



# **The MENA Typhoid Project: New Insights on Typhoid Burden and Antibiotic Resistance**

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**On behalf of the MENA Typhoid Project Collaborators**

December 7, 2023

# What is the MENA Typhoid Project?

- A collaboration between the American University of Beirut (AUB), WHO, and US CDC to enhance typhoid surveillance and control measures in the Middle East and North African (MENA)/Eastern Mediterranean region
- Includes non-laboratory and laboratory-focused initiatives

# The MENA Typhoid project: Non-laboratory Initiatives




- Published review of typhoid fever occurrence and antibiotic resistance in the Eastern Mediterranean region from 1990-2021\*
  - ~45,000 blood culture-confirmed cases identified from 12 countries
  - Limited burden data, especially from countries outside of Pakistan (22/70 or 31% of studies)
  - Of 56 studies with AMR data:
    - 68% of isolates were fluoroquinolone resistant
    - 40% MDR
    - 48% XDR of tested isolates from Pakistan

\*Typhoid fever in the Eastern Mediterranean region: a systematic review, 1990-2021. GD Appiah et al. Am J Trop Med Hyg. 2022 Dec 19;108(2):285-292. doi: 10.4269/ajtmh.22-0075. Print 2023 Feb 1.

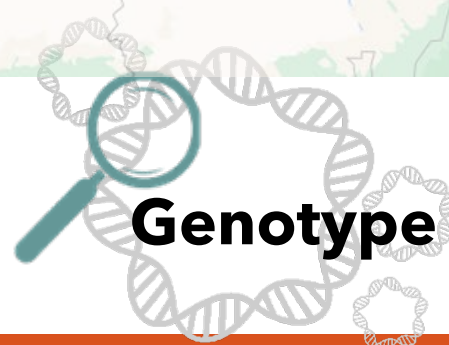
# The MENA Typhoid project: Non-laboratory Initiatives

- Typhoid fever surveillance systems and vaccination policy survey
- Regional workshop on challenges and opportunities related to typhoid fever laboratory surveillance and TCV introduction



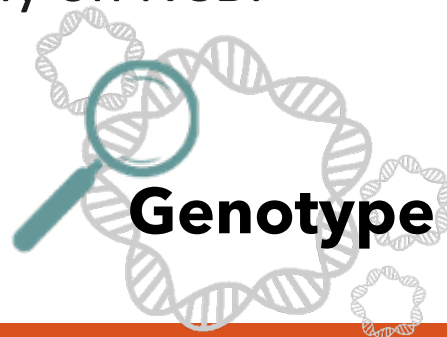
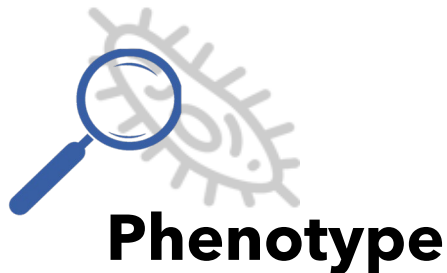
 <b>Organisation mondiale de la Santé</b> <small>REGIÃO REGIONAL DE U. O. Mediterrânea orientale</small>		 <b>World Health Organization</b> <small>REGIONAL OFFICE FOR THE Eastern Mediterranean</small>		 <b>منظمة الصحة العالمية</b> <small>المكتب الإقليمي لشرق المتوسط</small>	
<b>Consultative Meeting on Typhoid Surveillance and Vaccine Introduction in the Eastern Mediterranean Region</b>					
<b>25-26 July, 2022</b>					
<b>Day 1 - Monday, July 25</b> (All times Cairo Time (Atlanta Time +6 hours))					
12:00-12:30	Opening Remarks: Objectives of the meeting and adoption of the agenda	<i>Abdinasir Abubakar</i> <i>WHO-EMRO</i>			
12:30-12:40	Introduction of the participants	<i>All</i>			
<b>Session 1: The Global Burden of Typhoid and Current and Resources for Prevention and Control</b>					
12:40-13:00	Global Burden of Typhoid Fever, and available strategies to prevent and control typhoid fever outbreaks	<i>Adwoa Desma, BENTSI-ENCHILL</i> <i>WHO-HQ</i>			
13:00-13:20	Typhoid Fever Surveillance: An update on global and regional systems and resources for capacity building	<i>Ghassan Matar</i> <i>American University of Beirut</i>			
13:20-13:40	An Update on Regional Typhoid Laboratory Capacity and Resources for Capacity Building	<i>Tony Abou Fayad</i> <i>American University of Beirut</i>			
13:40-14:00	The Path to Typhoid Conjugate Vaccine Introduction: Regional Policies and Lessons Learned Around the Globe	<i>Jenny Walldorf</i> <i>WHO-HQ</i>			
14:00-14:10	Virtual coffee break				
14:20-14:40	Regional typhoid situation and strategic priorities of preventing and controlling potential typhoid epidemics in the EMR	<i>Muhammad Tayyab</i> <i>WHO-EMRO</i>			

