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Shortage of appropriate diagnostics for antimicrobial resistance in Lebanese clinical settings: a crisis amplified by COVID-19 and economic collapse

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Sir,

Antimicrobial resistance (AMR) represents an overwhelming health challenge, particularly in low- and middle-income countries such as Lebanon, which is currently experiencing severe medical and economic crises [1]. Despite the global attention spurred by the tripartite of the World Health Organization (WHO), World Organisation for Animal Health (OIE) and Food and Agriculture Organization (FAO), epidemiological investigations conducted in clinical, veterinary and environmental settings have consistently revealed an increase in AMR levels and the emergence of new antimicrobial resistance genes among clinically important pathogens worldwide [2–5]. Although some of these pathogens have been reported in Lebanon, which joined the WHO's Global Antimicrobial Resistance Surveillance System (GLASS) in 2017, the full burden of AMR in this country remains unclear due to the lack of national surveillance data, a limited number of well-designed national studies, weak epidemiological tracking, and the absence of adequate funding, infrastructure and oversight [4,5]. Despite these challenges, two retrospective studies based on yearly institutional antimicrobial susceptibility testing reports of several Lebanese hospitals described an increase in the prevalence of multidrug-resistant pathogens, including methicillin-resistant *Staphylococcus aureus* (MRSA) (28% in 2016 compared with 23% in 2011), vancomycin-resistant enterococci (2% in 2016 versus 0% in 2011), carbapenem-resistant *Acinetobacter* (88% in 2016 versus 51% in 2011), carbapenem-resistant *Pseudomonas* (30% in 2016 versus 20% in 2011) and extended-spectrum β-lactamase (ESBL)-producing Enterobacterales (34% in 2016 versus 32% in 2011) [6,7]. Furthermore, recent studies have shown an extensive occurrence of mobile colistin resistance (*mcr*) genes in clinical isolates, the community and the environment [8]. Notably, 3.6% of Enterobacteriaceae clinical isolates were resistant to colistin, while 0.6% carried the *mcr-1* gene [5], which was also reported in multidrug-resistant *Escherichia coli* isolated from toddlers (18%) in the community (non-clinical setting) [4].

Currently, AMR in Lebanon is being affected by two emergent and significant problems [8]. First, Lebanon has witnessed a huge drop in gross domestic product (GDP) from US$52.52 billion in 2019 to US$18.73 billion in 2020 owing to political turmoil, leading to a steep decline in the Lebanese currency. The devaluation (90%) of the Lebanese pound has resulted in severe socioeconomic repercussions, including increased poverty and higher medical costs. This has been especially problematic because Lebanon relies heavily on imports to meet most of its nutritional and medical needs. The latter has been further confounded by the COVID-19 (coronavirus disease 2019) pandemic, which caused a worldwide economic crisis and shortages in importation, decreasing the availability and increasing the prices of materials that impact public health, including crucial items such as research and medical chemicals and diagnostic toolkits. Subsequently, many Lebanese suppli-

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Table 1
Shortage of antibiotic disks at El Youssef Hospital Center (Lebanon) from January–December 2020 and the associated difficult-to-detect resistance phenotypes and patterns

