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HUMAN HEALTH
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ARE NOISY HOSPITALS MAKING US SICK?

Georgios Chatzilampri[1*] *and Frank Stevens*[2*]

[1] *Hydrock, London, United Kingdom*
[2] *University of York, York, United Kingdom*

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AGES: 9–14

If you have ever been woken up by noise in the night, you will know just how annoying it can be. But noise does not only disturb us; it can actually be bad for our health. People can be affected by noise in many environments and, unfortunately, hospitals that are occupied by the most vulnerable groups of people are no exception. Studies show that people trying to recover need peace and quiet. But despite all the "quiet please" signs, noise in hospitals is one of the main reason patients cannot sleep, besides physical pain. In this article, we explore how noise affects people and how it impacts those trying to get well in hospitals.

WHAT IS SOUND AND HOW DO HUMANS DETECT IT?

Things around us produce sound when they are either moving or shaking. We call this shaking movement **vibration** [1]. Think of the strings of a violin, or a car passing by. Even your voice is the result of movements and vibrations. This movement is the reason that sound is also a form of energy, similar to electricity or heat, for example.

VIBRATION

A periodic motion back and forth or from side to side.

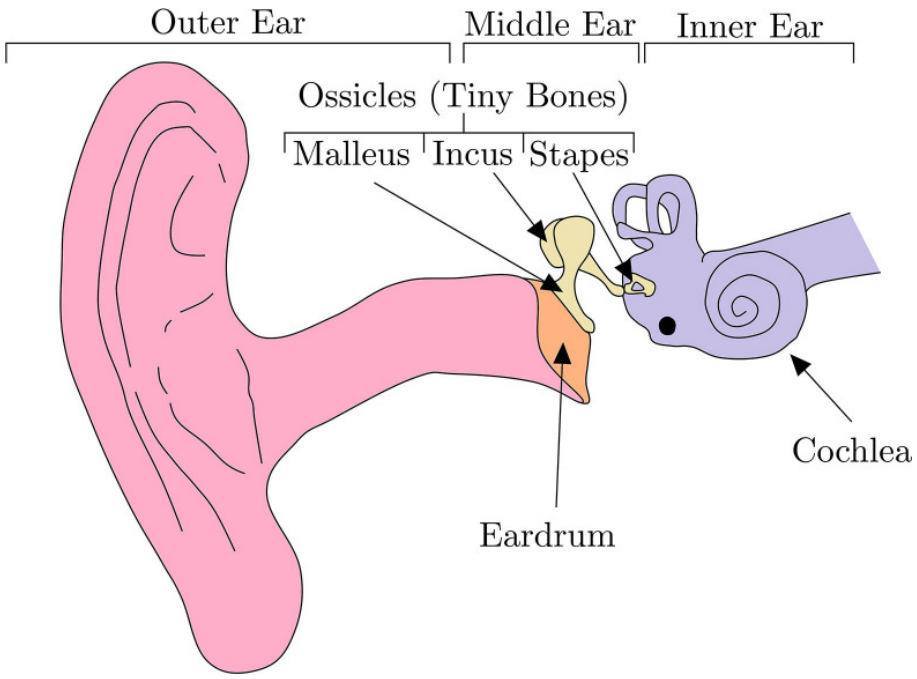

Figure 1

Structure of the human ear. Structure of the human ear. The outer ear is the part you can see on the outside of your head—it ends at the tympanic membrane (eardrum). The middle ear consists of small bones called ossicles that transfer vibrations at the eardrum to the cochlea. The cochlea is the main part of the inner ear and it converts vibrations to nerve firings that our brain understands as sound.

The human ear is made up of three different parts, the outer ear, the middle ear, and the inner ear (Figure 1). When something vibrates, air molecules travel through the air as sound waves. Sound waves are detected by our ears, which convert the waves into electrical pulses that travel to our brains. Sound arriving at the outer ear causes vibration of a small piece of skin-like tissue called the tympanic membrane (also known as the eardrum). The tympanic membrane is connected to a set of three small bones, the ossicles, that make up the middle ear. These bones allow vibrations in the eardrum to act on a tiny organ in the inner ear called the cochlea. The changing pressure in the cochlea caused by these vibrations is then sent to the brain in the form of nerve signals.

PITCH

Allows to judge sounds as "high" and "low."

INTENSITY

The energy carried in sound waves.

