

ARE AMBULANCE DRIVERS EXPOSED TO LOUD SIREN NOISE WITHIN THEIR AMBULANCES? IDENTIFYING THE RISKS INVOLVED

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ABSTRACT

Objective: To identify the risk to the ambulance drivers from the siren systems of their rescue vehicles.

Methods: This was a cross sectional study and carried out at two rescue centres, namely, Gulberg and Johar Town areas of Lahore, where the ambulances were parked. A sound pressure meter was used to measure the sound intensity inside and in the vicinity of the ambulance in use. This was done in two centers in Lahore in 10 vehicles.

Results: It was evident that the ambulance drivers are constantly exposed to unsuitable and noxious levels of noise which can over time damage their hearing. A recommendation is contributed regarding hearing assessment for ambulance drivers and their compulsory periodical hearing assessment.

Conclusion: The sirens in the Pakistani ambulances have almost the same sound intensity levels as the ones abroad which can have a damaging effect on the inner ear. Pakistani ambulance drivers should wear ear protection while in their vehicles to protect against ear damage.

Key words: Noise, Occupational Exposure

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INTRODUCTION:

This study sets out to identify any risk from the noise generated by the siren system to the regular user of an emergency vehicle in Lahore. Ambulances worldwide have various siren systems mounted on top but most end up producing sounds which can be injurious to the cochlea especially if allowed to be exposed for an extended period of time¹.

It seems that vehicle siren location makes a difference in the sound pressure level inside the ambulance cabin as well. In a study looking at various

locations where the siren was mounted concluded that the ones placed on the roof had the most potential to damage the person (79dBA) in the cabin as compared to when it is mounted either on the front bumper (71 dBA) or the front wheel arch (72dBA)¹.

According to some studies, although the levels are below the recommended 85dBA levels, it was observed that the paramedics still had communication difficulties if the sirens were mounted on the roof of the vehicle.

There are several characteristics the experts who select and install the sirens take into consideration. The obvious one is loudness which should be of sufficient loudness so that it serves its purpose especially on busy roads and intersections². Secondly, in a busy urban setting there are several acoustic stimuli at work of various intensities and frequencies, an effective alerting siren should be able to have sufficient ‘masking’ effect to overcome the noises in the vicinity of the ambulance from passengers in a car, fans, audio and wind³.

Thirdly, a rapid rise in pitch of the siren sound is most effective for alertness of its surrounding people and vehicles. There is also recommended a ‘rapid recycling time’. Occupational noise induced hearing loss which can be complete or partial and in both or either ears, results due to one’s profession or occupation. Why it is important to identify the possible risk of damage is because it is wholly preventable. The disability resulting from occupational noise shows a wide range from 7 to 21% and effects adversely more if the victim is a male and resides in the developed world⁴.

METHODS:

The device used for this study was the NEDA 1604 IEC. The device used was properly calibrated and standardized before use. The meter sensor was protected by a wind filter to cancel any sound produced by wind or a breeze.

The sirens under investigation were customarily mounted on top of the vehicle cabin. The siren had two settings of “low” and “high”. However, the rescue staff responsible for the switching on the siren admitted using the ‘high’ setting levels as a norm. The rescue personnel described vehicles as ambulances, water rescue vehicles and specialized vehicles. The sirens attached were however identical in almost all vehicles.

The time to measure the sirens was chosen as the peak school off time so that there is maximum traffic on the roads at the time. This was around 2 PM in the afternoon. For this study the Gulberg and the Johar Town areas of Lahore were selected. The selection was not out of any special reason but was convenient to the author for measurements of the sirens. Simultaneous measurements were taken both inside and outside the vehicle while the siren was sounded at “low” and then the “high” settings. The sound pressure level was measured outside the vehicle at a distance of 2 meters. Rescue workers have a 10 hour shift in which they might have 3 to 4 call outs for an emergency for which the sirens are used. The distances thus travelled are varied depending on the site of the casualty. Similarly the noise exposure time is varied as well but the intensity remains the same as long as the sirens are switched on.