# The MENA Typhoid project: Laboratory Surveillance



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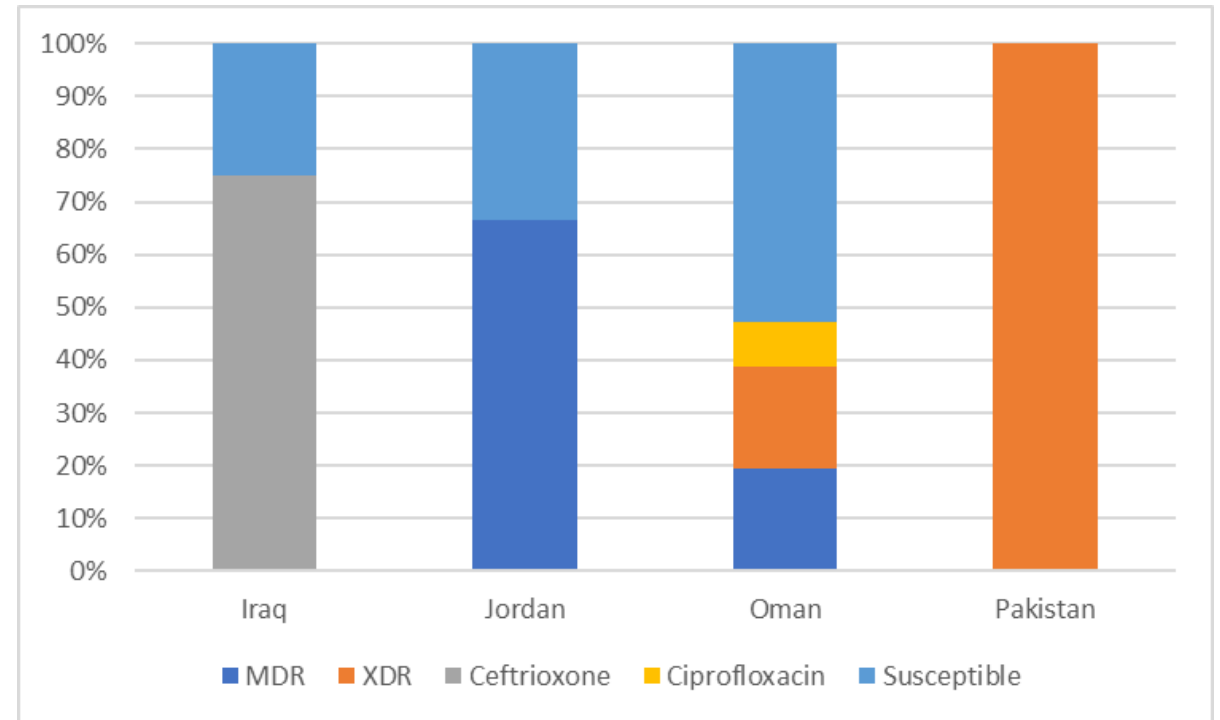
- Antibiotic susceptibility testing (AST)
  - Broth microdilution
  - All experiments run in duplicate
  - MDR=resistance to ampicillin, chloramphenicol, and trimethoprim/sulfamoxazole
  - XDR=MDR+resistance to fluoroquinolones and third generation cephalosporins
- Whole genome sequencing (WGS) on Illumina MiSeq sequencer
- All sequences shared publicly on NCBI