Our brains figure out what these nerve signals mean. We can distinguish between the various parts of a sound, such as the **pitch** (how high or low the sound is) and the **intensity** (how loud or quiet the sound is). We are most likely to notice sounds that change in intensity and pitch. A siren is a good example of a sound that has been designed with this in mind, to get our attention.

WHEN DOES SOUND TURN INTO NOISE?

The simplest definition of noise is any sound that we do not want to hear, often sounds we find annoying or disturbing. This definition makes it immediately clear that noise is a somewhat individual judgment, and one that depends on context. For example, your favorite music might sound lovely to you, but might feel like noise to

someone else. Even if the other person normally likes the same bands as you, they might perceive your music as noise if you play it very loudly late at night when they are trying to sleep!

Scientists divide noise into three main groups, or categories. These categories make it easier to identify which types of noise affect us the most (Figure 2). **Continuous noise** is the type of noise that occurs without interruption, such as the noise produced by machinery, a fan running non-stop, or a gently crackling fire. As the intensity and pitch of sound remain basically the same, our brains tend to adapt and become less sensitive to continuous noise. As we will discuss later, this type of noise may sometimes be beneficial. **Intermittent noise** often includes fast changes in the noise level, such as an aircraft or a single vehicle driving by in a normally quiet area. This change in noise level tends to trigger the brain and can potentially disturb or even annoy us [2]. **Impulsive noise** is characterized by a sharp and sudden increase in noise level, such as that caused by fireworks or an explosion. Experiments have shown that this type of noise can cause us the greatest annoyance [2].

CONTINUOUS NOISE

Remains constant and stable over a given time period.

INTERMITTENT NOISE

Stops and starts rapidly.

IMPULSIVE NOISE

Rapid and loud noise of short duration 7.

NOISE POLLUTION AND OUR HEALTH

If we do not want to see something, we can close our eyes. But unfortunately, we cannot close our ears! This makes it difficult to protect ourselves from unwanted sounds. People living in large cities are bombarded with noise from road traffic, passing aircraft, sirens, construction, and general human activity. Unwanted sounds like these are often called **noise pollution**. Through many years of research, scientists have learned that long-term exposure to noise can make us unwell. It can increase our stress levels and reduce our ability to concentrate and communicate. Noise disturbance also affects how well we sleep, which can lead to more serious problems such as heart failure or stroke [3].

NOISE POLLUTION

Regular experience of noise levels that can be harmful for humans or other living organisms.

To attempt to address these problems, scientists and engineers have come up with recommended noise targets for different types of buildings, including our homes, hospitals, schools, and workspaces. With the help of these targets, acoustic engineers aim to design buildings that are pleasant to be in. Their acoustic design protects us from too much harmful noise.

Although our buildings are generally designed to protect us from external noise, what about noise that is actually generated indoors? When does this indoor noise become a serious issue?

Figure 2

The three main types of noise: **(A)** continuous, **(B)** intermittent, and **(C)** impulsive. Note that each of the plots shows a plot of variation in the noise level over time. This reflects the natural variation in the background noise level that occurs in real life.

