Potential Project Areas in the PhD Programme "Epidemiology"

1. Information Technology in Surveillance and Outbreak Management

a. Possible methods: systematic surveillance system evaluations, epidemiologic modeling, statistical algorithms, geographic information system
b. Priority pathogens: pathogens with antimicrobial resistance, vaccine preventable diseases, respiratory pathogens, gastro enteric bacterial infections, other high priority epidemic prone diseases in Africa
c. Preferred geographic focus: primarily Nigeria and Ghana; possibly also Africa, Latin America, Asia
d. Suggested link to ongoing and previous research: www.sormas.org
e. Language requirements: English (fluent), German (fair)

2. Prevalence and Determinants of Infections; Effectiveness of Health Interventions

a. Possible methods: (Sero-) epidemiologic surveys, systematic reviews and/or synthesis of available (surveillance) or other data, e.g. those obtained from screening records
b. Priority pathogens: infections in general, especially Hepatitis or vaccine-preventable infections
c. Preferred geographic focus: all countries
d. Suggested links to ongoing and previous research:
https://www.ncbi.nlm.nih.gov/pubmed/30268515
https://www.ncbi.nlm.nih.gov/pubmed/27592304
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4743086/
e. Language requirements: English (fluent), German (fair)

3. Infections as Precursor, Risk Factor or Cause of Non-communicable Diseases and Risk Factors/ Predictors for Infections

a. Possible methods: Analysis of research data already collected including machine learning, time series analysis, text mining, user experience research, focus on data generated by the German National Cohort or ZIFCO systematic/scoping reviews. Also, data generated by NAKO Gesundheitsstudie can be focus of a PhD project.
b. Priority pathogens/outcomes: e.g. respiratory pathogens, parodontal disease, metabolic and cardiovascular disease, neurological disease and others.
c. Preferred geographic focus: Germany, (Europe)
d. Suggested links to ongoing and previous research:
www.helmholtz-hzi.de/zifco; www.info-pia.de; https://nako.de/informationen-auf-englisch/;
e. Language requirements: German (fluent), English (fluent)
f. Stipend necessary. Project start from June 2022 onwards.

4. Control of Nosocomial Infections

a. Possible methods: medical informatics, data science, machine learning, epidemiologic modeling, time series analysis, text mining, user research, big data analytics
b. Priority pathogens: any
c. Preferred geographic focus: Europe
d. Suggested link to ongoing and previous research: www.highmed.org/about/use-cases/infection-control
e. Language requirements: German (fair, reading), English (fluent)

5. Novel Tools for (Self-) Sampling in Epidemiological Studies

a. Possible methods: handling of safety level 2 microorganisms and patient material serum, sputum, BAL) biophysical and molecular methods, focus on device design and application (i.e. usability studies), data analysis
b. Priority pathogens: respiratory pathogens, e.g. Influenza, *Pseudomonas aeruginosa*, *M. bovis* BCG; hepatitis viruses
c. Preferred geographic focus: does not apply
d. Suggested link to ongoing and previous research:
https://www.helmholtz-hzi.de/en/research/research_topics/bacterial_and_viral_pathogens/epidemiology/epidemiological_lab/,
https://www.helmholtz-hzi.de/en/research/research_projects/view/projekt/detail/-4a0c66b596/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4210747/
https://www.ncbi.nlm.nih.gov/pubmed/24813875
e. Language requirements: German (fluent) or English (fluent)

6. Differential Multiplex Serology

a. Possible methods: handling patient material (BAL, serum, sputum) ,molecular methods like cloning, heterologous protein expression, immunoblot, ,bead-based multiplex serology, biomarker-oriented research, data analysis, study support and project management (sample acquisition, ethics and data protection applications)
b. Priority pathogens: respiratory and chronic pathogens, vaccine-preventable diseases (e.g. measles, hepatitis viruses) and emerging pathogens
c. Preferred geographic focus: n. a.
d. Suggested links to ongoing and previous research:
https://www.helmholtz-hzi.de/en/research/research_topics/bacterial_and_viral_pathogens/epidemiology/epidemiological_lab/,
https://www.helmholtz-hzi.de/en/research/research_projects/view/projekt/detail/-9dc57fffd7/
https://www.ncbi.nlm.nih.gov/pubmed/28919226
https://www.ncbi.nlm.nih.gov/pubmed/29855458
https://www.thelancet.com/journals/ebiom/article/PIIS2352-3964(21)00317-0/fulltext
e. Language requirements: German (fluent) or English (fluent)

