Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Is there a terrible issue with bacterial resistance: pro–con

D. Raoult[1] **and M. Paul**[2]

1 *Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes, URMITE CNRS-IRD 198 UMR 6236, Faculté de Médecine, Université de la Méditerranée, Marseille, France and* 2 *Division of Infectious Diseases, Rambam Health Care Campus, Haifa, Israel*

Article published online: 26 March 2016

Corresponding author: D. Raoult, Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes, URMITE CNRS-IRD 198 UMR 6236, Faculté de Médecine, Université de la Méditerranée, Marseille, France
E-mail: didier.raoult@gmail.com

We are observing a major increase in antibiotic resistance of many bacterial species, *Klebsiella pneumoniae* and *Acinetobacter baumannii* in particular [1]. This triggers an alarmist response in major journals in the world, the WHO and the CDC [2]. It is clear that the response of the media and governments to ongoing events is not always rational and often leads to overreactions. Hence, very few of the virus or prion alerts in last 30 years have been confirmed, including bioterrorism, avian flu, 'Mad cow' disease, severe acute respiratory syndrome, Middle East respiratory syndrome, coronavirus and the globalized threat of Ebola which has been predicted since 1976 [3]. In this context, we must carefully appraise alerts on antibiotic resistance to avoid overreacting. Indeed, in the 1970s, the end of the antibiotic era had already been predicted at the time of the emergence of resistance in *Serratia marcescens* [4]. It is important to balance correctly the burden of disease, because this impacts drug development, drug agencies' approval thresholds for new drugs, allocation of research funds and more.

The medical literature draws attention to bacteria becoming resistant but neglects bacteria becoming susceptible. For example *Staphylococcus aureus*, which is perhaps the biggest bacterial killer in developed countries, is less resistant now than 10 years ago in most of the countries worldwide [5], and in Marseille there is three times less methicillin-resistant *S. aureus* now as there was 10 years ago [6]. The sum of bacteria that became less resistant and bacteria that became more resistant in the last 15 years in Marseille does not suggest that the problem of resistance has worsened [6]. Susceptibilities to old antibiotics such as trimethoprim-sulfamethoxazole in *S. aureus* and chloramphenicol or aminoglycosides in Gram-negative bacteria in hospitals is increasing with time in many hospitals. Moreover, community-acquired bacteria such as *Streptococcus pyogenes*, *Streptococcus pneumoniae* and *Haemophilus influenzae* are not more resistant now than they were 20 years ago. There is little evidence that community antibiotic prescribing has played a major role in resistance.

Also a large number of molecules have been abandoned for lack of profitability while retaining full effectiveness and the implementation of a business model that would give new life to old molecules is probably necessary. A systematic evaluation of these molecules alone or in combination can probably answer many of the problems we currently face. For example, in tuberculosis, extensively drug-resistant *Mycobacterium tuberculosis* strains were defined while omitting those molecules that were most likely to be effective—those used to treat leprosy [7].

This theme issue presents two different views; Mical Paul thinks that there is a real problem of resistance while Didier Raoult thinks the opposite. A study carried out by Jean Marc Rolain [6] defends the position that there are no major problems, but the reviews by Patrice Courvalin [1] and Yehuda Carmeli [8] consider that there is a very big problem and finally Fernando Baquero [9] tries to put this in a much more distant perspective as only his experience allows him to do. Overall, we tried for the first time to balance the information between those who believe that there is a problem of resistance and those who think that ecosystem balance has simply shifted. The point on which everyone agrees is that irrational use of antibiotics in human and veterinary health creates an ecosystem change that will surely promote the multiplication of multiresistant bacteria in the environment and in hospitals.

References

[1] Courvalin P. Why is antibiotic resistance a deadly emerging disease? Clin Microbiol Infect 2016;22:405–7.
[2] Raoult D. Alice's living croquet theory. Int J Antimicrob Agents 2016 Apr;47(4):249.
[3] McConnell J, Raoult D. Emerging respiratory viruses: is it 'much ado about nothing'? (Shakespeare). Clin Microbiol Infect 2014;20:187–8.
[4] Yu VL. Serratia marcescens—Historical perspective and clinical review. N Engl J Med 1979;300:887–93.

http://dx.doi.org/10.1016/j.cmi.2016.03.004

[5] Rolain JM, Abat C, Brouqui P, Raoult D. Worldwide decrease in methicillin-resistant *Staphylococcus aureus*: do we understand something? Clin Microbiol Infect 2015;21:515–7.
[6] Rolain JM, Abat C, Jimeno MT, Fournier PE, Raoult D. Do we need new antibiotics? Clin Microbiol Infect 2016;22:408–15.
[7] Brouqui P, Aubry C, Million M, Drancourt M, Raoult D. Totally resistant tuberculosis: will antileprosy drugs be helpful? Int J Antimicrob Agents 2013;42:584–5.
[8] Friedman ND, Temkin E, Carmeli Y. The negative impact of antibiotic resistance. Clin Microbiol Infect 2016;22:416–22.
[9] Rolain JM, Baquero F. The refusal of the society to accept antibiotic toxicity: missing opportunities for therapy of severe infections. Clin Microbiol Infect 2016;22:423–7.