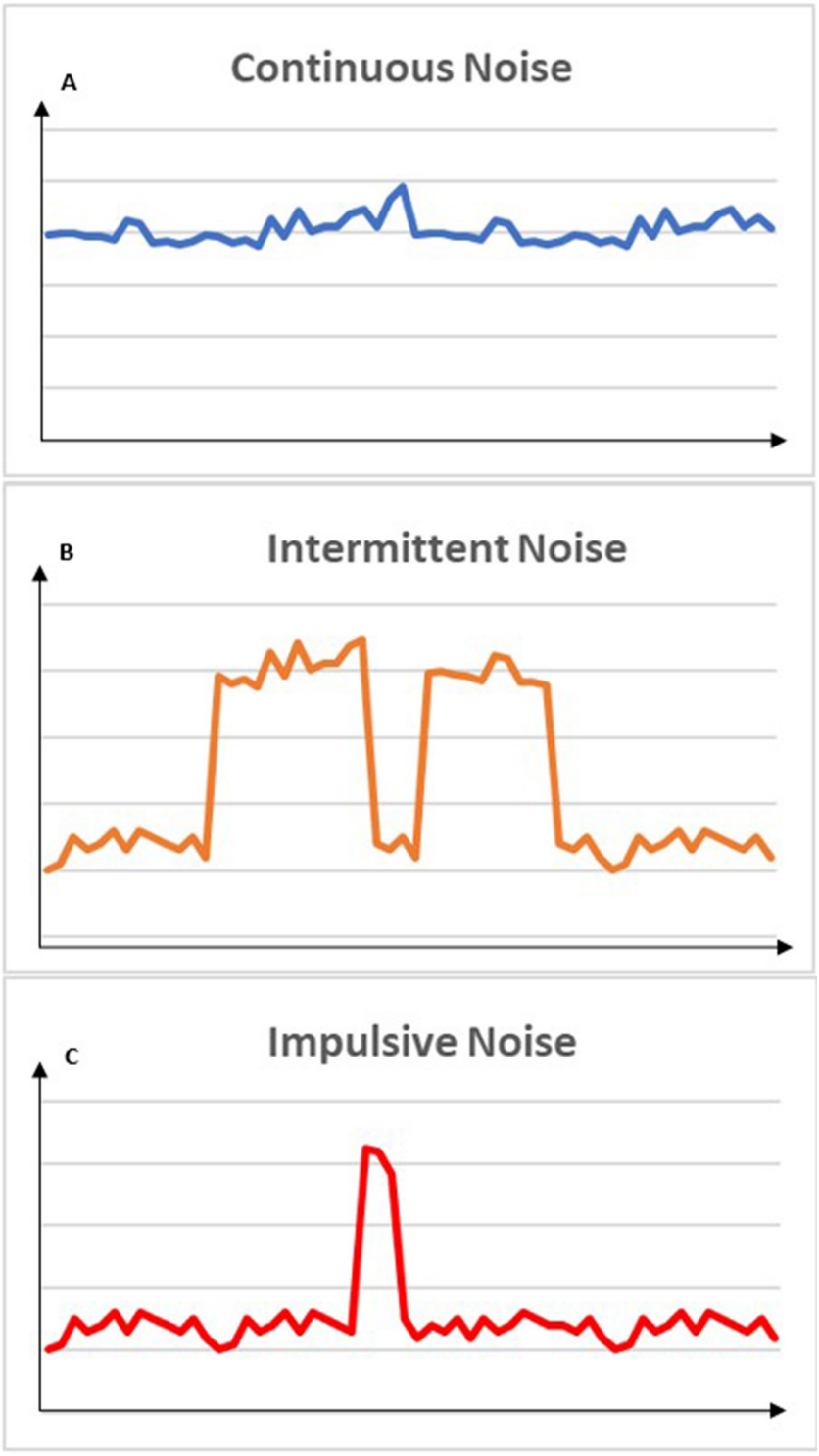

Figure 2

NOISE IN HOSPITALS

Hospitals are typically occupied by the most vulnerable groups of people, such as the elderly, sick people, or people with physical disabilities. These groups are often less able to cope with stress than healthy people are. Evidence suggests that people recover

better in a peaceful and relaxing atmosphere, so it would be natural to assume that hospital buildings are good at ensuring noise is kept to a minimum [4]. However, sound scientists have discovered that the noise generated from everyday activities in hospitals far exceeds recommended levels. General patient noise, visitor and staff conversations, medical equipment, alarms, televisions, trolleys, phones, and doors all create a highly noisy environment that is difficult to control.

Despite the attempts of many hospitals to reduce noise levels with "quiet please" signs, patients are often exposed to various types of noises at random hours, including at night. In some cases, the noise levels in some hospital rooms are similar to very loud music through headphones and are almost loud enough to damage patients' hearing! As a result of these disruptions, 40% of hospital patients in the United Kingdom have reported that they found it difficult to sleep, which made them feel annoyed and stressed [5]. This means that noise in hospitals can make people who are already sick even sicker, which means they take longer to recover. However, this does not need to be the case. There are methods that can be used to reduce unnecessary noise in hospitals and protect patients' health.

WHAT CAN BE DONE?

Noise can be controlled in three main ways. We can control noise at its source—the place it comes from. Or we can control the noise as it travels—on its path (through the air, for example). Finally, we can control noise where it is received by our ears (Figure 3). Although controlling noise at its source is often considered to be the most desirable, it may not always be possible.

When we think about the problem of noisy hospitals, there are several possible approaches that could be used to protect patients from noise. To control noise at the source level, hospitals could provide training to staff to keep noise low, and they could inform patients and visitors of the importance of being quiet. Hospitals could also avoid unnecessary noise by ensuring hospital equipment, such as trolleys, beds, and doors, is kept in good condition. To control noise at the path level, hospitals could use sound-absorbing panels in patient rooms. They could also use loudspeakers in the ceiling to produce constant background noise, similar to the continuous noise discussed earlier. This type of noise can help patients to be less disturbed by other noise sources. This process is often called **sound masking** [5]. Finally, to control noise at the receiver level, hospitals could give patients earplugs to help minimize disturbance and allow them to sleep further away from noisier areas, such as reception.