7. Infections of the Immunocompromised Host

a. Possible methods: evaluation of data quality, data mining and data cleaning, research communication (reporting and visualization), machine learning, longitudinal study designs
b. Priority pathogens: any bacterial, viral, fungal or parasite infection (postoperative)
c. Preferred geographic focus: Europe
d. Suggested link to ongoing and previous research:
www.dzif.de/en/research/infections_of_the_immunocompromised_host/transplantationskohorte_e_v/
e. Language requirements: German (fluent), English (fluent)

8. Statistical Methods in Epidemiological Research

a. Possible methods: Multivariate Methods, Time Series Analysis, Extreme Value Theory, Econometrics, Environmetrics, Monte Carlo Methods, Forecasting, Backcasting, Nowcasting, Multi-State Modeling, Bayesian Statistics
b. Priority pathogens: any; preferably, with a focus on demography and gerontology, such as neurodegenerative or cardiovascular diseases; impact of infections on labor market and social insurance
c. Preferred geographic focus: Europe
d. Suggested link to ongoing and previous research:
https://link.springer.com/article/10.1007/s12062-019-09258-2
https://link.springer.com/article/10.1007/s11135-020-00968-w
https://genus.springeropen.com/articles/10.1186/s41118-021-00123-9
https://onlinelibrary.wiley.com/doi/full/10.1002/bimj.202000112
https://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-020-01884-4
e. Language requirements: English (fluent), German (rudimentary)

9. Privacy and Fairness Preserving Algorithmic and Visualization Methods for the Support of Infectious Disease Surveillance, Forecast, Preparedness and Response)

a. Possible methods: Machine learning, statistical modeling, compartmental models, web application development (R-Shiny), interactive visualizations, data processing
b. Priority pathogens: any; preferably outbreak-prone
c. Preferred geographic focus: any
d. Suggested link to ongoing and previous research:
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0225838
https://royalsocietypublishing.org/doi/10.1098/rstb.2020.0266
https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/tg.aspx => Outbreak detection (TG-Outbreaks)
e. Language requirements: English (fluent); recommended: German (rudimentary)

10. Diagnosing and treating infections in vulnerable population groups and health care systems

a. **Often** specific population groups have higher infection or disease risk than the general population and specific frailties in health care systems lead to higher burden of infectious diseases, different targeted interventions and diagnostic pathways can be assessed to mitigate this risk
b. possible methods: observational studies, diagnostic accuracy studies, meta-ananlyses, operational research priority pathogen: tuberculosis, HIV, hepatitis, vaccine preventable diseases
c. preferred geographic focus: any
d. suggested link to ongoing and previous research
https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-021-06474-0
https://www.sciencedirect.com/science/article/pii/S0264410X1931624X
https://www.nature.com/articles/s41591-020-1076-0
e. Language requirements: English (fluent); recommended: German (rudimentary)

11. Pandemic response evaluation and preparedness

a. COVID-19 pandemic has shown that pandemic response has very different levels and needs to be prepared and evaluated before a pandemic happens. This needs to be done retrospectively now to be better prepared for the next pandemic.
b. Available data within HZI (seroprevalence data, notification data) as well as with cooperation partners are available to evaluate different forms of pandemic responses and their mid- and long-term effects on infection risk and other health outcomes
c. Different epidemiological methods can be applied here (statistical analyses, infectious disease modelling, evidence synthesis, meta-analyses)
d. Suggested link to ongoing and previous research:
https://www.aerzteblatt.de/pdf.asp?id=221932
https://bmjopen.bmj.com/content/11/11/e052690.abstract
https://genus.springeropen.com/articles/10.1186/s41118-021-00123-9
https://www.sciencedirect.com/science/article/pii/S0163445320307568
e. Language requirements: English (fluent); recommended: German (rudimentary)