



# MediPIET Summary report of work activities

Sonia Dhaouadi

Tunisia, Cohort 4 (2021)

## 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/medi Piet>

### Pre-fellowship short biography

Sonia holds a medical degree in preventive and community medicine in Tunisia, obtained in May 2021. Since March 2022, she has been an assistant professor in preventive and community medicine at the National Observatory of New and Emerging Diseases/Tunisian Ministry of Health and at the Faculty of Medicine of Tunis/University Tunis El Manar. During her residency, she worked with the cancer registry in Northern Tunisia (incidence, trend, prediction and burden of diseases), coordination of

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behavioural studies, COVID-19 surveillance at international and national levels, seroprevalence survey of SARS-CoV-2 antibodies in 2020 in Great Tunis. In addition, she was a mentor/facilitator in the Tunisian FETP/ cohort 2022.

## Fellowship

On September 2021, Sonia Dhaouadi started her MediPIET fellowship at the National Observatory of New and Emerging Diseases in Tunisia. This report summarises the work performed during the fellowship.

**National supervisors:** Hind Bouguerra (main supervisor), Aicha Hechaichi (co-supervisor), Nissaf Bouafif ép Ben Alaya (general director of training site)

**Scientific coordinators:** Liese Van Gompel, Pawel Stefanoff.

## Fellowship projects

### 1. Surveillance

#### 1.1. Co-circulation of respiratory viruses in Tunisia during 2022/2023 season

**Background:** Following the COVID-19 pandemic and lifting of restrictive measures in Tunisia, we monitored the circulation of influenza virus, SARS-CoV-2 and Respiratory syncytial virus (RSV) in the 2022/2023 season to adopt appropriate preventive measures.

**Methods:** Respiratory specimens from ILI and SARI cases from 73 sentinel surveillance sites (64/85 ILI sites based on primary healthcare sites and 9/11 SARI sites based on regional and university hospitals) were tested weekly for 19 respiratory viruses by multiplex rRt-PCRs in the National Reference laboratory (NIC). We calculated positivity rate (PR) for at least one of the three viruses (influenza, SARS-CoV-2 and RSV) using the number of submitted specimens as the denominator. We considered a co-circulation period when at least two of the three viruses circulated during the same week.

**Results:** During 2022/2023 season, a total of 1 948 specimens were tested. The number of tests ranged from 25 in week (W) 40/2022 to 133 in W1/2023 (mean=65/week). Of all specimens, 56% were collected from SARI sites. The duration of co-circulation was 22 consecutive weeks with PR>10%. The PR during the co-circulation period was 46% among ILI and 38% among SARI and increased in W45/2022 to reach 63% in W50/2022. Influenza PR was 21%, followed by RSV (13%) and SARS-CoV-2 (6%). 74% of ILIs were caused by influenza virus only, while 52% of SARIs were caused by RSV only. The PR among ILI and SARI cases was highest among females (43%) and in the northern and southern regions (42%). Children <5 years had the highest SARI PR (64%).

**Conclusions:** The 2022/2023 season was marked by early increase and long-duration in co-circulation of influenza virus and RSV that mostly affected children <5 years, females and residents in northern and southern regions of Tunisia. We recommend adapting the sentinel system to alert on co-circulation and facilitate timely preventive measures. This will reduce the burden of seasonal respiratory infection epidemics on healthcare services.

**Role and outputs:** Sonia was responsible for the data cleaning from the NIC, data analysis (overall from sentinel and sentinel sites and subset analysis among sentinel sites for the abstract) and data reporting for the 2022/2023 season to the Ministry of Health. She prepared an article for the national bulletin (in French; <https://onmne.tn/?p=17369>) and submitted an abstract for ESCAIDE 2023 (rejected).

**Supervisor(s):** Nissaf Bouafif ép Ben Alaya, Hind Bouguerra, Aicha Hechaichi

**Status:** Completed.

#### 1.2. Implementation of event based surveillance system in Tunisia, 2022/2023

**Background:** The changing epidemiology of communicable diseases requires maintaining reliable indicator-based surveillance (IBS) systems. However, these well-established systems are often not sufficient in sensitivity and in the timely detection of acute events to inform and implement appropriate actions. Such sensitive and timely data collection can be provided by event based surveillance systems (EBS), where information is gathered from both formal and informal sources. Tunisia did not implement an EBS yet. We aimed to design stepwise EBS implementation at national level (National Observatory of New and Emerging Diseases (ONMNE)) to improve surveillance and response strategies.