# Laboratory Surveillance Results to Date: AST

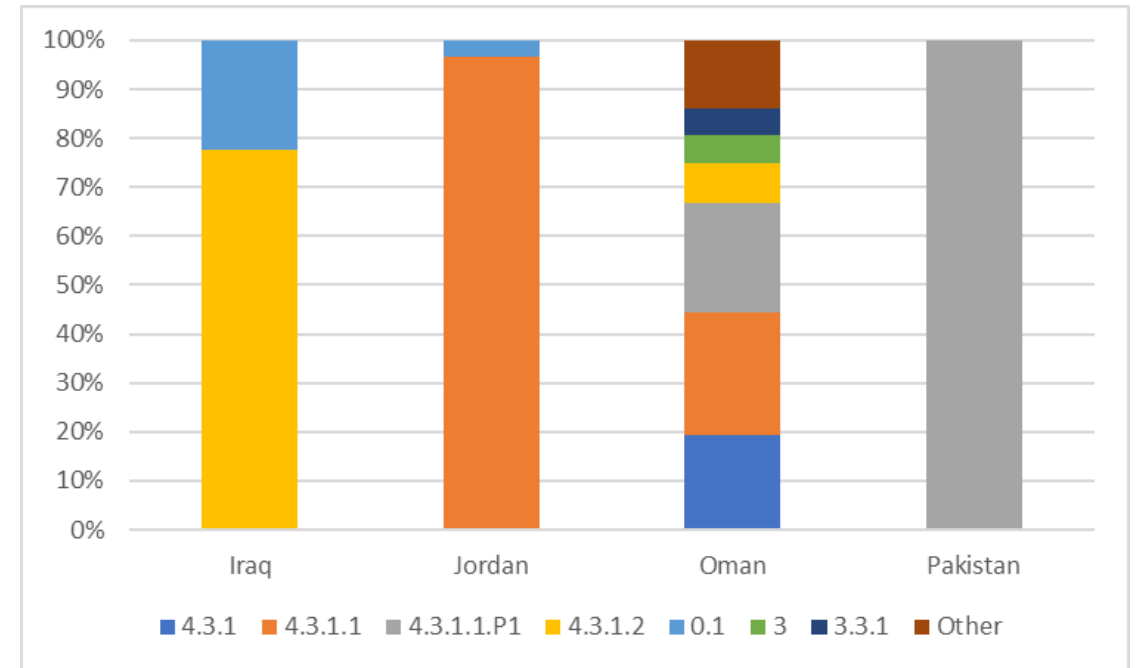
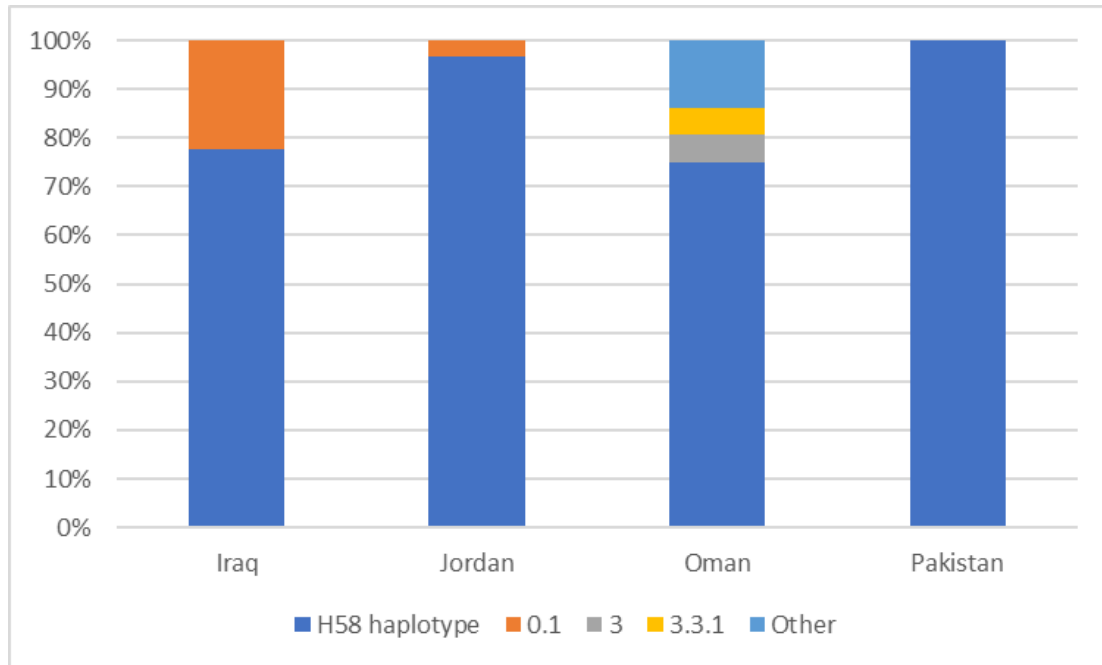
- The majority of isolates were resistant to chloramphenicol (98%), ampicillin (68%), nalidixic acid (65%), and trimethoprim/sulfamethoxazole (56%)
- All isolates susceptible to azithromycin, meropenem, colistin, and gentamicin
  - 67% (20/30) of isolates from Jordan were MDR
  - 100% (22/22) of isolates from Pakistan and 19% (7/36) from Oman (all Pakistan travel-associated) were XDR
- 72% (13/18) of isolates from Iraq were ceftriaxone resistant



\*Ceftriaxone refers to ceftriaxone resistance without MDR or XDR. Ciprofloxacin refers to ciprofloxacin resistance without MDR or XDR.

