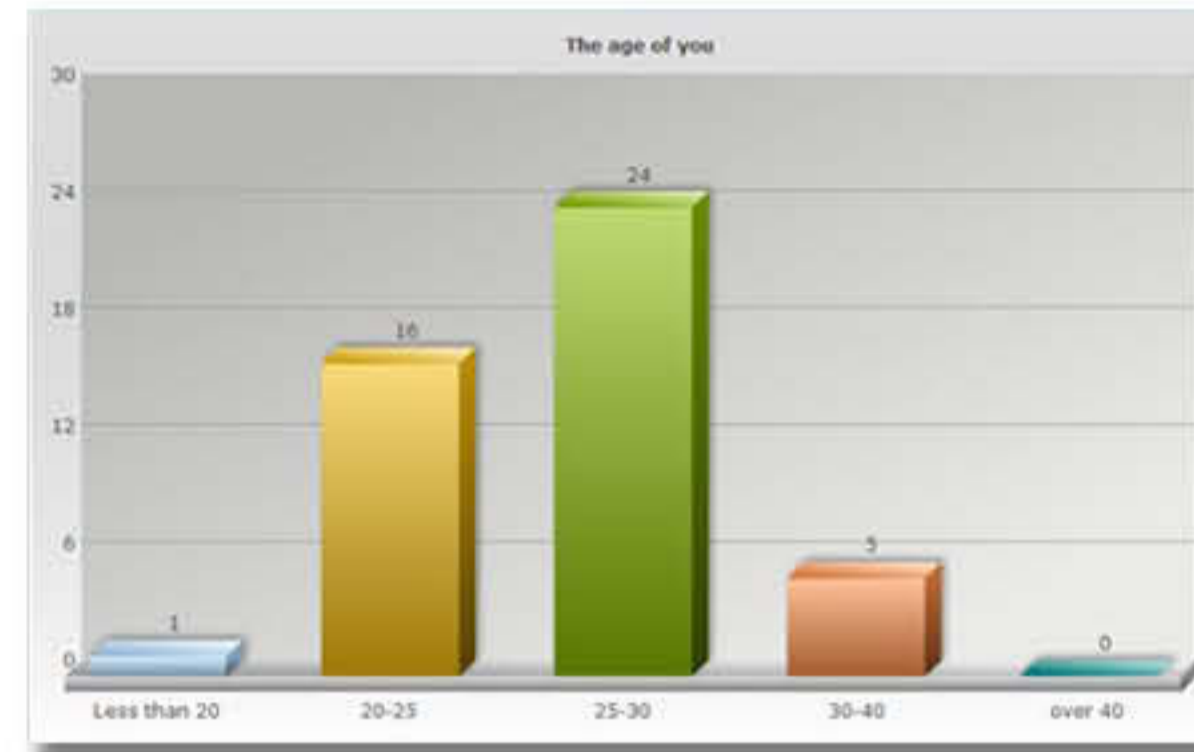
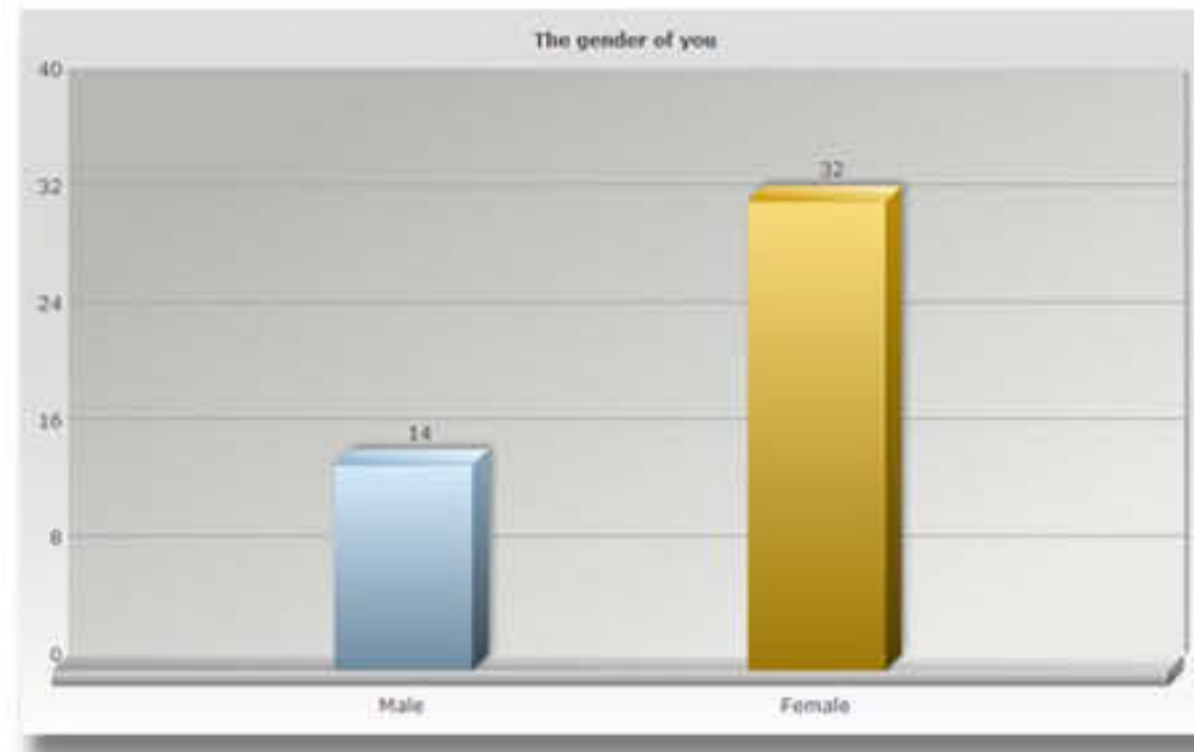
Many time when I need to communicate