**Methods:** We examined previous reports on surveillance strategy and experiences related to implementation of the Early Warning and Response System (EWARS) in Tunisia. We used the WHO and AFRICA CDC guidelines to design our strategy. We identified the list of events to be notified under EBS (all-hazards approach) where routine surveillance is suboptimal. In addition, we determined different sources of information including formal and informal sources from human and animal health sector, media, community and environment. The process included signal detection and reporting, signal triage and verification, risk assessment and response.

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The local level (health district) with the multisectoral trained rapid response team, were the first actor for integrated surveillance and response (using one health approach) with support from regional (regional health directorate) and national (ONMNE) levels if necessary. Funding was provided internally from ONMNE budget and externally from Africa CDC.

**Results:** We organised four meetings involving stakeholders from different sectors and disciplines (laboratory, pharmacy, hospital, food security authority, animal health, environmental health, meteorology and community presenters) to validate the list of notifiable events. We also prepared a health information exchange legal framework for the exchange of health information between sectors. At the national level, we implemented the Epidemic Intelligence from Open Sources (EIOS) platform for media screening, with the support of EMRO/WHO. We set up a hotline for event notification from different sources of information along with an electronic signal reporting form at the local level, ensuring timely access at both regional and national levels. We defined verification criteria for public-health event and developed Standard Operating Procedures (SOPs) and guidelines to outline the data flow diagram and orient actions for each event in the field. We also prepared training materials for risk assessment, management and communication. We also prepared the agenda and the target audience for this training. To begin implementation, we defined six pilot regions (North, Centre and South). We also formulated indicators for monitoring and follow-up and designed the dashboard for data reporting.

**Conclusion and recommendations:** EBS implementation with collaboration with other sectors, can serve as a crucial component of an effective integrated early warning and response system, which support country capacity to be better prepared for epidemic and pandemic health threats.

**Role and outputs:** Sonia reviewed published literature, international guidelines and previous national reports, she drafted the protocol of EBS implementation in Tunisia. She co-facilitated the workshop with selected regional directorates of health and other sectors to identify the event to be notified within EBS and the data workflow.

**Supervisor(s):** Aicha Hechaichi, Hind Bouguerra, Nissaf Bouafif ép Ben Alaya

**Colleagues from ONMNE:** Souha Bougatef, Hejer Letaief

**Status:** completed

## 2. Outbreaks

### 2.1 Extended Spectrum Beta-lactamase producing *Shigella sonnei* nationwide outbreak likely linked to unsafe water sanitation practices, Tunisia, 2022/2023

**Background:** On 3 November 2022, the reference laboratory confirmed 60 infections of *Shigella sonnei* producing extended spectrum beta-lactamases (ESBL) among hospitalised children. National and regional multisectoral outbreak response teams started investigations to identify the source.

**Methods:** We defined suspected cases as residents in Tunisia with gastro-intestinal symptoms without any other identified cause and confirmed cases as suspect cases in which *S. sonnei* was isolated from 1 June 2022 onwards. We actively searched for cases through case interviews and laboratory and medical records. We inspected sanitary conditions in index cases' households and collected environmental samples. We calculated attack rates (AR) of suspected cases per 100 000 inhabitants.

**Results:** As of 30 June 2023, 653 suspected cases (AR=5.5) were reported, of which 378 (58%) were confirmed and one died. The epi-curve suggested an initially common source followed by human-to-human transmission with a peak in week 48/2022 (74 cases) followed by subsequent incidence decrease. AR was highest among children <10 years (AR=22.8). Of 95 households inspected, 69 (72%) resided in rural areas, 14 (15%) and 31 (32%) were not connected to the water supply or sewage system, respectively. Handling soiled diapers and interruption of running water seven days before symptom onset were respectively reported in 31 (32%) and 21 (22%) households. Environmental investigations (n=223) were negative for *S. sonnei*. Three water samples from water tank deliveries were positive for coliform bacteria. Most isolated strains produced ESBL. Regional authorities reinforced control of clandestine water distribution and conducted risk communication on hygiene practices.