# Laboratory Surveillance Results to Date: WGS

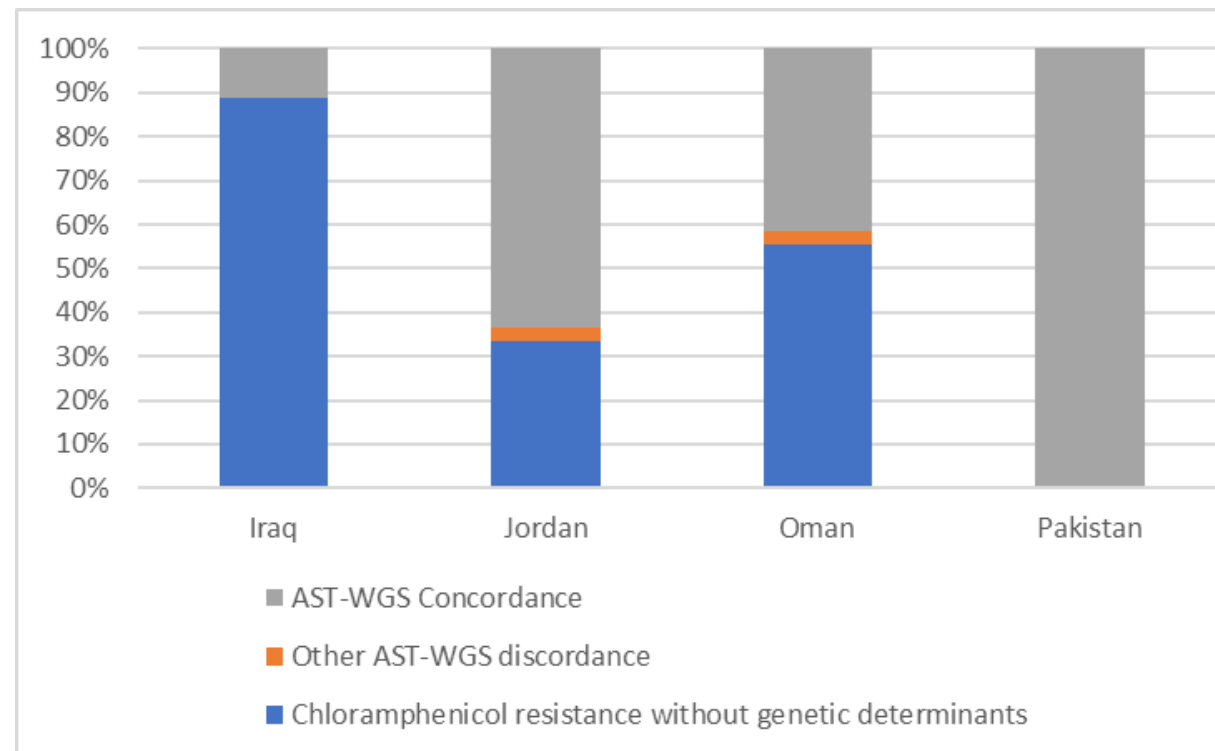
- The majority (88%; 93/106) of isolates belonged to the H58 haplotype





# Chloramphenicol resistance without known genetic determinants

- 43% (46/106) of isolates demonstrated chloramphenicol resistance without any relevant genetic determinants of chloramphenicol resistance
- Discordance was observed only in isolates from Iraq, Jordan, and Oman



# Implications for Typhoid Control

- Chloramphenicol resistance by AST without genetic determinants underscores importance of maintaining capacity to perform culture with AST to inform empiric treatment
- Travel-associated XDR cases in Oman underscore the risk of spread of XDR S. Typhi from Pakistan
- Results highlight the continued need to improve surveillance for rapid detection and effective implementation of control measures

# Next Steps: The Role of Data Moving Forward

- Continued country recruitment and results dissemination
- Continued phenotypic and genotypic analysis to accurately characterize resistance, understand linkages with regional and global strains, and anticipate future risk of drug-resistant strains
- Leverage of partnerships to encourage public sharing of surveillance data and support countries in using available data to inform control measures

# Acknowledgements

## AUB

Tony Abou Fayad  
Jana Ezzeddine  
Ghassan Matar  
Ahmad Sleiman

## WHO-EMRO

Abdinasir Abubakar  
Evans Buliva  
Sherein El Nossery  
Muhammed Tayyab

## WHO-HQ

Adwoa Bentsi-Enchill  
Musa Hindiya  
Anna Minta

## CDC

Lucy Breakwell  
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Graeme Prentice-Mott  
Morgan Schroeder  
Yesser Sebeh  
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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

