MediPIET Summary report of work activities

Fatma Ben Youssef

Tunisia, Cohort 6 (2023)

Background

About MediPIET

The Mediterranean and Black Sea Programme for Intervention Epidemiology Training (MediPIET) aims to enhance health security in the Mediterranean and the Black Sea region by supporting capacity building for prevention and control of natural or man-made threats to health posed by communicable diseases. It is a competency-based in-service two-year fellowship during which selected fellows conduct projects and field investigations at a MediPIET Training Site in their home country and attend MediPIET modules.

Since mid-2021, MediPIET is implemented by ECDC as a part of the EU Initiative on Health Security. You can find more information about the programme at: https://www.ecdc.europa.eu/en/training-and-tools/training-programmes/fellowships/medipiet

Pre-fellowship short biography

Fatma is a medical doctor and a resident in preventive and community medicine (MD degree obtained in January 2024). During her residency, she worked as an epidemiologist in different departments at the Ministry Of Health at national and health facility levels, focusing mainly on infectious diseases, and non-communicable diseases. At the National Observatory of New and Emerging Diseases, she contributed to COVID-19 surveillance, Shigellosis outbreak investigations, and respiratory virus monitoring. She also supported epidemic intelligence and event-based surveillance activities. In addition, Fatma gained hands-on experience in infection prevention and control at University Hospital Taher Sfar and contributed to research projects and public health initiatives at Habib Thamer University Hospital. She also worked on cancer prevention and tobacco cessation programmes at Abderrahman Mami University Hospital. Fatma is also a graduate of the intermediate Tunisian Field Epidemiology Training Programme (FETP), cohort 2022.

Fellowship

On September 2023, Fatma Ben Youssef started her MediPIET fellowship at the National Observatory of New and Emerging Diseases, Tunis in Tunisia (training site). This report summarises the work performed during the fellowship.

National supervisors: Dr Hajer Letaief (Main supervisor), Dr Sonia Dhaouadi (co-supervisor), Dr Nissaf Bouafif ep Ben Alaya (general director of training site and National Focal Point).

Scientific coordinator: Katie Palmer.

Fellowship projects

1. Surveillance

Completeness of malaria notification in the Greater Tunis region, Tunisia, assessed by capture recapture method, January 2017–July 2025

Introduction

Malaria is a mandatory notifiable disease in Tunisia. In 1979, Tunisia became malaria free. However, there still a risk of re-emergence of autochthonous malaria cases, especially due to international travel to endemic regions (sub-Saharan Africa), migration, and climate change. We aimed to describe the malaria surveillance data and to estimate the completeness of malaria notification in the Greater Tunis region between January 2017 and July 2025.

Methods

We conducted a descriptive retrospective survey, including all laboratory-confirmed cases of malaria reported in Greater Tunis region between January 2017 and July 2025. We used two source-capture-recapture method (CRM) and collected data from the four Regional Directorates of Health (RDH) (Tunis, Ariana, Manouba and Ben Arous) and public laboratories (Pasteur Institute of Tunis and Microbiology Laboratory of Rabta hospital). Completeness rate (CR) was calculated using the following formula: $C=(b+c-a)/n$, where b and c are the number of cases reported in one of the sources, a is the number of cases in both sources and n is the number of the estimated number of cases.

Results

In total, 610 malaria cases were recorded after excluding duplicates. The estimated total number of cases was 781 (95% CI=726–836), for a CR of 78.1%. Laboratories contributed 68.5%(n=532) of notifications, with a CR of 68.1% (95% CI=63.6%-73.3%), compared to 31.2% (95% CI=29.2%-33.6%) for RDH. Cases were mostly male (80.7%, n=427), with a mean age of 33.5 years, and 43.4% (n=250) were Tunisians, who were significantly older than other nationalities ($p < 0.01$). Fever (88.1%, n=258) was the most common symptom, and *Plasmodium falciparum* accounted for 93.7% (n=478) of identified species. The main reasons for travel were missionary work (n=232, 38%) and studying (n=189, 31%). Furthermore, 55.8% (n=148) of Tunisians did not take chemoprophylaxis. Most infections were linked to travel to Côte d'Ivoire (31.1%, n=166) and the Democratic Republic of Congo (DRC) (17.8%, n=95), with cases peaking in October (11.8%, n=72), November (10.2%, n=62), and December (9.5%, n=58).

