there was an increase in morbidity and length of stay, but there was no significant increase in mortality due to multidrug-resistant (MDR) or extremely drug-resistant gram-negative bacterial infection [3].

India is the largest consumer of antibiotics, but human use accounts for the minority of the total antimicrobial products consumed, with the majority of antibiotics being used as growth enhancers in the feed animal sector [4]. Although there are strict guidelines on nonutilization of important human antibiotics, for example, colistin in the feed animal sector, there is widespread belief and evidence that these are regularly ignored, resulting in increasing transmission of AMR from farms to hospitals. This has put increasing pressure on regulatory authorities to ban the use of antibiotics in the animal section in the hope of saving them for clinical use [5]. This overutilization has been shown to be responsible for increasing AMR.

In India, infections caused by MDR organisms are very frequent, often resulting in mortality due to a paucity of treatment options [6]. To address these issues, the Indian Council of Medical Research initiated a nationwide Antimicrobial Resistance Surveillance and Research Initiative (AMRSRI) in 2016. The aim of AMRSRI is to provide reliable and authentic estimates of AMR burden encompassing local resistance patterns as well as molecular epidemiology of isolates throughout the country as this data will be invaluable in guiding national policy. AMRSRI has subsequently released annual reports that detail the various resistance encountered in clinical isolates nationally [7].

Collectively, Gandra et al’s report on mortality due to AMR is a welcome step to gauge the effect of AMR on mortality rates in India. This issue is projected to cost the global economy $100 trillion and result in 10 million deaths by 2050 [8]. In order to more accurately represent the effect of AMR on mortality, data from AMRSRI and other initiatives should be collated, along with data from private healthcare providers. Additionally, there should be stringent implementation of antibiotic stewardship and infection control programs in the healthcare sector and nonutilization of important human antibiotics in the farm and animal husbandry sector as growth promoters. Research aimed at understanding the genetic and molecular basis of AMR in MDR organisms as well as novel drug discovery and development should be declared a national priority as AMR does not respect international boundaries.

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to differences in infection location and disease severity. Overall mortality in the study of 116 patients by Naim et al. was only 4.3% (in contrast to 13.1% in our study), and none of their patients had bacteremia or lower respiratory tract infections (nearly 90% were from wounds or urine). In our study, the odds of mortality were significantly higher among patients with lower respiratory tract and bloodstream infections when compared with urinary tract and wound infections. Understanding these differences was only possible because of high data availability. Yet, national data are needed to understand the frequency of these infections and to develop national-scale plans to combat the problem of resistance.

While the scale of the problem is national and even global in nature, the outcomes are local. Thus, we further endorse the call by Chopra et al that there needs to be stringent implementation of antimicrobial stewardship and infection control activities to improve patient outcomes; however, greater investments are necessary on a country-wide level [7]. Large investments in training are needed as there are few in India. These investments would likely bring significant returns as interventions by infectious diseases physicians in the United States are associated with improved outcomes and lower costs [8]. Furthermore, because resistance can spread rapidly around the world, greater investments are needed in AMR hot spots, such as India, to help contain and reduce the spread of resistance. In addition, increased investments in novel drug discovery is of significant importance as currently available therapeutic options are not effective against the common resistance mechanisms encountered in extremely drug-resistant bacteria in India.

Notes

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Cerebral herniation after lumbar puncture

To the Editor—In their recent article, Costerus and colleagues [1] conclude that cerebral herniation after lumbar puncture (LP) is a rare event, giving a frequency range of 0.1–3%. However, in the context of adverse drug reactions to medicinal products European Commission guidance considers this level of risk to be uncommon (0.1% to 1%) or even common (1% to 10%); rare would typically be defined as 0.01% to 0.1% [2]. Furthermore, the severity of the adverse reaction, in this case death, needs to be considered. Most doctors and patients would be concerned by a risk of death of up to 3 in 100 procedures and would likely choose not to proceed.

Although LP is an important investigation in patients with suspected bacterial meningitis, given the risk of undertaking an LP in this patient group it is valuable to consider the role of other less invasive diagnostic tests that may complement data from LP or confirm a microbiological diagnosis in patients where LP is contraindicated.

UK and European guidelines on bacterial meningitis stress the importance of blood cultures, which can be positive in up to 74% of patients if samples are taken prior to commencing antibiotics [3, 4]. Too often, this simple procedure is not performed, and this represents a missed opportunity to confirm the bacterial etiology: Shallcross and colleagues found that of 4357 patients attending the emergency department who received parenteral antibiotics, less than a third had blood cultures taken [5].

Of newer molecular tests, polymerase chain reaction of peripheral blood for Neisseria meningitidis has been shown to have high sensitivity and specificity for detection of meningococcal infection [6] and remains positive for up to 5 days after initiation of parenteral antibiotics [7]. Urinary pneumococcal antigen has been assessed for the diagnosis of pneumococcal meningitis. Although