**Conclusion:** This outbreak was likely caused by drinking unsafe water and non-compliance with basic hygiene practices. We recommend enhancing microbiological surveillance in public health given the emergence of ESBL-producing *S. sonnei* and continuing multisectoral collaboration. Given the absence of identification of the main source of contamination, we recommend avoiding exposures to risk factors that can lead to such infection. Strengthening the early warning and response mechanisms including the multisectoral collaboration (one health approach) is also essential. The public health actions taken were the reinforcement control for the clandestine water distribution and raising hygiene awareness among general population.

**Role and outputs:** Co-investigator in the national outbreak investigation team. Sonia was involved in the development of the protocol for an analytical study, questionnaire development and laboratory data form notification. She also was involved in the training of interviewers about case investigation, the outbreak data analysis and the bulletin writing. She participated to the national seminar of shigellosis in December 2022. Sonia drafted an article in French for the national bulletin (<https://onmne.tn/wp-content/uploads/2023/01/SHIGELLOSE-BULLTIN-N%C2%B01-2023.pdf>). In addition, she submitted an abstract for ESCAIDE 2023.

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**Supervisor(s):** Aicha Hechaichi, Hind Bouguerra, Nissaf Bouafi ép Ben Alaya, Pawel Stefanoff

**Status:** Completed.

## 3. Research

### 3.1. Long-term health effects of COVID-19 in Tunisia, 2020-2021

**Background:** Some patients suffer from persisting symptoms following COVID-19 infection, referred to as long COVID. The aims of the study were to estimate the prevalence and study the determinants of long-covid in Tunisia.

**Methods:** We surveyed a representative sample of COVID-19 survivors residing in Tunisia. We selected a random sample, stratified by age and region, among residents registered in the national surveillance database with a SARS-CoV-2 positive test taken from September 2020 to September 2021. We defined a patient with long COVID as having at least one self-reported symptom lasting for more than four weeks after the first confirmation of SARS-CoV-2 infection and not explained by an alternative diagnosis. Trained healthcare workers interviewed consenting respondents by phone using a structured questionnaire. We estimated the prevalence of long COVID and the association between explanatory variables (socio-demographic, lifestyle and comorbidities, SARS-Cov-2 history infection, COVID-19 vaccination status) and long COVID using a log-binomial model, reporting adjusted prevalence ratios (a-PR).

**Results:** Of 1 094 persons contacted, 416 (38%) were recruited. Long-covid prevalence was 64% (267/416); 95%CI: 59%-69%. The sex-ratio (M:F) was 0.72. Age ranged from 1 to 101 years (median 41). The most common symptoms were: fatigue (63%), myalgia/arthritis (33%) and cognitive symptoms (52%). The median duration of long-covid symptoms was 11 months (IQR: 3-14). In multivariate analysis, having more than three symptoms during acute infection (a-PR=1.5; 95%CI: 1.0-2.1), being a woman of childbearing age (a-PR=1.2; 95%CI: 1.0-1.4) and residence in the central region (a-PR=1.5; 95%CI: 1.1-2.0) were significantly associated with higher long-covid prevalence.

**Conclusions:** Long-covid is highly prevalent in Tunisia affecting patients with multiple symptoms initially, residing in the central region and mostly young women. We recommend enhancing healthcare access and medical follow-up during and after the infection, focusing on identified risk groups. We also recommend further research to optimize management of long COVID patients.

**Role and Outputs:** Sonia was the principal investigator in this research. She wrote the protocol, developed the questionnaire, submitted to ethical committee for Pasteur Institute of Tunis for approval, developed data entry mask on epi-info, performed some data collection and data entry, performed the data analysis and the first draft of the manuscript. Sonia presented the finding of this research at the MediPIET scientific event (oral communication), ECDC, Sweden, November 2022 and at the TEPHIENT/FETP international nights (poster), Atlanta, USA, April 2023. In addition, Sonia prepared a manuscript that will be submitted to a peer-reviewed journal.

**Supervisor(s):** Hind Bouguerra, Aicha Hechaichi, Nissaf Bouafi ép Ben Alaya, Pawel Stefanoff

**Colleague from training site:** Hejer Letaief

### 3.2. Health-related quality of life among long-covid patients in Tunisia, 2020–2021

**Background:** Long-covid affect patients' well-being and quality of life. We aimed to assess the impact of long-covid on the patients' health-related quality of life in Tunisia.