Conclusions

Between 2017 and 2025, 610 malaria cases were reported in the Greater Tunis region, with 78.1% CR overall which is a satisfactory level of data completeness. We recommend the digitalisation of the malaria surveillance system, updating the malaria surveillance system guide with standardised definitions, and harmonising the forms used by the laboratories and the RDH.

Role and outputs: Fatma served as the principal investigator. She reviewed literature (national and international), developed the study protocol and data entry mask in Excel in collaboration with the training site, and was responsible for field data collection, data cleaning, and analysis. She also prepared the final report and shared it with various stakeholders.

Supervisors: Hajer Letaief, Sonia Dhaouadi, Nissaf Bouafif ép Ben Alaya.

2. Outbreaks

Investigation of a brucellosis cluster in an agricultural complex: a retrospective cohort study, Mateur, Bizerte, Tunisia, March 2024

Background

On 27 March 2024, the Regional Health Directorate of Bizerte reported 11 cases of brucellosis to the National Observatory of New and Emerging Diseases (ONMNE) through the weekly epidemic intelligence videoconference EPITEC. All 11 cases were among workers from the same agricultural professional setting (dairy cattle farming) – Mateur, in the Bizerte governorate (north-east Tunisia). We aimed to investigate this cluster to identify the risk factors in order to implement appropriate control and preventive measures.

Methods

A retrospective cohort study was conducted during April 2024. The main exposures were through contact with animals (in either professional or household settings) and consumption of unpasteurised dairy products. A case was defined as a worker having at least one of the following symptoms (fever, sweats, arthralgia, asthenia, headache, anorexia) or presenting positive brucellosis-specific antibodies between January and March 2024. The overall attack rate (AR) was defined as the number of cases by the number of exposed workers in the professional setting. We calculated adjusted relative risks (aRR) with 95% CIs using binomial regression.

Results

We included 35 workers (response rate=70%) with a total of 16 cases (AR=45.7%). Mean age was 50.6±6.2 years [40-61] with 97.1% (n=34) males. Eighty-nine percent (n=31) of workers reported having contact with animals in a professional setting and 25.7% (n=9) from their households. Further, 54.3% (n=19) of workers consumed at least one dairy product.

In multivariable analysis, milking herds in the professional setting (aRR=2.8, 95%CI=1.1-34.1; p=0.03) were significantly associated with brucellosis. Workers exposed to abortifacients and farrowing products had a higher risk of brucellosis (aRR=2.2, 95%CI=0.7-15.5; p=0.12) although the association was not statistically significant.

Conclusions

We identified milking herds in the professional setting as the risk factor for brucellosis. We provided training to workers on preventive measures against brucellosis, emphasising the proper use of personal protective equipment and effective disinfection practices. We recommended enhancing the integrated investigation of the brucellosis cluster and undertaking further environmental, animal, and human microbiological analysis with a One Health approach to support our epidemiological results.

Role and outputs

Fatma was the principal investigator. She was responsible for data collection, development of the questionnaire and the data cleaning and analysis. She presented the findings of this study as a report and as an abstract at the first Clinical Microbiology and Infectious Diseases Congress, Middle East North Africa region, held on 22−24 May 2025 in Hammamet, Tunisia.

Supervisor: Hajer Letaief, Sonia Dhaouadi, Nissaf Bouafif ép Ben Alaya.

3. Research

COVID-19 vaccination knowledge, attitudes, perception and practices among frontline healthcare workers in Tunisia, 2024

Background/objectives

Healthcare workers in primary care settings play a significant role in recommending vaccines to patients. We aimed to describe the COVID-19 vaccination knowledge, attitudes, perception, and practices (KAPP) of healthcare workers in Tunisia and identify associated factors.

Methods

We conducted a national cross-sectional survey (29 January − 3 February 2024) among healthcare workers in primary public healthcare centres using purposive sampling. Factors associated with good knowledge, positive attitude, and good practice, measured through Likert scales via face-to-face questionnaires, were identified using binary logistic regression.