RESULTS:

Table 1 shows the sound pressure readings measured in dBA scale inside and outside the vehicle during the siren set at “low” and then the “high” setting. Sound pressure levels were measured inside as well as outside the vehicle at the same occasion but in successions. The measured sound pressure levels were consistently high inside and outside the vehicle. These were 71.1 dBA

and 92.8dBA inside the vehicle cabin and 94.8dBA and 102.9dBA outside the vehicle at the “low” and “high” settings respectively. It is clear from the above measurement levels and the routine selection of the siren intensity switching practices of the ambulance drivers (“high”) that they will be exposed to a high level of sound intensity on a regular basis, which is on average of 92.8 dBA. However, bystanders are at risk as well if they are exposed to 102.9 dBA as shown in table 1.

Table 1: Sound pressure readings measured in dBA scale inside and outside the vehicle during the siren set at “low” and then the “high” setting.

Sound pressure levels dBA	Inside the vehicle cabin low	Inside the vehicle cabin high	Outside the vehicle cabin low	Outside the vehicle cabin high
1	65	95	95	104
2	68	90	92	104
3	66	85	80	103
4	83	95	98	104
5	88	95	104	104
6	67	88	97	100
7	69	96	98	105
8	70	98	98	105
9	68	96	98	102
10	67	90	88	98
Average	71.1	92.8	94.8	102.9

DISCUSSION:

It is important to understand the concept of a decibel, which expresses the level of the sound. The zero decibel is the level at which the human ear hears a very quiet sound. As the decibels increase in numerical quantity the sound intensity which hits the ear increases so that after every 3 decibels the sound intensity increases by a double. So, for example if a dish washer makes a sound of 75dB and an ordinary fridge 40dB, the 75dB sound will be four times what the fridge makes giving a 100 times more acoustic intensity⁵. In the UK, the allowable sound exposure is limited to 8 hours of a 85dBA noise on a daily basis, this will be a maximum noise at a peak sound pressure that one is allowed to be exposed to on a daily basis. In the Pakistani ambulances examined the sirens are usually set at the “high” setting which means that the rescuers are exposed to sound pressure levels on an average of 92.8dBA even inside the vehicle.

In the present study these recorded noise values are in general in agreement with previous studies outside Pakistan where the values recorded were 79 to 80 dB(A) 7, and (84–96 dB (A) ⁸. In the US

Ambulances as well the noise levels during the use of the siren were found to be intense (mean of 102.5) as well whereas the allowed level according to the Occupational Safety and Health Administration's suggested guidelines is 90 dBA⁹. In the UK the ambulances have a louder, more powerful siren system which gives a sound pressure level of 115dBA and exposure to this is strongly cautioned against a prolonged exposure. The exposure to this sound pressure level is only allowed up to 33 seconds only¹⁰. In New Zealand as well the sound pressure levels that the sirens generate during emergency services are around 110dB but they may increase to 110 or 120dBA in some studies and may increase to 110 to 120 dBA in some studies¹¹. It is evident from the data collected from the Pakistani ambulances that an exposure of almost 103 dBA on average can pose serious risks for the ambulance drivers who would presumably have at least an hour long round trip from a single call out emergency. The time allowed for exposure at 103 dBA in a 24 hour exposure is only 7.5 minutes¹².

The ambulance drivers are exposed to on average 92.8 dBA of sound pressure levels inside the ambulance cabin. The maximum acceptable noise exposure level is 85 decibels over eight hours (a typical working day)¹³. The rescue vehicles used in the Western world are superior in construction as compared to the ones in Pakistan and their cabins are better noise insulated as compared to Pakistani vehicles. That is why in spite of higher intensity siren noise levels of 110 dBA or more, the rescuer inside is better shielded from the noise exposure than Pakistani ambulances. The siren system uses either the Yelp or the wail system or a variation of these. Wail is a gradual increase and decrease in pitch. Yelp is a much more rapid increase and decrease in pitch. Some manufacturers have created additional devices that process the siren sound and amplify it at a few octaves lower that can penetrate and be felt in the cars where the plain siren is not. One of these devices is the Howler system.