SOUND MASKING

Is the generation of certain sounds to cover or partially cover other sounds

Figure 3

Noise can be controlled at three basic levels: at the source of the noise, as the noise travels along its path, and at the level of the receiver—the person who hears the noise.

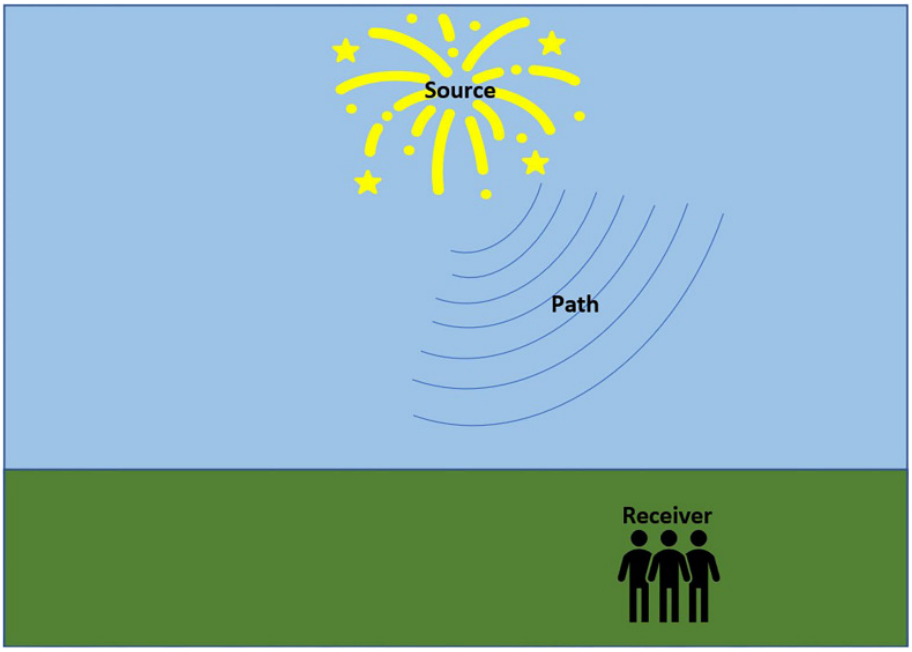

Figure 3

CONCLUSION

Our ability to hear allows us to communicate with one another, to listen to our favorite music, and to protect ourselves from danger. But too much noise pollution is very harmful for our health. Many patients in our hospitals find it hard to sleep because of high noise levels, which can increase the length of time it takes for them to recover. While there are ways to help reduce the impact of noise in our world, there is a lot more to be done to deal with the issue. We hope that, as our world and technology develop, new ways of controlling noise will be invented to help us protect ourselves and others from the harmful effects of noise pollution.

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Our Guides work together as a unit or as small groups and decide together what to do within meetings. Guides support each other to have fun, make friends, go on adventures and try new things. Guides is a chance to make a difference and they are encouraged to speak out about what matters to them and to do something about it. With this in mind, they were keen to make a difference for anybody staying within a hospital environment.

AUTHORS

GEORGIOS CHATZILAMPRI

I am a senior acoustic engineer in the Institute of Acoustics (MIOA). I graduated with a bachelor of science in sound engineering, from Southampton Solent University, United Kingdom in 2015. Then I studied at the Institute of Acoustics and received a diploma in noise and vibration control. After graduation, I started working as an engineer in the field of acoustics. Since then, I have been exposed to a broad spectrum of acoustic consultancy and engineering, entailing most sectors in the field, including residential, industrial, healthcare, education, construction, and workspace schemes. *george_hadjilambri@hotmail.com

FRANK STEVENS

I am an associate lecturer in audio and music technology at the University of York, where I work in the Department of Electronic Engineering. I teach electronics, acoustics, psychoacoustics, and digital signal processing for music

technology. Following my undergraduate degree in electronic engineering with music technology systems, I completed a Ph.D., in which I investigated methods for the measurement, modelling, and evaluation of environmental sound. Following my Ph.D., I studied the impact of noise in hospital wards on health and wellbeing. *frank.stevens@york.ac.uk