Results

We included 906 healthcare workers (mean age=41.87 ± 8.89 years). In total, 37.75% (342/906) of them had a good knowledge and perception, 4.30% (39/906) had a positive attitude, and 24.9% (226/906) employed good practices related to COVID-19 vaccination. Working in urban compared to rural areas was associated with a good knowledge (aOR=1.57, 95%CI=1.12-2.21) and positive attitude (aOR=4.94, 95%CI=1.19-20.44) towards COVID-19 vaccination. Physicians had better KAPP scores than other medical professionals. Healthcare workers working in departments with high-risk patients were more likely to have good knowledge (aOR=1.28, 95%CI=1.00-1.72). A positive attitude was also associated with being male (aOR=2.97, 95%CI=1.75-5.07) and having at least one non-communicable disease (aOR=1.92, 95%CI=1.14-3.23). Being male (aOR=1.97,95%CI=1.35-2.88) and having more years of professional experience (aOR=1.81,95%CI=1.29-2.52) was associated with good practice.

Conclusions

Just over a third of healthcare workers in primary healthcare clinics had a good knowledge of COVID-19 vaccination, however positive attitudes and good practices were less evident. It is necessary to target interventions, particularly towards healthcare workers with less professional experience working in rural settings, in order to increase good practices and help improve COVID-19 vaccination coverage in Tunisia.

Role and outputs: Along with the team at the ONMNE, Fatma contributed to the development of the protocol and questionnaire. She also participated in data collection, data cleaning, and data analysis. The outputs from this project included an abstract which was presented at the ESCAIDE 2024 conference and a manuscript published in the journal 'Vaccines'.

Supervisor: Hajer Letaief, Sonia Dhaouadi, Aicha Hechaichi, Nissaf Bouafif ép Ben Alaya.

4. Scientific communication

Conference presentations

- Ben Youssef F, Letaief H, Dhaouadi S, Hchaichi A, Zouayti A, Fitouri S, Fourati A, Mhadhbi R, Guedri N, Ben Jomaa H, Taboubi N, Mhamdi M, Jemeli A, Maalel I, Maatoug T, Charaa N, Saidi B, Bouafif ep Ben Alaya N. Factors associated with influenza vaccination uptake among frontline healthcare workers in Tunisia, 2022/2023 season. Poster presented at European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 20−22 November 2024, Stockholm, Sweden.
- Ben Youssef F, Dhaouadi S, Letaief H, Jedidi S, Mechergui S, Bouafif ep Ben Alaya N. Investigation of a brucellosis cluster in a professional setting: a retrospective cohort study- Mateur (Bizerte, Tunisia), April 2024. Poster presented at the First Clinical Microbiology and Infectious Diseases Congress, Middle East North Africa Region; 22−24 May 2025, Hammamet, Tunisia.
- Dhaoudi S, Ben Youssef F, Mziou E, Hechaichi A, Letaief H, Safer M, Mhadhbi R, Larouchi F, Jelassi S, El Mili S, Smaoui H, Hammami A, Guermazi S, Rebhi M, Bne Aissa R, Bouguerra H, Bouafif ep Ben Alaya N. Extended spectrum Beta-lactamase producing *Shigella sonnei* nationwide outbreak, likely linked to unsafe water sanitation practices, Tunisia, 2022/2023. Poster presented at the First Clinical Microbiology and Infectious Diseases Congress, Middle East North Africa Region; 22−24 May 2025, Hammamet, Tunisia
- Fourati A, Hechaichi A, Ben Youssef F, Naghmouchi G, Fitouri S, Derouiche S, Mhadhbi R, Zouayti A, Talmoudi K, Sahli A, Nouira K, Ghanjati F, Bacha E, Hachfi W, Ourari B, Ammous A, Souissi S, Abdelkafi M, Abdellatif S, Kouraichi N, Kilani B, Boussarsar M, Bouafif ep Ben Alaya N. Effectiveness of COVID-19 vaccine in preventing SARS-CoV-2 severe outcomes 2021−2023. Poster presented at European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 19−21 November 2025, Warsaw, Poland.
- Silini A, Dhaouadi S, Letaief H, Hechaichi A, Safer M, Derouiche S, Bouabid L, Bouaziz I, Mhadhbi R, Fitouri S, Fourati A, Ben Youssef F, Fehri M, Setti I, Bougatef S, Bouafi ép Ben Alaya N. Artificial Intelligence for Early Detection: Tunisia's EIOS-based model for digital epidemic intelligence. The 10th Scientific Symposium of the AHEAD Research Network. AI and Digital Health: Challenges and Opportunities for Public Health in the MENA, 11−12 December 2025, Marseille France.
- Dhaouadi S, Hechaichi A, Letaief H, Fitouri S, Ben Youssef F, Fourati A, Mhedhbi R, Naghmouchi G, Ghanjati F, Bouafif ép Ben Alaya N. Exposure to national influenza programme and COVID-19 vaccine outcomes among frontline healthcare workers in Tunisia, 2023/2024 season. Second National Congress and First International Congress on Prevention and Research in Health, 25−26 Avril 2025, Hotel Rosa Beach Monastir, Tunisia.
- Doghri S, Letaief H , Dhaoudi S, Hechaichi A, Ben Youssef F, Bouafif Ep Ben alaya Nissaf. Knowledge, attitudes and perceptions of Tunisian healthcare workers regarding the influenza vaccine for older adults. Tunisia 2024. Medical Congress of the LR01ES04 Laboratory, 2025 'Prevention of cardiovascular risks and community engagement', 26−27 September 2025, Faculty of Medecine, Tunis.