**Methods:** We surveyed a representative sample of COVID-19 survivors registered in the national SARS-CoV-2 surveillance database in Tunisia from September 2020–September 2021 (n=479 743). We defined long-covid as self-reported one or more symptoms lasting for at least four weeks after the first SARS-Cov-2 infection and not explained by alternative diagnosis. Trained healthcare workers interviewed consenting respondents by phone using the EQ-5D-3L questionnaire to examine five dimensions of their quality of life: mobility, self-care, usual activities, pain-discomfort and anxiety-depression. Each dimension was scored: none; some and extreme problems. Interviewers recorded respondents' perceived quality of life on the day of the survey on the numerical visual analog scale VAS (0–100). We measured the internal consistency of the survey items using Cronbach's Alpha. We compared quality of life measures between respondents reporting long-covid symptoms and those without long-covid.

**Results:** Out of 1 094 persons contacted, 416 responded (38%). Among respondents, long-covid prevalence was 64% (95%CI 59%-69%). 31% (95%CI 26%-35%) of participants reported problems in all dimensions: 41% among those with long-covid respondent compared to 13% among those without (p<0.001). Compared to responders without long-covid, those with long-covid reported more problems in all dimensions: mobility: 14.8% vs 4.1% (p=0.001), usual activity: 12.6% vs 4.8% (p=0.010), pain-discomfort: 22.4% vs 3.4% (p<0.001) and anxiety-depression: 19.8% vs 8.1% (p=0.002). The VAS score was significantly lower among long-covid responders compared to non-long covid: 73 vs 84 (p<10<sup>-3</sup>). Cronbach Alpha's was 0.7.

**Conclusion:** Long-covid impacted quality of life, affected mobility and caused disability. We recommend providing both physical and psychological health-care services during and after acute COVID-19 episode to preserve the well-being of affected patients.

**Role and outputs:** Sonia was the principal investigator of this research. She wrote the protocol, developed the questionnaire, submitted to ethical committee for Pasteur Institute of Tunis, developed data entry mask on epi-info, performed some data

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collection and data entry, performed the data analysis and the first draft of the manuscript. Sonia presented the finding of this research at international conferences. Sonia submitted an abstract to the 17 th World Congress on Public Health (Rome, May 2023) and to ESCAIDE 2023 (online poster).

**Supervisor(s):** Hind Bouguerra, Aicha Hechaichi, Nissaf Bouafif ép Ben Alaya, Pawel Stefanoff

## 4. Scientific communication

### Conference presentations

- Dhaouadi S, Aichouch C, Zouayti A, Bougatef M, Neffati A, El Mili N, Mhadhbi R, Hechaichi A, Letaief H, Safer M, Bouguerra H, Bouafif ép Ben Alaya N. Long-term Health Effects of COVID-19 in Tunisia, 2020-2021. MediPIET Scientific event. Stockholm, Sweden. November 2022. (oral presentation)
- Dhaouadi S, Aichouch C, Zouayti A, Bougatef M, Neffati A, El Mili N, Mhadhbi R, Hechaichi A, Letaief H, Safer M, Bouguerra H, Bouafif ép Ben Alaya N. Long-term Health Effects of COVID-19 in Tunisia, 2020-2021. Atlanta, United States of America. April 2023. (poster presentation)
- <https://www.tephinet.org/learning/fead/long-term-health-effects-covid-19-tunisia-2020-2021>
- <https://flickr.com/photos/tephinet/52832647490/in/album-72177720307644966/>
- Dhaouadi S, Safer M, Letaief H, Hechaichi A, Bouguerra H, Zouayti A, Aichouch C, Neffati A, Bougatef M, Mhadhbi R, El Mili N, Talmoudi K, Bouafif ép Ben Alaya N. Health-related quality of life among long-covid patients in Tunisia, 2020-2021. ESCAIDE. Barcelone, Spain. November 2023. (online only poster)
- Mziou E, Dhaouadi S, Hechaichi A, Ben Youssef F, Letaief H, Guermazi S, Safer M, Derouiche S, Bouabid L, Bougatef S, El Milil S, Rebhi M, Bouafif ép Ben Alaya N. **Risk factors for household transmission of Shigella during an outbreak in Tunisia, July-November 2022.** ESCAIDE. Barcelone, Spain. November 2023. (poster presentation)