**Submit**





## Appendix 2: The questionnaire about user communication





Appendix 3: The figure list

Figure 01: the relation of 3 key aspects in research question .....	1	Figure 23 the involved hospital .....	35
Figure 02: Cello is a product that definitely designed using activity-centered design .....	2	Figure 24 the possible errors .....	41
Figure 03: the relation of keywords of CPR board .....	17	Figure 25 the possible errors 1 .....	42
Figure 04: different using surrounding .....	20	Figure 26 the possible errors 2 .....	43
Figure 05: the activity analysis of CPR executing in hospital sick ward .....	21	Figure 27 the possible errors 3 .....	44
Figure 06: the activity analysis of 'before CPR' .....	22	Figure 28 the possible errors 4 .....	45
Figure 07: the activity analysis of 'while CPR' .....	23	Figure 29 the character profiles .....	46
Figure 08: the activity analysis of 'after CPR' .....	24	Figure 30 Anthropometric analysis: width .....	48
Figure 09: the exiting CPR board .....	25	Figure 31 Anthropometric analysis: length .....	49
Figure 10: the ward bed in hospital .....	25	Figure 32 Anthropometric analysis: the head angle of elevation .....	50
Figure 11: the size of existing CPR board .....	26	Figure 33 Anthropometric analysis: weight 1 .....	51
Figure 12: the weight of existing CPR board .....	26	Figure 34 Anthropometric analysis: weight 2 .....	51
Figure 13: the way to connect of existing CPR board .....	27	Figure 35 Anthropometric analysis: weight 3 .....	52
Figure 14 the research approach .....	29	Figure 36 the role-play .....	64
Figure 15 the relation of the four modes of research .....	30	Figure 37 the relation between product (Model) , user and designer.....	65
Figure 16 the range of the research methods .....	31	Figure 38 the paper-prototype and scale modeling .....	66
Figure 17 the 'Learn' methods .....	31	Figure 39 the hospital mood board (1) .....	69
Figure 18 the 'Look' methods .....	32	Figure 40 the hospital mood board (2) .....	70
Figure 19 the 'Ask' methods .....	32	Figure 41 the inspiration of concept 1 .....	73
Figure 20 the 'Try' methods .....	32	Figure 42 the concept 1 .....	74
Figure 21 the three especially involved nursing students .....	34	Figure 43 the inspiration of concept 2 .....	75
Figure 22 the teachers in nursing department .....	35	Figure 44 the concept 2 .....	76
		Figure 45 the inspiration of concept 3 .....	77
		Figure 46 the concept 3 .....	78