The Howler system adds a very short eight second penetrating burst of a low frequency siren sound for use in heavy traffic, intersections or other high ambient noise conditions¹⁴. This sound is sharp to the ear and can be damaging to the cochlea. Thus a "sustained periodic exposure to loud sounds can cause hearing loss"- This caution comes from the Howler system manual itself. It further adds, CAUTION: Loud siren noise can cause hearing damage and/or loss. Refer to OSHA Section 1910.95 prior to putting ANY siren into service! Wear Protection! "

Thus it is evident that a loud sharp burst of the Howler system is clearly damaging to the ear and that's why comes with a vivid caution¹⁵.

Noise induced hearing loss (NIHL), as in a exposure to the ambulance siren can be caused by a one-time exposure to an intense "impulse" sound, such as an explosion, or by continuous exposure to loud sounds over an extended period of time, such as noise generated by an ambulance siren. A Continuous noise exposure throughout the working day and over years is more damaging than interrupted exposure to noise, which gives the ear some rest for recovery¹⁶. In exposure to noise, two aspects have to be kept in consideration. One is the volume of noise exposed to in terms of the Intensity of the noise and the second is the time for which one is exposed to this intensity level.

In the UK, the allowable levels are up to 85dBA for 8 hours in a day. The Occupational Safety and Health Administration (OSHA) of the US allows levels of noise exposure at 85 dB for an 8-hour time weighted average exposure time as well. However, there is evidence that noise exposure from 80 to 85 dB may contribute to hearing loss in individuals who are unusually susceptible to its ill effects. The risk of ear damage increases with long-term noise exposures above 80 dB and but the increase is significant as exposures rise above 85 dB¹⁷⁻¹⁸. It is evident from the above discussion that the person who is exposed to this sustained loud noise is bound to damage his or her hearing. In addition to auditory effects there can be non-auditory effects such as of a psychological dimension. But this should be elucidated in another study¹⁹. However, these effects may not be entirely the same and will depend on the Individuals susceptibility to the auditory effects of noise. There is a wide variability in this respect²⁰.

Studies have demonstrated direct damage to the cochlear hair cells. It is seen that the high frequency area of the cochlea is often damaged by loud sound more readily²¹. However, this is not the only area which can be damaged, although it is the most common one to be involved. It is evident from studies that even low frequency sounds can cause hair cell injury. This damage may be in the form of endolymphatic hydrops²². It is also seen that a central element in the control of Outer hair cells stiffness are the calcium ions²³. Thus, low-frequency sounds affect the active micromechanics in the human inner ear and the exposure to low frequency tones induces alterations in the calcium homeostasis in the outer hair cells and thus cell damage and hearing loss results²⁴. The hair cells in the cochlea can be damaged by 30% to 50% before changes in the hearing can be measured by a hearing

test. Therefore it is of paramount importance that the ambulance drivers get regular periodic checks regarding their hearing and a proper record kept. It is important for them to wear ear protection in the form of at least ear plugs while on service²⁵.

CONCLUSION:

The sirens in the Pakistani ambulances have almost the same sound intensity levels as the ones abroad except for the Howler system which is activated in foreign ambulances for an added sharp burst of sound for higher alertness. This increases the damaging effect to the inner ear. Pakistani ambulance drivers should wear ear protection while in their vehicles to protect against ear damage.

ETHICAL APPROVAL

The study was approved from Ethical Review Committee of Doctors Hospital & Medical Centre, Lahore, Pakistan.

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AUTHORS' CONTRIBUTION:

SA: Concept, Manuscript writing

MA: Manuscript writing

BH, FTK: Data Collection

LY, AM: Introduction