Publications and outputs

Ben Youssef F, Hechaichi A, Letaief H, Dhaouadi S, Zouaiti A, Talmoudi K, et al. COVID-19 vaccination knowledge, attitudes, perception, and practices among frontline healthcare workers in Tunisia, 2024. Vaccines. 2026;14(1):74. https://doi.org/10.3390/vaccines14010074

5. Teaching activities

Pertussis: epidemiology and prevention worldwide and in Tunisia

The teaching activity was part of a scientific day organised by the Tunisian Association of Epidemiology and Preventive Medicine in collaboration with the National Observatory of New and Emerging Diseases. It was held on 27 April 2024 at the National Observatory of New and Emerging Diseases, Tunis, Tunisia. The target audience included medical doctors and residents specialised in preventive and community medicine, Rapid Response Teams (RRT) working at the Regional Epidemiological Surveillance Units, paediatricians and ICU physicians, microbiology specialists from the reference laboratory, and experts from the public health and immunisation units.

This scientific day focused on pertussis and aimed to describe the epidemiological profile of pertussis at national and international levels, identify the main preventive measures at international level, present the preventive measures adopted in Tunisia, define the major challenges for controlling pertussis in Tunisia, deduct the best prevention strategies to overcome the challenges for controlling pertussis in Tunisia, and build recommendations for pertussis prevention in Tunisia.

One of the outputs of the day was to elaborate a policy brief for national stakeholders, covering the epidemic situation and the evidence-based recommendations to control and prevent pertussis in Tunisia.

Analysis of epidemiological data using R: introduction

The teaching activity took place at Grand Legacy Hotel, Kigali, Rwanda on 12−16 May 2025 as part of a capacity building event between ECDC and Africa CDC. The training aimed to introduce public health professionals working on surveillance to the basic concepts of analysis of epidemiological data (from surveillance or during outbreak investigation) using R. This included an introduction to R studio, importing and cleaning data, and visualisations. As a MediPIET fellow, Fatma was invited to the training as a facilitator.

6. International assignments

Best practices in respiratory virus surveillance systems: exchange of experiences in Tunisia and Ireland, 25 March–24 April 2025

Background
Tunisia's influenza surveillance system, active from October to April, was established in 1999 as a sentinel lab-based system. In 2022, it was expanded to detect a broader range of 19 respiratory pathogens, including SARS-CoV-2, using RT-PCR multiplex testing. That same year, Tunisia shifted from passive SARS-CoV-2 lab-based surveillance to a fully integrated respiratory system. Fatma was involved in the data analysis of SARS-CoV-2 and other respiratory pathogen from surveillance system. She developed a Power BI dashboard for the internal analysis of the integrated surveillance system.