### Publications and outputs

- Dhaouadi S, Bouguerra H, Hechaichi A, Letaief H, Safer M, Aichouch C, Zouayti A, Bougatef M, Neffati A, El Mili N, Mhadhbi R, Bouafif ép Ben Alaya N. **Long-term Health Effects of COVID-19 in Tunisia, 2020-2021.** Plos One (manuscript under submission)
- Dhaouadi S, Abid S, El Ghord H, Latifa M, Jlassi S, Bouabid L, Gzara A, Boutiba I, Bouafif ép Ben Alaya N. **Surveillance des viroses respiratoires dans le monde et en Tunisie, S40-2022 à S17-2023 (Fin de saison 2022/2023).** 2023. National Observatory of New and Emerging Diseases, Tunis. Tunisia. (<https://onmne.tn/?p=17369>)
- Dhaouadi S, Ben Youssef F, Mziou E, Hechaichi A, Letaief H, Mhadhbi R, Guermazi S, Larouchi F, El Mili N, Jlassi S, Nasri N, Derouiche S, Rabhi M, Bouafif ép Ben Alaya N. **Epidémie de Shigellose en Tunisie: Bulletin de veille et de riposte au 08/01/2023 (S01/2023).** 2023. National Observatory of New and Emerging Diseases, Tunis. Tunisia. (<https://onmne.tn/wp-content/uploads/2023/01/SHIGELLOSE-BULLETIN-N%C2%B01-2023.pdf>)

## 5. Teaching activities

### *Burden of COVID-19 using the European Burden of Disease Network consensus methodology*

Sonia was involved on the presentation of COVID-19 burden in Tunisia using the European Burden of Disease Network consensus methodology during the scientific workshop in research methodology (le Workshop scientifique sur la méthodologie de recherche). This was held on 30 December 2021 in Hammamet (El Mouradi Hotel), Tunisia in collaboration with Heidelberg Institute. She prepared the training material and training method. The target audience was: residents in preventive and community medicine and health professionals from regional directorates of health. The presentation duration was two hours. The objectives were to understand the concept of burden of disease (DALY, YLL and YLD), to apply the EBDN methodology on national/ regional COVID-19 data and to understand the concept of uncertainty analysis.

### *Introduction to epidemiology and surveillance for the employees of Antigua and Barbuda Ministry of Health*

During her deployment in Antigua Barbuda, June-July 2023 Sonia performed an introductory course lecture in field epidemiology. She presented the epidemiology principals and epidemiological studies design, frequency and impact measures, transmission chain and prevention of infectious diseases. In addition, she carried out an optional lecture on standardisation (direct and indirect).

### *Co-facilitating the ECDC workshop on the rapid risk assessment in Tunis, Tunisia (24-26 January 2023) in collaboration with Preparedness and Response Support / Communication ECDC staff.*

Sonia was involved in co-facilitation of the group work: RRA on Ebola virus disease transmission in Tunisia from an African country based on the ECDC RRA tool in addition to risk-communication. She also performed the evaluation survey after the workshop.

### *Co-Facilitation of the workshop about EBS implementation in Tunisia with WHO*

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Séminaire de validation du guide et des Procédures Opérationnelles Standardisées: Surveillance basée sur les événements/  
Seminar of validation of the guide and Standard Operating Procedure (SOP): Event based Surveillance system 26-28 December,  
Tunis, Tunisia.

Sonia co-facilitated the group work of validation of events to be notified under EBS and the key persons/structures to involve for notification.

#### *Instructor and Facilitator on the Tunisian-FETP:*

- Lectures performed for Tunisian-FETP/ Basic and intermediate levels/ 2022
- Co-facilitation of case studies:
  - Analysis of surveillance data using of Epi-info (version 7) (exp of emergent virus)
  - COVID-19 vaccine effectiveness in Tunisia/study design.

## 6. International assignments

### 6.1. Assistance of Epi-unit staff at Ministry of Health on competencies development: Deployment in Antigua Barbuda from June-July 2022

**Background:** Antigua and Barbuda is a country located in the Leeward Islands of the Caribbean, with a total population of approximately 90 755 (2015). The economy is dependent primarily on tourism, which contributes almost 60% of the GDP, as well as construction and financial services.

