

pre-eclampsia and eclampsia. Studies have been done on calcium supplementation and low-dose aspirin as preventive measures in pregnancy,<sup>8-10</sup> but evidence on effectiveness and on which interventions can be delivered at various levels of the health system is not always clear.<sup>8</sup> The Collaborative E trial (Magpie) provided evidence that magnesium sulphate should be the treatment of choice for preventing eclamptic seizures or their recurrence, and should be used in preference to diazepam, phenytoin, and a lytic cocktail. The Magpie trial also showed that magnesium sulphate halves eclampsia risk after pre-eclampsia, and probably reduces the risk of maternal death.<sup>11</sup>

In addition to the limitations noted by the investigators, it is important to recognise that the PIERS prediction is only useful if the health system and the community in which the woman lives have appropriate and sufficient transportation and referral systems, and the capacity to administer drugs (magnesium sulphate, antihypertensive drugs), induce labour, and provide postpartum care. We urge the maternal and neonatal health community to consider the study in the context of the large continuum of interventions that need to be in place. Recently, synergies and connections between the maternal and neonatal health fields have been emphasised.<sup>12</sup> Hypertension in pregnancy and pre-eclampsia challenge the public health community because of the need to simultaneously protect the mother and baby, and to balance sometimes competing needs to bring forward or delay the end of the pregnancy. This study focuses mainly on maternal outcomes but also has implications for neonatal health. Hypertension in pregnancy and pre-eclampsia are conditions that call for further collaboration between maternal and neonatal health experts.

We applaud von Dadelszen and colleagues in their efforts to validate the fullPIERS model and thereby

advance future treatments and interventions. We hope that this new knowledge will be translated into effective and immediate action and further adapted and validated for use in low-income and middle-income countries, and thus used to its greatest advantage to save the lives of mothers and babies.

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## Health-care-associated infections in developing countries

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Health-care-associated infections in developing countries are a serious issue that is scarcely addressed in the scientific literature. Hence, the systematic review and meta-analysis in *The Lancet* by Benedetta Allegranzi and colleagues from WHO, which assessed the epidemiology of health-care-associated infections, is impressive.<sup>1</sup>

In this study, the investigators analysed pooled data from 220 selected publications from 1995 to 2008, including data from the Americas (22%), Europe (20%), southeast Asia (16%), the eastern Mediterranean (8%), Africa (5%), and other regions (29%). The prevalence of health-care-associated infections in developing

countries was found to be 15.5 per 100 patients, at least double the rates published by the European Centre for Disease Prevention and Control.<sup>2</sup> The incidence of health-care-associated infections acquired in intensive-care units from developing countries was 34.2 per 1000 patient-days, triple the rates in the USA.<sup>3</sup>

Allegranzi and colleagues' study showed that critically ill patients admitted to hospital in low-income countries had at least double the device-associated health-care-associated infection rates of patients in industrialised countries.<sup>4</sup> Similar to the US Centers for Disease Control and Prevention National Healthcare Safety Network (CDC/NHSN) report, some of these data were presented as rates per 1000 device-days—ie, central line-associated bloodstream infections, ventilator-associated pneumonia, and catheter-associated urinary tract infection. This uniform format is especially valuable to allow benchmarking and comparisons. The International Nosocomial Infection Control Consortium (INICC) is a multinational research network established in 2002 to standardise surveillance and control of health-care-associated infections in hospitals in developing countries,<sup>5</sup> and is one of the main sources of data on device-associated infections reported in the accompanying review. 79% of the included studies showed rates of central line-associated bloodstream infection per 1000 device-days; 80% showed rates of catheter-associated urinary tract infection per 1000 device-days, and 71% showed rates of ventilator-associated pneumonia per 1000 device-days. In the most recent INICC report,<sup>6</sup> published in March, 2010, device-associated health-care-associated infection rates from 25 developing countries were substantially higher in INICC intensive-care units than CDC/NHSN rates from the USA; the pooled rate of central line-associated bloodstream infection in the INICC intensive-care units, 7.6 per 1000 device-days, is nearly triple the 2.0 per 1000 device-days reported from comparable US intensive-care units. The overall rate of ventilator-associated pneumonia was also much higher (13.6 vs 3.3 per 1000 ventilator-days), as was the rate of catheter-associated urinary-tract infection (6.3 vs 3.3 per 1000 catheter-days).<sup>6</sup>

