



ANNUAL REPORT FOR YEAR 2022 ON THE PERFORMANCE OF “BREATHING LIFE LUNG CENTER FOR CHILDREN” IN NICOSIA-CYPRUS

The Center is located at the ground floor of the Archbishop Makarios III Hospital in Nicosia in a specially designed wing with outpatient examination rooms and labs for a wide array of assessments of the respiratory system. It is currently staffed by three physicians specialized in respiratory paediatrics (Professor Panayiotis Yiallourous, Lecturer Pinelopi Anagnostopoulou and Dr. Khalid Wahbi), two nurse specialists (Phivos Ioannou, Elena Kongorozi) and secretarial personnel. The Center collaborates closely with the Respiratory Physiology Laboratory (<https://res-lab-pcd-service.eu/>) of the Medical School of the University of Cyprus (UCY) offering supplementary diagnostic services to special groups of patients. It also collaborates closely with other medical specialties and health professionals at Makarios Hospital such as Paediatric Cardiologists, Clinical Geneticists, Paediatric Neurologists, ENT surgeons, Dieticians and Physiotherapists to offer an all-round multidisciplinary care to patients with complex health problems. The physicians of the Center perform **regular clinical rounds every week** providing consultations to inpatients with complex respiratory problems on the General Paediatric Wards, the Pediatric Intensive Care and the Neonatal Intensive Care Unit of the Hospital, in close collaboration with the physicians of each Unit.

The Breathing Life Lung Center continued in 2022 offering within the national health system (GESY) **tertiary diagnostic services and therapeutic care** to children from all over Cyprus with a wide variety of complex lung conditions such as asthma, respiratory infections, upper airway obstruction, bronchiectasis, bronchopulmonary dysplasia, congenital lung anomalies and children requiring non-invasive home ventilation, implementing international guidelines and standards of care. The Center is also the **national hub for the diagnosis and management of Cystic Fibrosis (CF)** and **Primary Ciliary Dyskinesia (PCD)** and maintains for both conditions national prospective patient registries hosted at the Medical School of the University of Cyprus. The Center also provides, after consent, annual clinical data of Cypriot CF and PCD patients to the European Cystic Fibrosis Society Patient Registry and the International Primary Ciliary Dyskinesia Registry respectively. In parallel, all CF and PCD patients that are followed up at the Center undergo annual review of their clinical status by the team of the health professionals engaged in their care.

During 2022 the Center operated daily (Monday-Friday) outpatient clinics managing **3,353 cases** referred from all over the Republic of Cyprus, the Turkish Cypriot Community in Northern Cyprus and the British Military Forces. Our personnel continued functioning throughout the year with full protection gear and disinfection measures for the COVID-19 pandemic. A wide array of specialized diagnostic procedures were performed during 2022 including **spirometries (n= 217)**, **flexible bronchoscopies (n=35)**, **fractional exhaled nitric oxide (n= 52)**, **nasal nitric oxide (n=18)**, **lung clearance index (n=47)**, **nasal epithelium biopsies for cilia studies (n=20)**, **24hr pH-impedance studies (n=41)** and **overnight sleep studies (n=47)**.

New equipment was acquired during 2022 aiming to expand the diagnostic and monitoring capacity of patients with chronic respiratory disorders, including innovative measuring equipment (electrical impedance tomography device - ENLIGHT 2100, InnoVentiv, BG), and forced oscillation technique device (RESMON PRO, Restec, IT).



The Center also provided clinical placements and training in paediatric respiratory disorders to 5th Year Medical School students of the University of Cyprus, as well as to international students via exchange programs, as part of their curriculum.

International Quality Accreditation

During 2022 the Breathing Life Lung Center at Makarios Hospital successfully underwent external evaluation and was accredited with **ISO 9001:2015** and **ISO 15224:2016 quality standards** for all the provided diagnostic and therapeutic services. With this the Breathing Life Lung Center became the first Clinic amongst the Public Hospitals in Cyprus that received such an accreditation for the quality of its services.

Of note, since 2021 and following external evaluation by officials of the European Union, the Primary Ciliary Dyskinesia Service (<https://res-lab-pcd-service.eu/pcd-service/>) of the Center also enjoys **full membership of the European Reference Network for Rare Lung Disorders (ERN LUNG – PCD Core)**, while in parallel the service participates as a **Clinical Trials Center for PCD** to the relevant network created by the ERN LUNG – PCD Core (<https://pubmed.ncbi.nlm.nih.gov/35983540/>).

Research Activity at Breathing Life Lung Centre

Research activity continued in 2022 under the umbrella of the Medical School with participation of many patients from the Breathing Life Lung Center at Makarios Hospital and the contribution of human resources and infrastructure of the Respiratory Physiology Laboratory at SEKKI. The main thematic areas of the research activities are Childhood Asthma and Allergies, Primary Ciliary Dyskinesia, Cystic Fibrosis and Environmental Health.

