

# EVIDENCE-BASED HEALTHCARE DESIGN



Jeroen Bosch Hospital (EGM), photo: EGM

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for life



**BNAonderzoek**

Can we build a hospital where patients feel more comfortable thanks to the way it was constructed? Is it possible for that same hospital to offer its staff the best possible support in the course of their work? And can we combine that with other design specifications, such as a building with minimal operating expenses and low power consumption? These challenging questions are the starting point for the Evidence-based Healthcare Design project carried out by the Netherlands Organisation for Applied Scientific Research (TNO), in cooperation with the research department of the Royal Institute of Dutch Architects (BNA Onderzoek). This publication outlines the ambitions and presents the initial results.

## **AIMING FOR BETTER, MORE AFFORDABLE HEALTHCARE**

We are trying in all sorts of ways to improve healthcare and reduce costs. We are developing more effective therapies and medications and trying to organise healthcare better. The operating costs of hospitals are already taken into account wherever possible, as is power consumption. Jan Maarten Schraagen, project leader and senior researcher at TNO: 'If we manage to build a hospital where patients feel more comfortable and staff have a more pleasant work experience, it could contribute to a further reduction in costs. After all, it seems self-evident that patients who feel less uncomfortable will recover faster and employees who receive better support can work more effectively.'

# TOWARDS EVIDENCE-BASED HEALTHCARE DESIGN

We do not know much yet about the impact that specific building characteristics have on patients and personnel. The plethora of choices that architects and builders make are not based on any scientific principles. That is not to say that they do not work. But there is no hard data on the topic, at least not on how a design as a whole affects various aspects, such as well-being, the ability to work effectively, a sense of safety, etc. Internationally, there is an approach known as Evidence-based Design. This method shows how a design is performing, but the results do not become apparent until afterwards, once the building is already completed. TNO wanted to develop a methodology that would make it possible to predict performance during the design process. In cooperation with BNA, TNO researched how this predictive model could be structured and how it can support architects in making design decisions.

# THE METHODOLOGY

*For a detailed report, see: Evidence-based Healthcare Design, 2014, available from TNO.*

Jutta Hinterleitner, programme manager at BNA Onderzoek: 'In building a new hospital or adapting an existing hospital, there is always a packet of specifications that the building must meet. The management of the hospital decides what they want from a building and negotiates with the architect and the contractor accordingly.' The researchers started by mapping the key performance indicators (KPIs) that are specifically relevant to hospitals. When a hospital wants to improve its performance, what specific aspects does it want to address, and which of those aspects are feasible?

Two types of KPIs were formulated in this study: user performance and building performance. User performance included patient satisfaction and well-being, patient safety, personnel satisfaction, personnel efficiency and visitor satisfaction. Building performance covered flexibility, operating costs and sustainability. The researchers then wanted to be able to analyse relationships between aspects of the building and

KPIs. To gain a clear overview, extensive interviews were conducted with six architecture firms, all of which were experts in building hospitals. On that basis, relationship charts were drawn up mapping out aspects of buildings in relation to KPIs, displayed in tree structures. Layla Lebesque, researcher at TNO: 'To arrive at a predictive model, we had to convert these relationships into a numeric value. The value shows the effects of aspects of the building on KPIs.'



*Meander Medisch Centrum (Atelier PRO),  
photo: Dirk Verwoerd*

**THE PATIENT PERSPECTIVE  
AT THE ROOM LEVEL**

In the project, research was done on whether that conversion could be achieved, focusing on a single KPI: patient satisfaction and well-being. Existing data on the Arnhem and Zevenaar branches of the Rijnstate hospital were used for this purpose. This involved 365 patients who were surveyed about their room. Patient satisfaction and well-being were divided into six underlying indicators that determine whether the patient feels satisfied and pleased: spatial convenience, autonomy, comfort, safety, social amenities (such as sufficient distractions) and privacy. These aspects were then compared to various aspects of the building at the room level. The tree structure below shows the tree for patient satisfaction and well-being. Only building aspects that were mentioned by more than three of the participating architecture firms are displayed. The blue part shows performance indicators, while the yellow section shows aspects of the building.

Eliane Schreuder, researcher at TNO: 'It is important to understand that we need a design in order to use this model. We enter design aspects, and the model calculates how the design performs on spatial convenience, or other aspects that you would like to have clarified.'