Objectives of the exchange
Through this exchange, Fatma aimed to learn about the structure and operation of the integrated respiratory virus's surveillance system in Ireland, conduct a SWOT analysis (strength, weaknesses, opportunities and threats) of both systems, develop recommendations based on this and discuss potential collaboration. Results of the SWOT analysis of the Tunisian surveillance system aimed to inform strategy and optimise the weekly reporting and automation epidemiological updates using R.

Methodology
During the exchange Fatma had meetings with subject matter experts (SMEs) involved in the surveillance systems at HPSC and observed/shadowed relevant staff. She reviewed routine reports and relevant documents, participated in data analysis and dashboards updates (using R or other informatic tools PowerBI, ArcGIS), and conducted a SWOT analysis.

Results
The final report on the international exchange included a description of the exchange, a description of the Irish and Tunisian respiratory virus surveillance system, the output from the SWOT analysis for both systems, and recommendations on the respiratory virus system in Tunisia and in Ireland.

Conclusions and recommendations
The visit to the HPSC Ireland was very fruitful and provided insightful information about respiratory surveillance systems in particular. It provided a good model to follow especially with the implementation of the R working groups and the resilience of the team despite the threats facing the surveillance system. The exchange also showed a good example of how differences in surveillance systems can provide opportunities to inspire and learn, and how similarities between these systems can enhance collaboration and inspiration.

Hosting country and institute: HSE- Health Protection Surveillance Centre (HPSC)

Supervisors: Hajer Letaief, Sonia Dhaouadi

Contact person and supervisor at HPSC: Margaret Fitzgerald.

World Health Organization (WHO) Headquarters (HQ)/Global IMST (Incident Management Support Team) (remote support) Global Cholera, 21 April to 31 December 2025

Background
Cholera remains a significant public health emergency, affecting multiple regions. The World Health Organization (WHO) classified the global resurgence of cholera as a Grade 3 emergency in January 2023, its highest internal level for emergencies. In 2024, as of 29 September, 30 countries have reported a total of 439 724 cholera or Acute Watery Diarrhoea (AWD) cases and 3 432 deaths. Six countries (Democratic Republic of the Congo (DRC), Ethiopia, Myanmar, Nigeria, Sudan and Yemen) are experiencing acute cholera crises, while outbreaks persist in 18 other countries. Cholera disproportionately affects vulnerable populations in regions with limited access to safe water, sanitation, and healthcare infrastructure. The global spread of cholera is exacerbated by climate change, with increased frequency and severity of floods and droughts, and by military conflicts and social tensions, all contributing to disease transmission. Seasonal factors further aggravate the situation, as access to safe water and unsafe sanitation becomes increasingly compromised.

Objectives of the assignment
To support and strengthen WHO's Headquarters (HQ) in data collection, analysis and reporting of outbreak surveillance, risk assessment, and health information management research.

Methods and results
Fatma supported the Incident Management Support Team (IMST) by updating the global cholera and country specific epidemiological situations through data collection and data validation for specific countries (DRC, Congo, Afghanistan, Burundi and Angola), attending and representing the IMST epi pillar during the weekly three-level coordination calls with WHO AFRO and WHO country teams, maintaining and developing an R repository for data analysis and reporting for specific countries, and reporting on the epidemiological situation through different products. These products included data packs of global cholera surveillance data (a presentation shared internally and with partners), Acute Events and Emergencies Weekly Reports, and briefing notes for the global cholera situation and country specific situations. She also assisted countries with specific requests regarding cholera.

Conclusions and recommendations

Updating the cholera data from different sources can be very challenging due to inconsistency and changes over time. Coordinating with the countries and developing a joint reporting platform can easily accelerate data management.

Hosting country and institute: Remote - WHO HQ Geneva (Incident Management Support Team)

Contact person and supervisor at WHO: Caius Ikejezie.