In particular, the large four-year LIFE+ European grant **MEDEA - Mitigating the Health Effects of Desert Dust Storms Using Exposure-Reduction Approaches** examining the effects of desert dust storms in children with asthma and adults with heart arrhythmias (LIFE16 CCA/CY/000041) (<https://www.life-medea.eu/>) under the supervision of Prof Yiallourous was concluded in December 2022 with great success. The final report of the project will be submitted to the EU in March 2023, while in parallel the first results of the project have already been published with several more publications coming up in 2023.

Four other projects continue funded by IDEK or internal resources:

1. **Observational Study of Respiratory Exacerbations in Primary Ciliary Dyskinesia (PCD)** to assess for a period of 12 months the morbidity burden in PCD with participation of many PCD European Centers. The study is coordinated by Dr. Pinelopi Anagnostopoulou, data collection has been completed in December 2022 and data analysis will take place in 2023.
2. **Observational Study of Familial Concordance in Primary Ciliary Dyskinesia (PCD)** in siblings with PCD to assess agreement among sibling-pairs of phenotypic characteristics with participation of many PCD European Centers. The study is coordinated by Dr.



Panayiotis Kouis (Respiratory Physiology Laboratory of the UCY Medical School), the data collection has been completed in December 2022 and data analysis will take place in 2023.

3. **Whole genome sequencing of Pseudomonas Aeruginosa Isolates from Cystic Fibrosis and Primary Ciliary Dyskinesia Patients in Cyprus.** The project has finished data collection and the isolates have been genotyped in 2022. Analysis of genotypic data and associations with clinical data will be carried out during 2023.

4. **Biometeorological Aspect of Thermal environment and Health: impacts on public health and on special populations to improve the quality of life and tourism sustainability.** Project Acronym: BeAT Heat (Funded by Research Promotion Foundation). The project assessed impact of heat on health outcomes in cystic fibrosis patients and healthy controls in Cyprus and was completed in February 2022. The data analysis is continuing with first publications awaited in 2023.

Relevant Research Publications in 2021-2022

1. Kouis P, Kakkoura M, Elia SA, Ioannou P, Anagnostopoulou P, Potamiti L, Panayiotidis MI, Kyriacou K, Hadjisavvas A, Yiallourous PK. [Observational study of health utilities in adult Primary Ciliary Dyskinesia patients: associations with molecular diagnosis, clinical phenotype and HR-QoL measures.](#) Multidisciplinary Respiratory Medicine. 2022; volume 17:881.
2. Achilleos S, Michanikou A, Kouis P, Papatheodorou SI, Panayiotou AG, Kinni P, Mihalopoulos N, Kalivitis N, Kouvarakis G, Galanakis E, Michailidi E, Tymvios F, Chrysanthou A, Neophytou M, Mouzourides P, Savvides C, Vasiliadou E, Papasavvas I, Christophides T, Nicolaou R, Avraamides P, Kang CM, Middleton N, Koutrakis P, Yiallourous PK. [Improved indoor air quality during desert dust storms: The impact of the MEDEA exposure-reduction strategies.](#) Sci Total Environ. 2022 Dec 17:160973. doi: 10.1016/j.scitotenv.2022.160973.
3. Kouis P, Michanikou A, Galanakis E, Michaelidou E, Dimitriou H, Perez J, Kinni P, Achilleos S, Revvas E, Stamatelatos G, Zacharatos H, Savvides C, Vasiliadou E, Kalivitis N, Chrysanthou A, Tymvios F, Papatheodorou SI, Koutrakis P, Yiallourous PK. [Responses of schoolchildren with asthma to recommendations to reduce desert dust exposure: Results from the LIFE-MEDEA intervention project using wearable technology.](#) Sci Total Environ. 2022 Nov 26:160518. doi: 10.1016/j.scitotenv.2022.160518.
4. Halbeisen FS, Pedersen ESL, Goutaki M,, Yiallourous P, Nielsen KG, Kuehni CE. [Lung function from school age to adulthood in primary ciliary dyskinesia.](#) Eur Respir J. 2022 Oct 20;60(4):2101918. doi: 10.1183/13993003.01918-2021.
5. Raidt J, Maitre B, Pennekamp P, Altenburg J, Anagnostopoulou P,, Yiallourous P, Omran H, Nielsen KG. [The disease-specific clinical trial network for primary ciliary dyskinesia: PCD-CTN.](#) ERJ Open Res. 2022 Aug 15;8(3):00139-2022. doi: 10.1183/23120541.00139-2022
6. Kouis P, Michaelidou E, Kinni P, Michanikou A, Anagnostopoulou P, Dimitriou H, Karanicolas K, Matthaiou AM, Achilleos S, Papatheodorou SI, Koutrakis P, Middleton N, Galanakis E, Yiallourous



