

Cleaning up the hospital soundscape: How to reduce ambient noise to prevent stress and fatigue?

Author 123

Track 10: The machine that goes: ‘Ping!’

ABSTRACT

A lot of sounds can be heard in a hospital environment. Not all these sounds are relevant to all the people that can hear them. In other words: the hospital soundscape contains a lot of ambient noise.

This paper is about understanding this ambient noise in a hospital on both a perceptual and physical level. Relevant factors and details are provided on the perception of this soundscape. A study has been conducted in which papers are reviewed that are about sounds in the hospital and the effects on staff and patients. With the results of this study suggestions are made how to improve the way sounds are distributed to participants (patients and staff) of the hospital environment. These suggestions will be also reviewed from both a staff and patient perspective.

Keywords

INTRODUCTION

Most people are known with being in a hospital. They either visited, stayed or worked in there. In this hospital environment a lot of medical devices can be found, especially in the intensive care. These devices are ICUs devices make a lot of noises, which inform the people around the machine. These sounds can be split into two categories: sounds produced by the working process of the machine and sounds it uses to communicate.

The last category provides a lot of sounds that sometimes are relevant to the people listening, but most of the time are irrelevant. This means that the hospital soundscape contains a lot of ambient noise, or pollution. This ambient noise is a reason for a lot of people to experience fatigue. This could be alarm fatigue for nurses, which means that they won't notice sounds because they are used to hearing the machine. This fatigue could be dangerous because it creates a delayed response or even errors in the working process of the staff.

Another group affected by these sounds is the patients that are lying in the hospital. Often they experience the sounds as being too loud, which irritates them, keeps them out of their sleep and hinders their recovery process.

This ambient noise contains a lot of information that could be addressed more specific to the person it is relevant to. This paper is about finding how big of a problem this is, what sounds are relevant for whom, how these sounds are perceived by the people and a possible solution for this problem.

REVIEW

According to Topf (2000) ambient noise in hospital is one of the stressors in the hospital environment. Stated is that a volume of 45 dB(A) shouldn't be exceeded in order for patients to have a good rest. Often the sounds that are measured create a sound between 60 dB(A) and 83 dB(A). Looking at staff, Morrison et al. (2016) states that ambient noise in a hospital has a correlation with poor task performance and job frustration. This may be related to alarm fatigue staff experiences during work.

In figure 1 factors that cause stress are mapped. There is a direct link between ambient stressors, such as ambient noise, and stress. As stated by Rohmert (1973) particular stress results in an equal degree of fatigue.

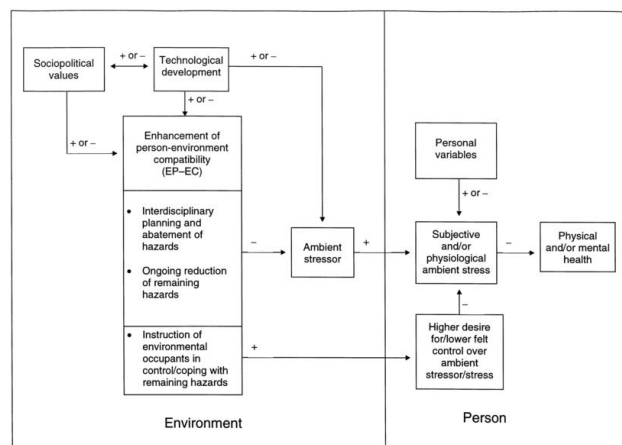


Figure 1. A model suggesting relationships between environmental stress, enhancement of person-environment compatibility, and health expanded from Topf (1984, 1994)

According to Johansson et al. (2012) there are five types of sound perceived by patients in a hospital environment: sounds related to setting, sounds related to staff, sounds related to patients, sounds related to equipment and sounds as a part of dreams. From these sounds the sounds related to equipment are important for this paper. They have a two-piece effect on patients. At first many patients find the sounds unfamiliar and

are frightened by thoughts about the meaning of the sound. Later they get used to the environment and recognize various alarms and sounds. Sometimes these sounds are even experienced as safe and friendly.

A paper written by Xie, Kang and Mills (2009) state that among the major noise sources in the ICU are the following sounds: ventilator alarms, heart monitor alarms, pulse oximeter tones and pulse oximeter alarms.

One of the conclusions made by Darbyshire (2016) is that lowering the overall sound levels may improve the environment for both patients (sleep) and staff (concentration). The suggestion is given to move away from a 24 hour average sound and using modern techniques to reduce the overall noise level.

Chambrin (2001) concludes that there are far over 40 possible alarms that can be produced by medical equipment. This results in a lot of false alarms which add up to the ambient noise experienced in the hospital environment. A decrease in these false alarms may be a (partial) solution to reduce the fatigue experienced by staff and patients.