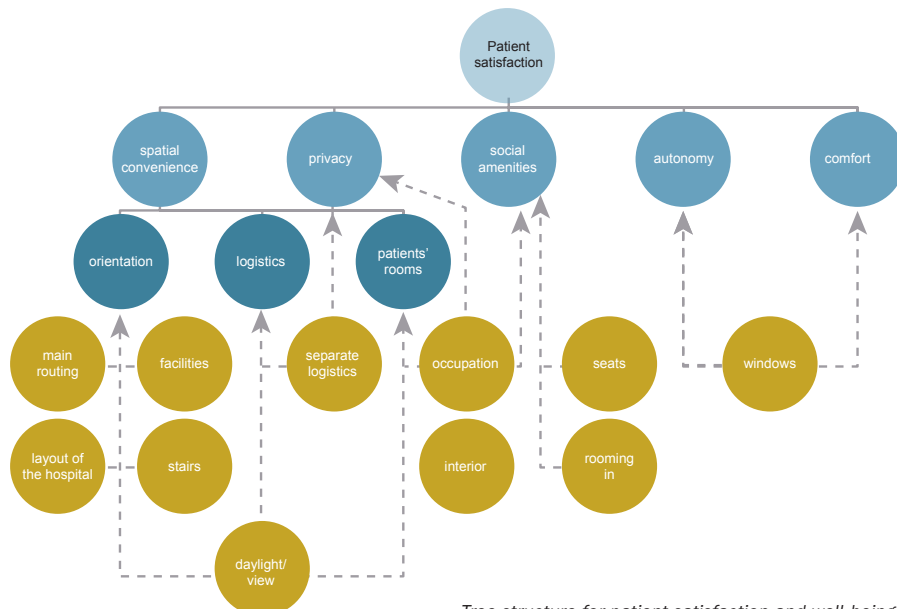
**INITIAL RESULTS**

Initial results for patient satisfaction and well-being offer the following impression. Spatial convenience and a sense of safety have the biggest impact on patient satisfaction and well-being, while social



amenities have the lowest relative impact. Patient appreciation of the view from the bed looking outside (part of spatial convenience) is higher when the surface of the window is greater, the balustrade is placed lower, and more sky and greenery can be seen. The degree to which unauthorised persons have access is the most important indicator of the patients' sense of safety. The speed with which they can switch on the lights is solidly in second place. Air quality is the primary indicator for whether a patient feels comfortable, following by hygiene, temperature, scent and sound (especially excessive sound). There were major differences between different target groups. People are more positive about their room if they are over 65 years old, less well educated, and less severely ill. Their gender and the length of their stay are less important.

Meander Medisch Centrum (Atelier PRO),  
photo: Dirk Verwoerd



Tree structure for patient satisfaction and well-being.

Eliane Schreuder: 'It is important to realise that these data cannot be used generically yet. Even so, we have demonstrated on a modest scale that it is possible to create a model that has predictive value, which the architect can use to substantiate his design choices. We will be subjecting the data to further analysis in a new knowledge development project and assessing how we can make the model usable for architects or other users, like hospital administrators. We will also be looking for new data from current hospitals. This improves our model, makes it useful for more generic application.'



## THE ARCHITECT

Roelof Gortemaker is an architect working at the De Jong Gortemaker Algra architecture firm. The firm took the initiative for the project by bringing it to BNA Onderzoek as a potential research project. 'A great deal of work is being done on Evidence-based Design in the USA. The question of how to create designs that improve well-being for patients and personnel is fascinating to me.'

### AND? ARE WE ON THE RIGHT TRACK?

'I am very pleased with the results we have now, even though they are still modest. It is amazing that TNO has been able to develop a calculating tool to provide a more solid foundation for design choices. This tool will also become more reliable as more data is added in future.'

### WHY IS SUCH A TOOL NEEDED?

'Hospitalisation is a stressful experience, by definition. I have extensive experience working as an architect in the mental healthcare and psychiatry sector. Everyone is familiar with situations in which they feel uneasy. If there is an open door behind you, for instance. People who are ill and vulnerable feel that sense of unease much more strongly. You can make enormous improvements by designing structures in such a way that hallways have a light at the end. Or in such a way that patients do not have to turn more than two corners to get from A to B, so they do not become disoriented and lose their way.'

I have seen for myself that schizophrenics really enjoy being able to find their own little spot in a larger space that is used collectively by patients and personnel. The freedom to not necessarily have to participate in the group experience, but still be able to be in the same room, can be very positive for them. So I try to adapt my design accordingly. It is clear to me that we will make serious strides forward as a society if we develop a tool that uses scientific principles before and during the building process and can act as a road map for improving the well-being of patients and personnel.'