Figure 47 the other concept .....	79
Figure 48 the compare of different concepts .....	80
Figure 49 the length test .....	82
Figure 50 the width test .....	82
Figure 51 the lower corner shape 1 .....	83
Figure 52 the lower corner shape 2 .....	84
Figure 53 the different pattern of front surface .....	85
Figure 54 the position of center lock pattern .....	85
Figure 55 the different shape of edges .....	86
Figure 56 the test of edge no.7 .....	86
Figure 57 the area of center space .....	87
Figure 58 the thickness of each step .....	88
Figure 59 the thickness of CPR board .....	89
Figure 60 the position and the size of the handle .....	89
Figure 61 the curve of head holding part .....	90
Figure 62 the slope between adjacent two steps .....	91
Figure 63 ABS plastic .....	91
Figure 64 the storage of CPR board .....	92
Figure 65 the product image .....	93
Figure 66 the model making .....	94
Figure 67 the model test .....	95
Figure 68 the head curve of the model .....	95
Figure 69 the model making (2) .....	96
Figure 70 the detail of the model .....	97
Figure 71 the presentation of the model .....	98
Figure 72 the inverted pyramid of people's experience .....	101





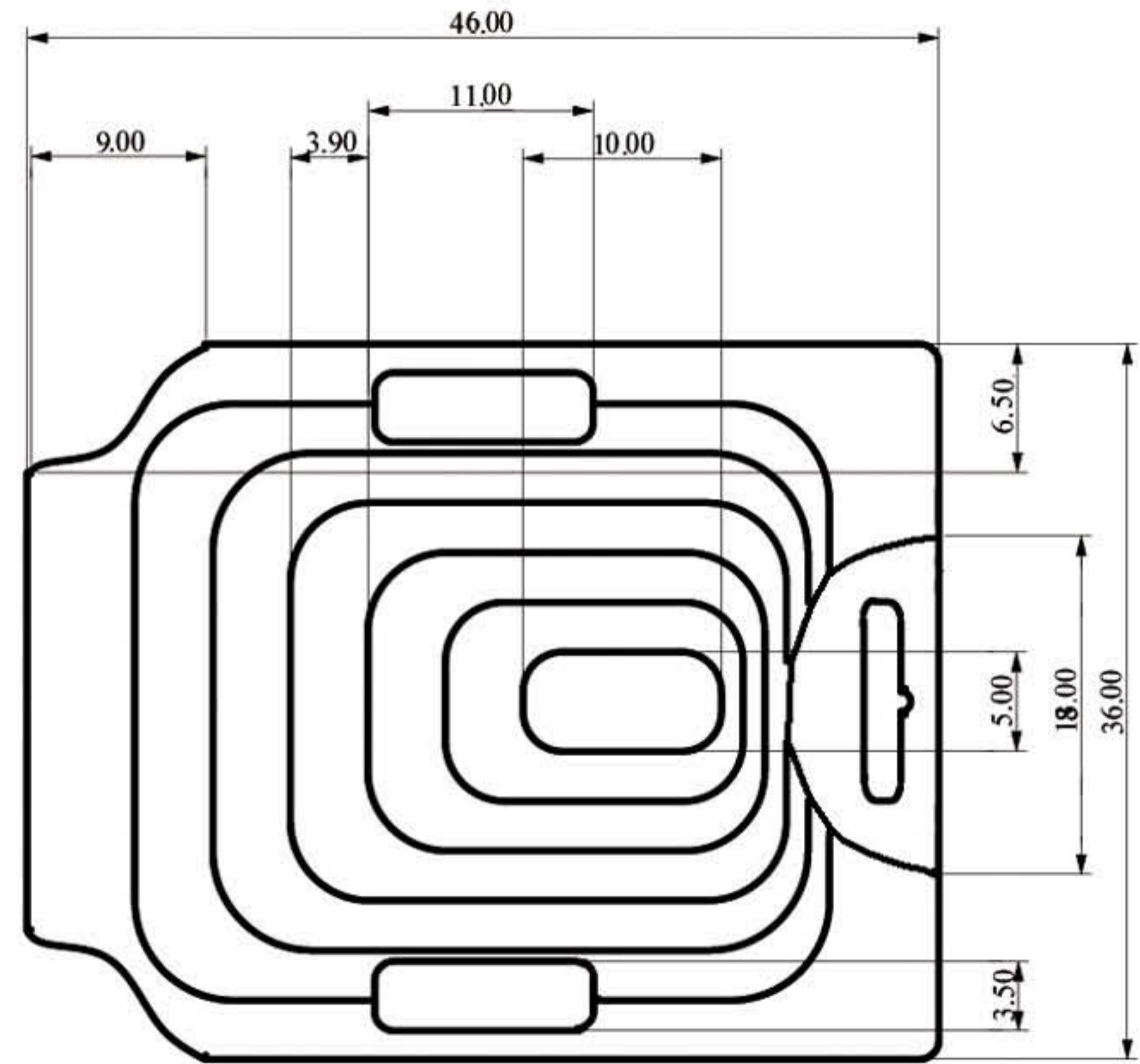
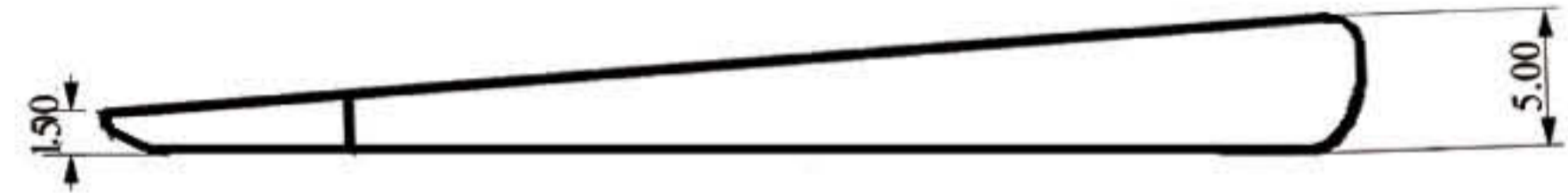
## Appendix 4: The table list