Out of these studies can be concluded that the soundscape of a hospital environment contains a lot of noise that causes stress and fatigue. Being more specific, noises made by alarms of medical equipment are a big factor in the experienced noise. However, these sounds are of course useful for monitoring the status of the patient. This does not mean that these sounds are always important or interesting to the ones hearing them. In order to decrease the experienced stress and fatigue a solution can be found. A study conducted by Christensen (2004) shows that staff has little to no knowledge about ambient noises and the effect this has on their selves and their patients. As a result can be concluded that either staff should be made aware of the consequences or a passive solution should be found.

METHOD

From ... papers possible solutions are reviewed on their effect. Positive and negative elements of the solutions will be stated. The expected result is to come up with a solution to reduce ambient noise in the hospital. Hereby the focus will be on reducing the sounds of medical equipment, experienced by both staff and patients.

Static solutions

First a few static solutions explained by Xie, Kang and Millis (2009) are reviewed.

Earplugs

A basic solution to reduce the sound level would be introducing ear plugs to both staff and patients. The benefit of this is a reduction in the amount of dB(A) which results in a decrease of annoyance and thus stress. This solution however is not available for all patients, since some are not allowed for medical reasons to wear earplugs (Darbyshire, 2016). Also this solution is not suitable for staff, since it hinders staff

communication and brings the potential danger of not hearing certain alarms.

Sound masking

Sound masking uses what is called white noise to minimize distraction from other sounds. It covers up the sounds and alarms made by medical equipment in order to provide a more comfortable environment. For patients this seems a rather interesting solution, because the noise around them will be passively reduced. For staff however this seems a less fitting solution. Covering up the noises could be a solution for sounds that are not important to staff, but the experience of alarms will also be influenced. As a result certain alarms may be missed by staff.

Acoustic absorbers

Acoustic absorbers reduce the sound level machines make. This is mainly effective for the passive sounds equipment makes (for example resonating as the result of an internal part, or the sound the engine makes). Besides of this, this solution actually is quite a good one to reduce the overall sound level on the intensive care.

Quiet periods

Another solution comes forth out of Darbyshires (2016) paper. It talks about the possibility to implement quiet periods in the hospital, in which sounds in general are reduced. In general this might have a good outcome, but looking at critical moments, this is not a good solution. Because certain alarms cannot be ignored, there is no possibility of completely quiet moments.

Dynamic solutions

Besides static solutions there are also some dynamic solutions to reduce ambient noise in the hospital environment.

Music

One solution given by Cabrera and Lee (2000) is to have a department of sound in the hospital. The purpose of this solution is using music therapy in order to enhance the environment. This solution is mainly pointed at patients as the music reduces their stress level. As a side effect, the music will also be relaxing to the staff on the intensive care. Positive about it is that for both groups a decrease in stress is seen. This results in experiencing less fatigue. The negative point about this solution is that a complete new department has to be formed inside the hospital. Experts need to continuously monitor different aspects of sounds and react to preferences of both staff and patients. This makes it a good, but expensive solution.

Individualizing alarm thresholds and volumes

By individualizing alarm thresholds and volumes a tailor-made solution is being tried (Darbyshire, 2016). When sound levels are specified to the needs of both staff and patients, a better environment can easily be reached. The obstacle in this solution is to find a way determine what level is likeable for which person. Also by selecting which sounds are important for whom, a more personalized soundscape can be produced.

Different sorts of alarms

Another possibility would be to use other alarms, such as visual alarms, to notify staff and patients of what is happening. Again, for patients this seems a good solution. They can decide for themselves if they want to see certain alarms. For staff this solution seems to be a little more difficult. Sometimes they have to react to important alarms and this needs to be visual to them in a second. In order to do this, they need to get a direct input which can be difficult to achieve.

RESULTS

As a result can be concluded that the use of a passive solution for this problem mostly helps the patients with experiencing the sound. Often staff will experience a less stressful environment, but will also be less alert on different alarms that may occur.

Ambient noise in a hospital environment can best be solved with the use of a dynamic solution. This gives the possibility to address sounds specifically to people for who they are useful. Especially the use of modern technology seems an interesting way to get the alarms more individual.

Suggestions on possible solutions

As a result of the reviews, a few possible suggestions will be suggested. These will include both the possibility of creating a more tailor-made environment for both patients as staff, as well as the possibility to make use of different kind of alarms, as they were the two most promising solutions.

Beepers

One solution to the problem could be a device for each staff member which has an audible function only they hear. Think of some sort of headset. This will inform them when a sudden alarm goes off. After this they can get information on what patient needs assistance and what is going on. This system can be smart enough to even give details on the status of the patient while heading towards the bed the patient is in. Positive about this is that the patient isn't bothered with any signals anymore, so that he can get the best rest. Also, the ambient noise for staff is reduced, since there are no useless sounds around him. Negative about this system is that a safety has to be built in case of a failure of the device. Also the patient may be discomforted by the lack of sound, both because of ignorance about the situation or the passive noise of the machine.