### WHY IS THIS NOT ALREADY BEING DONE?

'Architecture and aesthetics are highly subjective. There is hardly any scientific basis for those factors. You see that many architects are initially resistant to an initiative like this. Many architects perceive design as a near-mystical process that would be removed from their control to some extent by such an approach. And don't forget that many architects do in fact have difficulty taking user preferences into account. There just isn't a scientific basis for it. We do not know whether they are doing what they need to do in order to achieve their goal. There is resistance, but the same phenomenon happened when using computers to produce drawings first became popular. Now everyone does it.'

### IN YOUR EXPERIENCE, DOES THE CLIENT HAVE A CLEAR GRASP ON HIS SPECIFICATIONS AND PRIORITIES?

'That is often not the case. The programme of requirements can be tailored much more specifically to the content. I would strongly advocate having clients clearly state the effects that they would like the building to have. Including 'softer' aspects like the well-being of patients and personnel. We once built a hospital where we deliberately positioned management and doctors on the same layer of the structure. The hospital itself did not consider that a particularly high priority. In retrospect, however, we heard how well it went; the

management and doctors interacted very easily. Communication between the client and the architect is not always simple either. In general, architects simply have better spatial perception than their clients, for instance.'

### IS A PROJECT LIKE THIS UNIQUE?

'Yes, in the sense that a tool like this does not exist yet, to the best of my knowledge. In the US and Canada, the thought processes are much more advanced. In those countries, they are contemplating designs that prevent people from falling ill. Very interesting.'

*Deventer Hospital (de Jong Gortemaker Algra),  
photo: dJGA*



## THE PATIENT

Cock Vermolen is the managing director of Zorgbelang Brabant, a coordinating authority in the province that promotes and improves relations and partnerships between healthcare providers and people in need of care.

### WHAT DO PATIENTS NEED FROM A BUILDING?

‘What I say is based on experiences that I gained in the course of my work. I do not have any idea of what scientific data there is on the topic. There is a great deal of discussion in the healthcare sector about how healthcare providers can improve quality of life for their patients. In nursing homes, for instance, concepts like a small-scale facility move to the forefront. The same applies to hospitals. The ‘living room’ feel is important to people. Older hospitals are often office-style environments where everything looks very clinical. Modern hospitals do a better job of it; they have a more pleasant atmosphere and are smaller in scale.

The human measure also seems relevant in a logistics sense as well. Patients do not enjoy not being able to find their way around easily. Do not make things too far away from each other. Having enough privacy is important too, although there are patients who prefer sharing a room with others who are in the same boat. I can tell you from personal experience, by the way, that there is a relationship between your physical environment and how pleasant you feel (and behave) in that setting. I am currently working in a beautifully designed new office that has flexible workspaces. I see myself and those around me behaving slightly differently than when we were working in the old building. It may be my own personal observation, but I really think that’s how it works.

I also think that hospitals could learn something from the hotel industry in that respect. How do you design a hospital that has enough privacy, where people feel at ease? Ask a hotel owner how they do it.’

## THE PERSONNEL

Frans Faber is head of the Operations ward and Pain Management department in the Antonius Hospital in Sneek.

### ARE YOU FAMILIAR WITH PROBLEMS RELATED TO HOW THE HOSPITAL WAS BUILT?

‘Oh, absolutely. The primary process in a hospital deserves the most floor space, in my view. Offices could be smaller. It would make a huge difference, for example, if personnel did not have to lift patients in toilet stalls that are too small. I would also like to see personnel have enough workstations where they can write their reports. Now they have to wait and see if a computer is available. That computer should always be at their disposal. And storage facilities are always incredibly squeezed in hospitals. Materials, medicine carts, chairs and stools should not be left knocking about the halls; there should be a decent place to store them.’

### WHAT SHOULD CLIENTS, ARCHITECTS AND BUILDERS KEEP IN MIND?

‘Think about how you organise logistical flows. Here in Sneek, we have a single-level building where people have to walk vast distances. There aren’t many higher buildings in the area, that’s why. But it does mean that we have to transport lots and lots of people and equipment every day. I think it’s very important to look at how you structure the environment around the operating room. Look at it from the perspective of the function it serves. For instance, there are types of medicine that focus on examinations and tests rather than operations: pulmonary medicine, for example. Group those together. And make sure that doctors that will have to perform operations regularly are situated close to the operating room, and put the Intensive Care department there too. You should not have to transport blood samples all the way to the other side of the building. Another theme is climate control. We always hear a lot of complaints from personnel about this aspect. The area is too cold, or too warm. Have climate control arranged per ward rather than per building or section. That would significantly improve working conditions.’