- PK. [Pediatric asthma symptom control during lockdown for the COVID-19 pandemic in Spring 2020: A prospective community-based study in Cyprus and Greece](#). *Pediatr Pulmonol*. 2022 Feb;57(2):386-394. doi: 10.1002/ppul.25765
7. Kinni P, Kouis P, Dimitriou H, Yarza S, Papatheodorou SI, Kampriani E, Charalambous M, Middleton N, Novack V, Galanakis E, Yiallourous PK. [Health effects of desert dust storm events in the south-eastern Mediterranean: perceptions and practices of local stakeholders](#). *East Mediterr Health J*. 2021 Dec 1;27(11):1092-1101. doi: 10.26719/emhj.21.037.
8. Jung A, Orenti A, Dunlevy F,, Woz Niacki L, Yiallourous P, Zolin A, Downey DG, Naehrlich L. [Factors for severe outcomes following SARS-CoV-2 infection in people with cystic fibrosis in Europe](#). *ERJ Open Res*. 2021 Dec 27;7(4):00411-2021. doi: 10.1183/23120541.00411-2021.
9. Goutaki M, Lam YT, Alexandru M, Anagiotos A,, van Gogh C, Yiallourous P, Zappe SM; EPIC-PCD team, Papon JF. [Study protocol: the ear-nose-throat \(ENT\) prospective international cohort of patients with primary ciliary dyskinesia \(EPIC-PCD\)](#). *BMJ Open*. 2021 Oct 11;11(10):e051433. doi: 10.1136/bmjopen-2021-051433.
10. Yiallourous PK, Matthaïou AM, Anagnostopoulou P, Kouis P, Libik M, Adamidi T, Eleftheriou A, Demetriou A, Ioannou P, Tanteles GA, Costi C, Fanis P, Macek M, Neocleous V, Phylactou LA. [Demographic characteristics, clinical and laboratory features, and the distribution of pathogenic variants in the CFTR gene in the Cypriot cystic fibrosis \(CF\) population demonstrate the utility of a national CF patient registry](#). *Orphanet J Rare Dis*. 2021 Oct 2;16(1):409. doi: 10.1186/s13023-021-02049-z.
11. Marthin JK, Lucas JS, Boon M,, Yiallourous P, Johansen HK, Nielsen KG. [International BEAT-PCD consensus statement for infection prevention and control for primary ciliary dyskinesia in collaboration with ERN-LUNG PCD Core Network and patient representatives](#). *ERJ Open Res*. 2021 Aug 2;7(3):00301-2021. doi: 10.1183/23120541.00301-2021.
12. Naehrlich L, Orenti A, Dunlevy F, Kasmi I, Harutyunyan S, Pflieger A, Keegan S, Daneau G, Petrova G, Tješić-Drinković D, Yiallourous P,, van Koningsbruggen-Rietschel S, Jung A; [European Cystic Fibrosis COVID project group](#). [Incidence of SARS-CoV-2 in people with cystic fibrosis in Europe between February and June 2020](#). *J Cyst Fibros*. 2021 Jul;20(4):566-577. doi: 10.1016/j.jcf.2021.03.017.
13. Stylianou-Riga P, Boutsikou T, Kouis P, Kinni P, Krokou M, Ioannou A, Sihanidou T, Iliodromiti Z, Papadouri T, Yiallourous PK, Iacovidou N. [Maternal and neonatal risk factors for neonatal respiratory distress syndrome in term neonates in Cyprus: a prospective case-control study](#). *Ital J Pediatr*. 2021 Jun 3;47(1):129. doi: 10.1186/s13052-021-01086-5.
14. Kouis, P., Michanikou, A., Anagnostopoulou, P., ...Nikolopoulos, G.K., Yiallourous, P.K. [Use of wearable sensors to assess compliance of asthmatic children in response to lockdown measures for the COVID-19 epidemic](#). *Scientific Reports*, 2021, 11(1), 5895
15. Kouis, P., Papatheodorou, S.I., Kakkoura, M.G., ...Koutrakis, P., Yiallourous, P.K. [The MEDEA childhood asthma study design for mitigation of desert dust health effects: implementation of](#)



[novel methods for assessment of air pollution exposure and lessons learned](#). BMC Pediatrics, 2021, 21(1), 13

16. Yiallourous PK, Kouis P, Kyriacou K, Evriviadou A, Anagnostopoulou P, Matthaïou A, Tsiolakis I, Pirpa P, Michailidou K, Potamiti L, Loizidou MA, Hadjisavvas A. [Implementation of multigene panel NGS diagnosis in the national primary ciliary dyskinesia cohort of Cyprus: An island with a high disease prevalence](#). Hum Mutat. 2021 Jun;42(6):e62-e77. doi: 10.1002/humu.24196.

Panayiotis K. Yiallourous
Professor of Pediatrics & Pediatric Pulmonology
Medical School - University of Cyprus