Table 1: three approached to design .....	12
Table 2: the different level of 'function' .....	18
Table 3: the different level of 'fast' .....	19
Table 4: the compare of different using surrounding .....	37
Table 5: Activity analysis .....	38
Table 6: Error analysis .....	40
Table 7: Character profiles .....	46
Table 8: Anthropometric analysis .....	47
Table 9: Fly on the wall .....	53
Table 10: Shadowing .....	53
Table 11: Survey & Questionnaires .....	56
Table 12: the answers from survey & questionnaire 1 .....	57
Table 13: the answers from survey & questionnaire 2 .....	58
Table 14: the answers from survey & questionnaire 3 .....	58
Table 15: the answers from survey & questionnaire 4 .....	59
Table 16: the answers from survey & questionnaire 5 .....	59
Table 17: Extreme user interview .....	60
Table 18: Scenarios .....	61
Table 19: Role-playing .....	64
Table 20: Paper-prototyping .....	65
Table 21: Scale-modeling .....	65
Table 22: the classification of verbal and non-verbal research methods .....	67
Table 23: the comparison of the shape of CPR board .....	83
Table 24: the evaluation .....	99





Appendix 5: The 2D drawing of the CPR board





## Appendix 6: The reference

### Book:

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## Appendix 7: The time table

Time schedule:

January	February	March	April	May	June
1 5	1 1	1 1	1 4	1 6	1 2
2 6	2 2	2 2	2 5	2 7	2 3
3 7	3 3	3 3	3 8	3 1	3 4
4 1	4 4 literature	4 4	4 7	4 2	4 5
5 2	5 5 contact company	5 5	5 1 model-making	5 3	5 6
6 3	6 6	6 6	6 2	6 4	6 7
7 4	7 7	7 7	7 3	7 5	7 1
8 5	8 1 scenario	8 1	8 4	8 6	8 2
9 6	9 2	9 2	9 5	9 7	9 3
10 7	10 3	10 3	10 6	10 1	10 4
11 1	11 4	11 4	11 7	11 2	11 5
12 2	12 5	12 5	12 1	12 3 print ready	12 8
13 3	13 6	13 6	13 2	13 4	13 7
14 4	14 7	14 7	14 3	14 5	14 1
15 5	15 1	15 1	15 4	15 6	15 2
16 6	16 2 observation/	16 2	16 5	16 7	16 3
17 7	17 3 discussion	17 3	17 6	17 1	17 4
18 1	18 4 interview	18 4	18 7	18 2	18 5
19 2	19 5 questionnaire	19 5	19 1	19 3	19 6
20 3	20 6	20 6	20 2	20 4	20 7
21 4	21 7	21 7	21 3	21 5 presentation?	21 1
22 5	22 1 result statistic	22 1	22 4	22 6	22 2
23 6	23 2	23 2	23 5	23 7	23 3
24 7	24 3	24 3	24 6	24 1	24 4
25 1 discussion	25 4	25 4	25 7	25 2	25 5
26 2	26 5	26 5	26 1	26 3	26 6
27 3	27 6	27 6	27 2	27 4	27 7
28 4 final structure	28 7	28 7	28 3	28 5	28 1
29 5		29 1	29 4	29 6	29 2
30 6		30 2	30 5	30 7	30 3
31 7		31 3		31 1	

The Gant diagram

■ weekend     
 ■ hand-in     
 ■ holiday