### COULD EVIDENCE-BASED HEALTHCARE DESIGN HELP?

‘Definitely! It is important to be aware of personnel preferences at the point in time when the management is contemplating building specifications and priorities. It is even better if you can then calculate whether a design meets those specifications. There is so much you can do to make it more pleasant and more effective. Introduce indirect lighting. Use floor lighting at night instead of overhead fluorescent tubes. Remember that security staff will also need to sit down sometimes - and it helps if they can still see something! So the windows need to be lower. Put doctors and office managers together, rather than keeping them separate. I strongly feel that employers should be engaged: you simply need to be in physical proximity to the work.’

### HOW CAN YOU MAKE SURE THAT THE MOST IMPORTANT PREFERENCES ARE INCORPORATED INTO THE PROGRAMME OF REQUIREMENTS?

‘Involve the people who are working in a specific ward or department in the process of constructing that part of the building. The people using it really do know what’s needed. About 20 years ago, we had the personnel help design the Intensive Care Unit in Sneek. 20 years later, they are still happy with it. Those ‘institutions’ can be found everywhere, veterans who have been working in the same place for 20 years or more. You need those people; they know everything. And finally: manage expectations. Draw up a realistic budget in advance and be clear about what is and is not possible.’



Jeroen Bosch Hospital (EGM), photo: EGM

# THE FACILITY MANAGER

Arjan Windhorst is sector manager of facility services for the Tweesteden hospital in Tilburg and Waalwijk.

## WHEN A NEW HOSPITAL NEEDS TO BE BUILT, HOW DOES THE PROCESS GO?

'We built a new outpatient clinic not that long ago. Ideally, we draw up a programme of requirements in which users are also asked about what their preferences are. Then you go to the contractor, who tells the architect what to do. My experience is that there's a tendency to lose sight of user preferences after that. In our outpatient clinic, I have to conclude now, we should have focused more attention in the design on how it would be used in practice. For instance, personnel have to walk very far when they need to go to the office, which limits use here and there.'

## COULD EVIDENCE-BASED HEALTHCARE DESIGN HELP?

'I certainly think so, but it remains important to reassess the design again afterwards and see how it performs from the perspective of individual users, which is sometimes subjective. You can explain which aspects had to be taken into consideration and how the evaluation process went. This increases acceptance.'

## WHAT HAS TO GO WELL IN A HOSPITAL, FROM YOUR PERSPECTIVE?

'Climate control, which is largely responsible for comfort. This should not be taken for granted. For example, if you use a design flexibly, it may turn out that comfort factors can no longer be arranged properly. And maintenance costs need to be kept as low as possible. It is difficult to make it stick. There are always costs that end up being higher than expected; the floor might need to be cleaned far more often than estimated in advance. What we want is for integrated maintenance costs to be clear beforehand, but that is incredibly difficult in practice.'

## DO YOU HAVE TIPS TO KEEP IN MIND WHEN CREATING A USER-FRIENDLY DESIGN?

'Take the time to think through all the aspects of a design. Set up a cardboard

model of an operating room and check what has to happen there, who uses it, how the flows of logistics are patterned. Regularly have users take a look and participate in the brainstorming process.

Agreements with builders about guarantees and maintenance costs could also be structured much better. Builders are often unresponsive when things do not go well, especially when the money is gone. For example, try to make the agreement that you have a guarantee on facility operating costs, especially for the first three years after delivery, and arrange for more automatic involvement on the part of the builders if something isn't working properly.

And last but not least: the patient perspective often depends on the coincidental personal involvement of someone who represents that perspective in the sounding board group. Reinforce this perspective and make it a more fixed item on the agenda. I think that Evidence-based Design can address this to some extent.'

## CONCLUSION

The initial response from the interviewees highlights how important it is that a tool is being developed that offers a tangible, objective representation of the 'softer' aspects, such as the well-being of patients and personnel. These aspects can then be neutrally compared to other relevant factors, such as the operating costs of the building. In order to continue developing the model, TNO is looking for established hospitals where the impact of the building can be researched. If you are interested in partnering with TNO, please contact Joram Nauta (Joram.Nauta@tno.nl).

Do feel free to contact us if you have other suggestions about how you could contribute to the project

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