7. Other activities

Data visualisation of weekly surveillance report of influenza and other respiratory viruses

Following the COVID-19 pandemic, Tunisia expanded virological surveillance of influenza to include SARS-CoV-2 and other respiratory pathogens using multiplex PCR testing. Weekly laboratory-based data from the National Influenza Center at Charles Nicolle Hospital are transferred to the National Observatory for New and Emerging Diseases. Data include patient demographics (age and gender), type and location of the centre (ILI, SARI), specimen number, collection dates and results. To support timely analysis, Fatma developed an interactive Power BI dashboard featuring epidemic curves, percentage positivity (overall and by pathogen, by gender, sites and by region) and trends in pathogen co-circulation. Her key tasks included data cleaning and dashboard creation for national reporting. Fatma is currently developing an auto-updated dashboard using R.

COVID-19 vaccine effectiveness in Tunisia 2024

In 2021, Tunisia conducted a national study on COVID-19 vaccine effectiveness among individuals aged over 60 years, estimating an effectiveness of 70% (95% CI=62.8%–75.8%) during the Delta variant circulation. Due to limitations such as age restriction, absence of booster data, and variant specificity, a follow-up case-control, test-negative study was initiated in hospitals to assess overall and relative vaccine effectiveness across different dosing regimens. We enrolled 1 372 individuals, 538 cases matched with controls 1:1 and 125 matched 1:2. After adjusting for tobacco use, weight status, and Charlson Comorbidity score, the final model revealed that complete vaccination with booster dose in ≥6 months showed a high vaccine effectiveness in preventing Intensive Care Unit (ICU) admission (VE= 72%; 95%CI: 49%-85%). Fatma contributed to this study by participating in data collection. The findings of the study were presented during the poster sessions at ESCAIDE 2025, Warsaw, Poland.

Epidemic intelligence and event based surveillance activities

Fatma conducted screening, validation, and reporting activities through the Epidemic Intelligence from Open Sources (EIOS) platform. She also participated in moderating and reporting during EPITEC (weekly videoconference on epidemic intelligence between the 24 governorates at national and sub-national level) sessions in Tunisia.

MediPIET modules attended

1. Introductory Course and Outbreak Investigation, 25 September–13 October 2023, Spetses, Greece, attended in person.
2. Study Protocol and Scientific Writing, 26–27 October and 7–8 November 2023, attended online.
3. Multivariable Analysis, 19–23 February 2024, Berlin, Germany, attended in person.
4. Qualitative Research, 19 and 22 March 2024, attended online.
5. Vaccinology Inject Day 2024, 2 April 2024, attended online.
6. Rapid Assessment and Survey Methods and Mass Gatherings, 15–19 April 2024, Dublin, Ireland, attended in person.
7. One Health and Vector Borne Diseases Module, 3–7 June 2024, Belgrade, Serbia, attended in person.
8. Project Review Module 2024, 26–30 August 2024, Lisboa, Portugal, attended in person.
9. Ethics, 6 November 2024, attended online.
10. Time Series Analysis, 9–13 December 2024, Utrecht, Netherlands, attended in person.
11. Chemical, Biological, Radiological and Nuclear (CBRN), 7–11 April 2025, Budva, Montenegro, attended in person.
12. Project Review Module 2025, 25–29 August 2025, Lisboa, Portugal, attended in person.

Personal conclusions of fellow

The MediPIET fellowship was a pivotal experience that deepened my understanding of applied epidemiology and strengthened my ability to contribute meaningfully to public health. I embraced every opportunity to grow, engaging in field assignments, international deployments, and collaborative learning with peers and mentors. These experiences challenged me to step outside of my comfort zone, refine my technical and communication skills, and critically assess health systems in diverse contexts. The fellowship not only enhanced my competencies in outbreak response and surveillance but also reinforced my commitment to bridging research and practice for greater public health impact. This fellowship strengthened the MediPIET countries' capacities to address public health challenges and advance preparedness. Looking ahead, I am eager to apply these skills and perspectives to foster stronger health systems, promote regional collaboration, and contribute to sustainable solutions for emerging health threats.

Acknowledgements

I sincerely thank my supervisors, Dr. Hajer Letaief and Dr. Sonia Dhaouadi, frontline coordinator Dr Katie Palmer, and national focal point Prof. Nissaf Bouafif Ben Alaya for their invaluable support throughout the fellowship. I am also grateful to my colleagues at the training site for their contributions. Special thanks to the MediPIET programme and ECDC coordinators for making this enriching experience possible.