Following the first experiences with COVID-19 response in 2020/2021, the country requested technical support to the subnational incident management teams, Ministry of Health within the WHO Health Emergencies Incident Management System (IMS). The country needed specifically assistance in strengthening surveillance and response for priority diseases, conditions and events in the context of Integrated Disease Surveillance and Response (IDSR), monitoring the implementation and operations of surveillance and response programmes with special focus on early detection, verification and rapid response to epidemics and other public health events of international concern, as well as capacity building of national experts, in compliance with IHR (2005).

**Objectives of the assignment:** The main objective was to support the country in COVID-19 response by strengthening the COVID-19 surveillance system and other communicable diseases and training the epidemiology staff in applied epidemiology.

**Methodology followed:** The mission lasted from 28 June to 23 July 2023. First, I conducted a needs assessment to identify the topics for training of epi-unit staff in applied epidemiology and to identify the gaps in the surveillance system for communicable diseases (CD). I also studied the surveillance reports in the country and the neighbouring Caribbean countries to understand the epidemiological profile of COVID-19 and other CD in the Region in addition to reviewing the evaluation report of CD in the country performed by the Caribbean Public Health Agency (CARPHA) team in 2018 in order to provide target recommendations.

**Results of assignment:** The background for the epi-unit staff on epidemiology and public health ranged from none to Master's level expertise. Training courses in applied epidemiology were targeted according to the needs assessment. I conducted a pre-test questionnaire on field epidemiology followed by a first lecture and an evaluation questionnaire to improve the next lectures. Regarding surveillance, many gaps were identified; mainly lack of collaboration with the Central Board of Health (CBH) and with the Vaccine-Preventable Diseases and Immunization (VDI) unit. There has been a low level of participation among private physicians in SARS-CoV-2 notification. The genomic sequencing was not done locally and there were no specific guidelines in place. The COVID-19 surveillance database did not include ID number for each record which lead to difficulties deduplication of observations. The Go.Data platform was not yet operational and the generation of weekly report was done manually. I updated the data flow diagram for the communicable diseases surveillance system which dated from 2008. I provided support to the surveillance officers for COVID-19 data management and for surveillance reports of COVID-19 and other communicable diseases. I actively contributed to staff skills development in map design for COVID-19 surveillance reports using QGIS software.

**Conclusions and recommendations:** The main recommendations were to continue the training of epi-unit staff in applied epidemiology to enhance their knowledge and response capabilities during acute public health emergencies in addition to their ongoing surveillance activities. Additionally, the IT team should provide assistance to epidemiology-unit staff in particular to speed up the implementation of the Go.Data platform, which will improve the notification process. Collaboration with the CBH, VDI unit and other departments should be strengthened. The Ministry of Health staff should use a Unique identifier (ID) for each citizen when analysing data for Public Health purposes. We recommend enhancing laboratory's capacity for testing and sequencing especially for emerging viruses (SARS-CoV-2 and Monkeypox). We also recommend updating the surveillance manual of communicable diseases including COVID-19 and SARS-Cov-2 genomic surveillance's strategy. Finally, we recommend developing a plan of preparedness and response for public health threats (including epidemic-prone diseases).

**Hosting country and institute:** Antigua and Barbuda. Ministry of Health, Wellness and the Environment, epi-unit department

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**Supervisors:** Hind Bouguerra, Pawel Stefanoff