Motion detect sound

Another solution is the possibility to add a location based sound. This means that when a staff member walks along a patient the machines will give audible feedback. As a result there will not be a constant noise of the equipment. This will result in a more relaxed environment. The same problems occur as in the beeper-solution. Additional patients will hear when a patient close to him is inspected.

Check-in

Similar to the motion detection is the possibility for staff to check in at the bed of a patient. This will give

them general information when needed, but the rest of the time the environment will be quiet. As a result it is important that alarms will sound throughout the room, in order to notice the staff about important events.

Individual visual alarms

A completely different solution is to make use of devices such as Google Glass. This gives the staff the possibility to notice certain alarms when they pop up in their view. It creates an environment where sound becomes a thing that is really optional and can be individualized to what both the patients and staff prefer.

It also can be combined with the first solution to provide a hybrid system. This solution seems most promising, because it has the most personal approach. One of the important aspects is that the staff members don't have to carry a device, so that they have both hands free to perform actions.

DISCUSSION

In this paper no attention has been given to the visitors of patients. They also are a factor within experiencing the soundscape. For them it can be, for example, important that there is some sort of audible feedback to make them feel comfortable about the wellbeing of the patient.

There is little information found about what patients actually want to hear from the medical equipment during their stay at the intensive care. These results in little understanding about what they find important to hear when they are in the hospital. Also the influence of sounds produced by medical equipment of surrounding patients could be investigated more.

Besides the sounds medical equipment makes, or sounds in general, other factors need to be taken into account before a conclusion about stress can be made. Examples are pain and medication which influence the awareness of the patient of their surroundings. These may influence their experience of sound. Research on this in the future is needed to implement solutions.

For this paper the assumption has been made that the most important sounds on the intensive care come from both monitors and pumps. Monitors are often used to collect data from different devices, while pumps often are standalone equipment. This results in a generalization of the distributing of sound. In the real world this generalization is a thing that actually happens, but from a designerly perspective these sounds could be individual sources. Research can be conducted to see what possibilities there are to split these sounds into different groups. Also the importance of these different sound groups can be investigated.

The alarms are not researched in this paper. The possibility to change them into more comfortable sounds could be another solution to the stress problem. There is information available on this topic.

CONCLUSION

As a conclusion can be said that the ambient noise caused by sounds of medical equipment contributes a lot to the stress and fatigue of both staff and patients in on the intensive care. For this problem there has been thought of possible solutions, without making them concrete already.

The possibility to improve the soundscape of the hospital in a way that it is less stressful and causes less fatigue, by addressing sounds to the people that actually need them seems a good solution. A note must be made that the solutions as provided by the paper all have their positive and negative points. The most promising solution seems a device which gives both visual and audible feedback to staff, without hindering them in their work. In this way they will know what is going on, while the patient will only get the feedback it prefers.

REFERENCES

- Cabrera, I. and Lee, M. (2000). Reducing Noise Pollution in the Hospital Setting by Establishing a Department of Sound: A Survey of Recent Research on the Effects of Noise and Music in Health Care. *Preventive Medicine*, 30(4), pp.339-345.
- Chambrin, M. (2001). Alarms in the intensive care unit: how can the number of false alarms be reduced? *Critical Care*, 5(4), p.184.
- Christensen, M. (2004). What knowledge do ICU nurses have with regard to the effects of noise exposure in the Intensive Care Unit?
- Darbyshire, J. (2016). Excessive noise in intensive care units.
- Johansson, L., Bergbom, I., Waye, K., Ryherd, E. and Lindahl, B. (2012). The sound environment in an ICU patient room—A content analysis of sound levels and patient experiences.
- Morrison WE, e. (2003). Noise, stress, and annoyance in a pediatric intensive care unit. *PubMed*.
- Rohmert, W. (1973). Problems in determining rest allowances. *Applied Ergonomics*, 4(2), pp.91-95.
- Topf M. (1984) A framework for research on aversive physical aspects of the environment. *Research in Nursing & Health*, 7, pages 35-42.
- Topf M. (2000) Hospital noise pollution: an environmental stress model to guide research and clinical interventions. *Journal of Advanced Nursing*, Vol 31, nr 3, pages 520-528.
- Topf M. (1994) Theoretical considerations for research on environmental stress and health. *IMAGE: Journal of Nursing Scholarship*, 26, pages 289-293.
- Xie, H., Kang, J. and Mills, G. (2009). Clinical review: The impact of noise on patients' sleep and the effectiveness of noise reduction strategies in intensive care units. *Critical Care*, 13(2), p.208.