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Earthquake-Prone Cities

David Sharp

The recording of earthquakes as they happen is well established, and the US Geological Survey provides almost instantaneous access to the data. On average, there are about four earthquakes with a Richter rating of 5 or more every day worldwide and many more less powerful ones. The public's reactions to such incidents will depend on the site as well as on the strength: an event that was trivial seismologically speaking and hardly strong enough to rattle the crockery in homes away from the epicenter became headline news in the UK in 2008 while those close to one of the world's major fault lines are well used to life with tremors. Not all earthquakes are catastrophes. In the country that hosts the San Andreas Fault, earthquakes have little impact on total mortality figures. Official US statistics for 1979–2004 covering over 21,000 deaths associated with natural events showed that three quarters were due to extremes of heat or cold.[1] With predicted climate change, the future league table of natural disaster is likely to remain dominated by the burden of temperature extremes, storms, droughts, and floods rather than angry clashes between neighboring geological structures.[2] Nonetheless, the earthquake tragedy around the Italian city of L'Aquila earlier this year is a reminder that not all natural disasters can be blamed on man's carbon footprint. Sadly, there are too many parts of the world that need no such reminders, and often they are countries less able economically to tackle the sometimes appalling consequences.

Although earthquakes can be recorded accurately, they cannot yet be foreseen reliably. In 1975, the northeastern Chinese city of Haicheng was evacuated before an earthquake struck. Changes in land elevation, ground-water levels, and animal behavior together with foreshocks had hinted at a forthcoming disaster. More than 2,000 people did die, but the death toll would have been far higher in the absence of a warning. The following year, however, there were no such signs when the unforeseen earthquake in Tangshan killed 250,000. The earthquake near Kobe in 1995 was unexpected too, even though the Japanese government has long been a strong supporter of research into warning technology. The earthquake prediction in Parkfield, California for 1988 give or take a few years[3] was not fulfilled. Research continues. For example, on the anniversary of last year's terrible earthquake in Sichuan(Wenchuan), the Chinese authorities announced the establishment of over 2,000 fixed and 5,000 mobile seismic monitors,[4] while the San Andreas Fault Observatory at Depth now has devices at sites drilled 2–3 km down into this notorious geological formation.[5]

Perhaps nowhere on earth is completely earthquake-free, but the areas of greatest risk are well charted. Unfortunately, human settlements (villages, towns, cities, and even megacities) have long been established in these very same areas. A list of the world's 20 most earthquake-vulnerable cities contains only three

Correspondence: David Sharp, 2 Iron Mills, Minchinhampton, GL6 9AL, UK. (E-mail: david744 sharp@btinternet.com)
Sharp is a freelance writer in Minchinhampton, UK.

locations, all Japanese, that are in an industrialized or developed country.[6] The US Geological Survey's catalog of earthquakes associated with 50,000 deaths or more since 1900 carries a similar message.[7] Furthermore, epidemiological studies suggest that it is the poorer sections of city populations that suffer most when an earthquake hits.[8,9] A United Nations report noted that "Over the past 25 years, 1 billion people were added to the population of cities of developing countries, a disproportionate number of which are prone to earthquakes," adding that these cities' resistance to earthquakes has been declining and that resources tend to be allocated to the aftermath of such events rather than to "mitigation, preparedness and prevention."[10] Since earthquakes themselves cannot be prevented or predicted and since secondary prevention by permanently relocating vast urban populations is hardly practicable, what does mitigation mean here?

Every natural disaster carries lessons for emergency response teams and the emerging specialty of disaster medicine. Dissemination of facts about the type of injury likely to be seen after one earthquake[11] and the psychological sequelae in survivors (the latter can be complex[12]) must help those called in after the next one. Several such studies of the Sichuan disaster in 2008 have already appeared, many in Chinese journals. Hospitals in earthquake-prone cities can do more to prevent damage to equipment.[13] Occasionally, there is a direct link between building technique (surely the most obvious candidate for mitigation) and health care. A relation between type of injury after the Wenchuan earthquake and roofing material has been reported,[14] and anecdotally, the heavy roof tiles crashing down through damaged buildings in Kobe are said to have caused deaths and injuries. However, by and large, mitigation is not a medical issue; it is a matter for architects, engineers, planners, and politicians. Earthquake damage and consequent deaths and injuries often lead to criticism of the design and construction of the buildings that collapsed. In one city, there was much mistrust of authority; victims of an earthquake preferred to stay in the shanty towns they were used to.[15] On the other hand, an office block 100 km away from the San Andreas Fault swayed noticeably in one recent earthquake, but no one was hurt, and there was no damage.[16] Mitigation via the tools of land-use planning and design and construction are well established in the USA and are being developed elsewhere.[17] Furthermore, there are platforms such as GeoHazards International willing to share the technical knowhow. There are few opportunities for clinical epidemiologists to join forces with architects, but more studies attempting to relate specific building faults to specific types of injury might persuade governments to take more notice of earthquake-mitigating design principles.

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