Colleagues form the WHO/PAHO country office

**Colleague from training site:** Hejer Letaief

## 7. Other activities

- Epidemic Intelligence activities:
  - Event coordinator of epidemic-prone respiratory diseases (for event verification and rapid risk assessment)
  - Co-authoring the Abstract submitted to the 3rd International Conference on Public Health in Africa (CPHIA 2023). Epidemic Intelligence from Open Sources implementation in Tunisia: experience of seven months: December 2022-August 2023 (result by 30 September 2023).
- Excess mortality of COVID-19 in Tunisia, 2020-2021. Supervision and co-authoring the abstract submitted to the 3rd International Conference on Public Health in Africa (CPHIA 2023).
- Assisting two Tunisian-FETP fellows for the abstract for the Eight EMPHNET Regional Conference 2023, October 2023, Amman, Jordan.
  - 'Exploratory Investigation of Shigellosis Outbreak in Ben Arous Governorate, Great Tunis, Tunisia, December 2022' (accepted as poster presentation)
  - 'Influenza Burden in Tunisia During 2022/2023 Season Using the WHO Seasonal Influenza Burden of Disease Estimator' (accepted as oral communication)
  - Epidemiological profile of covid-19 deaths in Tunisia, 2020-2022 Popul. Med. 2023;5(Supplement):A448
  - DOI: <https://doi.org/10.18332/popmed/164687>
- COVID-19 in Tunisia: 2020/2023: Surveillance, data management and bulletin writing: <https://www.onmne.tn/?p=15695>  
[https://www.onmne.tn/?page\\_id=5792](https://www.onmne.tn/?page_id=5792)
- Bulletin of monitoring international situation of epidemic-prone diseases: Bulletin Mensuel de Veille Sanitaire Internationale Janvier 2023. National Observatory of New and Emerging Diseases, Tunis, Tunisia. (<https://onmne.tn/wp-content/uploads/2023/02/Bulletin-de-Veille-internationale-Janvier-2023-NBA.pdf>)
- Equipe de rédaction: Ben Youssef F, Mziou E, Fitouri S, Fourati A, Triki W, Benzarti A, Derbali C, Jellassi S, Mhadhbi R.
- Equipe de validation: Dhaouadi S, Letaief H, Hechaichi A, Safer M, Derouiche S, Gharbi D, Bouabid L, Bougateg S, Besbes N, Chahed MK, Bouafif ép Ben Alaya N

## Publications (Manuscripts/ abstracts):

- Dhaouadi S, Kharroubi G, Cherif A, Cherif I, Bouguerra H, Bouabid L, et al. Knowledge attitudes and practices toward seasonal influenza vaccine among pregnant women during the 2018/2019 influenza season in Tunisia. PLoS ONE. 2022. 17(3): e0265390. <https://doi.org/10.1371/journal.pone.0265390>
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### European Centre for Disease Prevention and Control (ECDC)

Gustav den III:s Boulevard 40, 169 73 Solna, Sweden

Phone: +46 (0)8 58 60 10 00 - Fax: +46 (0)8 58 60 10 01

[www.ecdc.europa.eu](http://www.ecdc.europa.eu)

## Training courses workshops attended:

- 24 Jan 2022-3 April 2022: Certificate of Monitoring and Evaluation in Global Health, University of Washington Global Health E-Learning Program (attended online course)
- -2/12/2021: Certificate of completion of Understanding Vaccine Acceptance & Strategies to Increase Vaccine Uptake (ECDC E-learning)
- 04/04/ 2022: Certificate of: Introduction to designing in- and after-action reviews (ECDC E-learning)
- 16 May-03 June 2022 : Développement des capacités dans le domaine de la sécurité sanitaire (GCSP: Geneva Center for Security Policy) Un parcours de formation virtuelle (online)
- 13-14 Sept 2022 Participation in the Training workshop in Risk Communication, 13-14 September 2022, ECDC, Stockholm, Sweden.
- 18 Sept 2022: Addressing Online Vaccination Misinformation e-learning (ECDC-e learning)
- 18 Jan 2023: Attendance the webinar (online): Emergency Risk Management, GHD/EMPHNET
- 15-16 Feb 2023: Refresher Training on Epidemic Intelligence at ECDC (participant)
- 20-22 Feb 2023: Mentorship Training Workshop /EMPHNET in Tunisia (participant)
- 27-28 Feb 2023: Attending a seminar-workshop "Strengthening the Surveillance and Seasonal Influenza Control Program in Tunisia: A One Health Approach" In collaboration with US-CDC, WHO/EMRO, NIC, IPT, MoA (Agriculture), DGSV
- 07-09 March 2023: Attending the ECDC workshop in Tunisia: Regional workshop on COVID-19 recovery in Tunisia
- 31 May-1 June 2023: Attending Training on Using Simulation Exercises (SimEx) to enhance Emergency Preparedness & Response plans, ECDC, Stockholm, Sweden
- 21/03-23/03/2022: Attending the Regional Workshop of FETP Sustainability in EMR, Amman, Jordan
- 23/09/2022: Participation to the workshop in collaboration with world bank, Tunisian ministry of health and other sectors: "Assessment of health system resilience and preparedness for pandemics/health emergencies in Tunisia", Tunis, Tunisia.
- 21-23 August 2023: Participation in the workshop with WHO/EMRO: Introducing EMFLU 2.0 and Rolling Out: Sentinel data reporting and capacity building on data management, Tunis, Tunisia.
- **Meeting:**
- 28 July 2023: Heatwave during June-July 2023 in Tunisia: data collection and analysis, situation report, participation in the national meeting with Emergency Operation Center (EOC, Shocroom) and head of emergencies department at public hospitals (PH measures and risk assessment; Shocroom)
- 4 July 2023: Participation in the meeting of risk assessment of local transmission of malaria in Tunisia after detecting of Anopheles mosquito in Kasserine
- 22-23 May 2023: Participation on the 'Exchange of Experts' meeting Belgium and Tunisia and focused on the Creutzfeldt-Jakob disease (CJD). The event was hosted by the University of Antwerp, Belgium, with the support of the European Centre for Disease Prevention and Control (ECDC).