Antibiotic (disk content)	Bacteria	Difficult to detect phenotype(s)	Period of shortage (%) [a]	Presence of an alternative during the shortage period [b]
Amoxicillin (20 μg)	Ent.	Penicillinase, cephalosporinase	100	–
Amoxicillin/clavulanate (20/10 μg)	Ent.	Penicillinase, cephalosporinase, ESBL	33.3	Yes (ticarcillin/clavulanate)
Ticarcillin (75 μg)	Ent., *Ab*, *Pa*	Penicillinase	100	–
Piperacillin/tazobactam (30/6 μg)	Ent., *Ab*, *Pa*	Penicillinase, cephalosporinase, ESBL	75	–
Cefalexin (30 μg)	Ent.	Cephalosporinase	16.7	–
Cefuroxime (30 μg)	Ent.	Cephalosporinase	100	–
Ceftriaxone (30 μg)	Ent., *Ab*	ESBL, overproduced cephalosporinase	33.3	Yes (cefotaxime, cefepime or aztreonam)
Ceftazidime (10 μg)	Ent., *Ab*, *Pa*	ESBL, overproduced cephalosporinase	100	Yes (cefepime)
Cefoxitin (30 μg)	Ent.	ESBL, cephalosporinase	83.3	–
	Sa	MRSA	83.3	–
Ertapenem (10 μg)	Ent.	Carbapenem resistance	33.3	Yes (imipenem and meropenem)
Imipenem (10 μg)	Ent., *Ab*, *Pa*	Carbapenem resistance	16.7	Yes (meropenem)
Amikacin (30 μg)	Ent., *Ab*, *Pa*	Amikacin resistance	66.7	–
Tobramycin (10 μg)	Ent., *Ab*, *Pa*	Tobramycin resistance	100	–
Gentamicin (10 μg)	*Sa*	KTG resistance	33.3	–
Gentamicin (30 μg)	*En*	HLAR	33.3	–
Nalidixic acid (30 μg)	Ent.	Quinolone resistance	83.3	–
Levofloxacin (5 μg)	Ent., *Ab*, *Pa*, *Sa*, *En*, *St*	Fluoroquinolone resistance	100	Yes (ciprofloxacin or moxifloxacin)
Fosfomycin (200 μg)	Ent., *Pa*, *Sa*, *En*	Fosfomycin resistance	100	–
Nitrofurantoin (100 μg)	Ent., *Sa*, *En*	Nitrofurantoin resistance	75	–
Trimethoprim/sulfamethoxazole (1.25/23.75 μg)	Ent., *Ab*, *Sa*, *En*, *St*	Trimethoprim/sulfamethoxazole resistance	100	–
Colistin (50 μg)	Ent., *Ab*, *Pa*	Colistin resistance	75	–

Ent., Enterobacterales; ESBL, extended-spectrum β-lactamase; *Ab*, *Acinetobacter baumannii*; *Pa*, *Pseudomonas aeruginosa*; *Sa*, *Staphylococcus aureus*; MRSA, methicillin-resistant *S. aureus*; KTG, kanamycin–tobramycin–gentamicin; *En*, *Enterococcus* spp.; HLAR, high-level aminoglycoside resistance *St*, *Streptococcus* spp.

[a] 100% is equivalent to 12 months.

[b] Presence of an alternative disk at the Department of Clinical Microbiology of El Youssef Hospital Center during the period of shortage of the original disk.

ers of chemicals and diagnostic kits are struggling to secure imports. Furthermore, hospitals and academic and private laboratories are unable to pay following devaluation of the national currency. Therefore, the country has been suffering from a dangerously limited amount of supplies, including in vitro diagnostics [9]. For instance, retrospective data collected from El Youssef Hospital (the biggest hospital in Akkar Province, North Lebanon) during 2020 showed a paucity in the number of tested antibiotics and a decline in the quality of antibiograms owing to the lack of several antibiotics and ready-to-use media supplemented with horse blood and β-NAD. Several resistant phenotypes in important pathogens, including MRSA and carbapenem-resistant Enterobacterales, have become difficult to identify owing to the scarceness of relevant material/disks (Table 1). Academic laboratories in major universities have significantly reduced or completely stopped AMR screening of environmental, clinical and food isolates. This catastrophe has made treating patients and tracking AMR epidemiology more complicated in a country that already had severe challenges in these areas.

Prior to the crises and COVID-19, the Ministry of Public Health in collaboration with Lebanese academic institutions and international non-governmental health organisations had begun a new programme of educational workshops and proficiency testing to standardise antibiogram testing methods performed in medical laboratories and to improve the quality and accuracy of results. However, the programme was impeded due to the aforementioned emergent problems, which pushed back the fragile AMR efforts in Lebanon.

In conclusion, the situation in Lebanon requires immediate action to avoid dangerous outcomes. There is a paramount need to devise interventions on a policy-based level and to implement an immediate national action plan to ensure the availability and affordability of AMR diagnostic tools. Lebanon is currently hosting approximately 1.5 million Syrian refugees, while the total number of poor among the Lebanese population is approximately 2.7 million. These numbers are staggering, and both populations are highly susceptible to antimicrobial-resistant and complicated infections. Given that AMR is a global threat that transcends borders, international stakeholders must play a key role by providing technical, financial and medical support.

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None declared.

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