Hospital of Marseille (a 3800-bed hospital),[2] as well as all deaths that occur each week in our hospitals (between 50 and 70 deaths) in patients with a positive bacterial isolate in any kind of microbiological sample in the preceding months. From these patients, we look for 30-day attributable mortality per multidrug-resistant bacteria and any infection site of these patients.[4] In practice, we have only reported one case of a bacterium resistant to all antibiotics tested within the last 5 years, associated with a death in intensive care unit (ICU), probably for multifactorial reasons.[4,5]

Because of this large discrepancy between estimation and real deaths, we asked an ICU doctor (ML) associated with our research unit to conduct a short survey within Société Française d'Anesthésie et de Réanimation (the French Society of Anaesthesia and Intensive Care Medicine, which comprises more than 350 ICU practitioners and anaesthetists in France) on their practice over the past 10 years. Participants were asked if they had dealt with patient deaths directly linked to an antibiotic therapeutic impasse despite treatment adjusted to antibiotic susceptibility test results. Among the 251 respondents, 116 (46%) had seen no cases of death and 106 (42%) had seen between one and five cases over the past 10 years. Thus, among 222 (88%) of the 251 participants with more than 10 years of experience, there were probably around 45 deaths per year (IQR 22–73, calculated from the median of responses) due to an antibiotic therapeutic impasse.

In France, the mortality of patients hospitalised in ICUs is around 19% (26 600 of 140 000 patients). This reflects the risk of drift without verifying and counting the number of real deaths. In France, the 2015 BURDEN study reported an estimated 12 500 deaths per year in France due to antibiotic resistance,[6] whereas the number of deaths due to bacterial infections in all French hospitals is less than 29 000 per year. The model used in the BURDEN study predicted a number of deaths per year that is more than two times higher than the number (5543 deaths) predicted by the model used by Cassini and collegaues.[1] In fact, Cassini and colleagues' report does not represent true data on number of deaths. Mathematical models for estimation of deaths are disconnected from the reality of clinical practice of hospital doctors and clinical microbiologists, who look daily for deaths and antibiotic resistance. In practice, we believe that it is becoming essential to create a national account register recording the true instances of deaths related to the presence of a bacterium in a pathogenic situation resistant to all antibiotics available. This is crucial to obtain a reasonable understanding of mortality due to antibiotic resistance, which cannot be acquired by unrealistic estimations using inappropriate mathematical models based on extrapolation of multiple and non-controlled studies.

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Authors' reply

"All models are wrong, but some are useful"—George E P Box[1]

We thank Didier Raoult and colleagues for their comments and agree that large population studies such as our estimation of the health burden of infections with antibiotic-resistant bacteria in the EU and European Economic Area carry frustrating limitations. We acknowledged these limitations in our Article and corresponding appendix,[2] including those limitations that affected estimations of the attributable mortality related to infections with antibiotic-resistant bacteria. In particular, the disease models were based on data retrieved from systematic literature reviews, which varied in availability and quality of evidence. For this reason, evidence was scored according to ad-hoc criteria reflecting the quality of the studies included in the reviews. Most studies were observational, matching cases and controls and following clinical outcomes for 7 or 30 days. The studies that scored the highest were used for extrapolation of the risk difference between cases (infected with antibiotic-resistant bacteria) and controls (non-infected or infected with antibiotic-susceptible bacteria). When other risk factors for death had been controlled for, we found that most studies showed an association between death and infection

with antibiotic-resistant bacteria. However, our study did not stratify for age-specific risks, comorbidities, appropriateness of antibiotic therapy, or type of care.

As an alternative method, Raoult and colleagues did a survey of 250 intensive care unit (ICU) doctors and concluded that around 45 deaths due to an antibiotic therapeutic impasse occurred in ICUs where the specialists interviewed have worked. As this survey is unpublished, we cannot assess its methodology and limitations. Studies based on physicians' self-assessments are inevitably fraught with cognitive biases, especially when there are several competing risks, as is common in modern health care. Over 32 types of cognitive biases affecting physicians have been described,[3] and a systematic review[4] found that at least one cognitive factor or bias was present in all studies.

In Raoult and colleagues' survey, doctors working in ICUs in France were asked to report "deaths directly linked to antibiotic therapeutic impasse despite treatment adjusted to antibiotic susceptibility test results". By contrast, our study was not limited to only ICUs or hospitals, and addressed a wider range of infections with antibiotic-resistant bacteria for which poor outcomes (including death) occur when treatment is not appropriate (ie, when the organism causing the infection is resistant to the antimicrobial used) or adjustment to appropriate treatment is delayed.[5–7]

We agree on the value of large-scale, multi-country, prospective studies to assess attributable mortality, although possible cognitive biases would need to be accounted for. Mathematical modelling applied to infectious diseases has proven useful in analysing the health of large populations.[8] We believe that disease models stemming from available scientific evidence are useful to describe the health effects of infections with antibiotic-resistant bacteria.

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Understanding HIV and hepatitis C virus risk among incarcerated young men with histories of injecting drug use

In their systematic review and meta-analysis, Jack Stone and colleagues[1] found that recent incarceration is associated with substantial increases in risk of HIV and hepatitis C virus acquisition among people who inject drugs. We support the authors' call to minimise the "use of criminal sanctions to manage drug use". Our qualitative data on the lived experience of injecting drug use in prison, collected from 28 young men aged 19–24 years who had been recently released from Australian prisons, highlights the need for greater access to prison-based harm-reduction interventions. Participants were recruited from the Prisoner and Transition Health (PATH) study,[2] the first research globally to examine the post-release trajectories for a cohort of prisoners who were injecting drugs regularly before they were incarcerated. More than 40% of participants continued to inject drugs during their sentence, without access to sterile needles and syringes.

Evidence shows that young male prisoners with histories of injecting drug use are more likely to report injecting in prison, to do so more frequently, and to be involved in riskier injecting-related behaviour (such as sharing needles and syringes) than their older counterparts (aged >25 years).[3] However, few studies have explored the lived experience of injecting drug use of these men in prison. Our study addresses this important gap in the literature. Participant narratives highlighted how the prohibition of sterile injecting equipment in prison led to the manufacture and re-use of a limited supply of homemade injecting equipment. This practice inevitably increased their risk of exposure to and acquisition of blood borne viruses. Our analysis showed that, although effective treatment for hepatitis C is available in Australian prisons, the risk of re-infection in prison continues, as does the risk of onward transmission of the virus to their injecting peers after release.

Substantive evidence in support of needle and syringe programmes to prevent blood-borne virus transmission in the community is definitive.[4] Our findings and those of Stone and colleagues[1] also provide evidence in support of the implementation of prison needle and syringe programmes