The occurrence of health-care-associated infection in developing countries implies higher mortality rates,<sup>7-11</sup> prolonged hospital stays,<sup>7,8,12-15</sup> excess costs,<sup>7,12,14,16</sup> increased microorganism resistance to antimicrobials,<sup>6</sup> and other adverse consequences. Therefore, data for these harmful

consequences in developing countries are indispensable. Among the few published data for these burdens in developing countries, the INICC data show that the cost of central line-associated bloodstream infection is around US\$5000 in Argentina,<sup>7</sup> and around \$12 000 in Mexico,<sup>14</sup> and that the cost of ventilator-associated pneumonia is around \$2500 in Argentina.<sup>12</sup> Additionally, by applying a novel time-dependent analysis methodology, INICC reported that the length of stay of patients with a central line-associated bloodstream infection is fewer than 5 extra days.<sup>13</sup>

Allegranzi and colleagues listed determinants of the burden posed by health-care-associated infections in developing countries: inadequate environmental hygienic conditions, poor infrastructure, insufficient equipment, understaffing, overcrowding, little knowledge and application of basic infection-control measures, prolonged and inappropriate use of invasive devices and antibiotics, lack of local and national policies, low hygiene compliance, and reuse of equipment (including needles and gloves). Specific risk factors for central line-associated bloodstream infections have recently been analysed,<sup>17</sup> including use of femoral central line (in 9% of patients, instead of 0% [the ideal use of a particular intervention to significantly reduce health-care-associated infections]), lack of insertion site dressing (12–32%, instead of 0%), intravenous container vented with a needle (36–63%, instead of 0%), use of a three-way stopcock (88–94%, instead of 0%), chlorhexidine sponge dressing (2–8%, instead of 100%),



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cutaneous antisepsis with chlorhexidine (7–27%, instead of 100%), sterile dressing in good condition (81–82%, instead of 100%), and administration set replaced every 72–96 h (18–50%, instead of 100%). A review of central line-associated bloodstream infections in developing countries also noted the following important determinants: insufficient rooms for isolation, lack of general medical supplies, and serious misapplication of infection-control measures, such as use of antiseptic-impregnated cotton balls from a contaminated container.<sup>18</sup>

Some of the limitations acknowledged by Allegranzi and colleagues should be mentioned. First, most of the papers in *The Lancet* review confirm use of the standard CDC/NHSN definitions to categorise device-associated health-care-associated infections; however, the probability of accurate data collection with high sensitivity and specificity is highly variable if surveillance is undertaken in different settings without a standardised case report form, and without external auditing and validation to ensure consistent application of NHSN methodology. Second, although I consider it important to use data for microorganism profile pooled by the WHO team, the fact that only 28 articles were included, showing around 5000 microorganisms, might make the information unrepresentative. Third, the article included very few studies reporting data for bacterial resistance, information that, I believe, is greatly needed to find causes and solutions to this global public health problem. Finally, a similar limitation is noted in the reported data for surgical site infection. Most of the articles about surgical site infection do not include nationwide data, and although they were the most frequently quoted throughout the review (57/101, 56.4%, from 24 countries), they represented just 16% of the developing world (24/147 developing countries), which might not be representative of all developing countries.

I firmly believe that Allegranzi and colleagues' study will be extensively discussed in coming years, because regional and international benchmarking data from developed and developing countries are essential to further advance the prevention of health-care-associated infection, by enabling health-care workers and researchers to make accurate and useful comparisons and increase their awareness of this affliction.

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