## 8. MediPIET modules attended

1. Introductory Course Part 1, 20/09/2021-08/10/2021, online
2. Outbreak Investigation, 6-10 December 2021, online
3. Multivariable Analysis, 14-18 March 2022, online
4. Project Review Module, 20-22 April 2022, online; Introductory course 2021 Part 2, 25-29 April 2022, Spetses, Greece, in person
5. Project Review Module 2022, Lisbon, Portugal, 29 August-02 September 2022, Lisbon, Portugal, face-to face
6. Time series analysis, 07-11 November 2022, Bithoven, Netherlands, face-to face
7. Chemical, Biological, Radiological and Nuclear (CBRN) Awareness and Mitigation Module, 13-17 March 2023, Petrovac, Montenegro, face-to-face
8. Vaccinology module, 29 March 2023, online
9. One health module, 2-4 May 2023 and 15-17 May 2023, online
10. Rapid Assessment and Survey Methods, Mass Gathering module, Stockholm, Sweden, face-to-face (with MediPIET cohort 5)
11. Project Review Module 2023, Lisbon, Portugal, 28 August-01 September 2023, Lisbon, Portugal, face-to-face

### Inject days:

1. Phylogeny and whole genome sequencing/Inject day 1, Module 1, 20 October 2021, online
2. Operational research/Inject day 2, Module 1, 27-28 October 2021, online
3. Data collection and management/ Inject day 3, Module 1, 10-11 November 2021, online
4. Qualitative Research, 31 January 2023 and 03 February 2023, online] (optional inject day)

## Supervisor conclusion

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**Hind:** Sonia was a hard-working and motivated fellow, showing significant progress in most competencies throughout the fellowship. Although she had already lots of experience in public health and scientific work before starting the programme, she demonstrated strong learning skills and was always engaged to put these skills into practice. Her involvement in COVID-19 surveillance, outbreak investigation of shigellosis and the national field epidemiology training program are only examples of the practical public health implications and the added value she had in the institute.

**Aicha:** Over the two years of the MediPIET fellowship, Sonia has exhibited diligence and motivation, showcasing significant advancements in various skills. She has taken the lead in an impressive range of public health projects, particularly in the surveillance of COVID-19. Sonia consistently analysed the epidemiological situation and conducted epidemic investigations, providing valuable support to our institution.

## Scientific coordinator conclusion

Sonia had a very successful fellowship due to her ambitious and enthusiastic approach and hard work. She did not focus on achieving only the minimum requirements to graduate, but she took all the opportunities to improve her skills and competencies. Even though she already had good experience with epidemiological methods and research, she actively participated in training modules and focused her field assignments on areas where she had less experience. She was not afraid to ask questions during the training courses and to her supervisors, using her fellowship to a maximum.

## Personal conclusions of fellow

This fellowship was a great opportunity for me to learn and practice more about applied epidemiology, another aspect non-academic for epidemiology. The support from the training site, my supervisors, my colleagues MediPIET Alumini, and frontline coordinators were very helpful to give my best. My deployment during the international assignment in Antigua Barbuda with GOARN/WHO was fruitful and gave me the opportunity to take responsibilities in a new country with different system. It was challenging, but allowed me to learn how to critically appraise a public health system and provide constructive recommendations. All of these experiences enabled me to improve my competencies and motivated me to continue working with the same enthusiasm after the end of fellowship.

## Acknowledgements

I'm grateful to all my colleagues at the training site who supported me during this fellowship and all who helped me to achieve the required deliverables.