



The CONTROL

**(COgNitive Therapy for depRessiOn in tubercuLosis
treatment) to improve outcomes for depression and TB in**

Pakistan and Afghanistan

Funded by: RIGHT3, NIHR

Reference: NIHR201773

**Workshop on Minimizing Bias in Clinical
Research through Directed Acyclic Graphs
(DAGs)**

3rd December 2024

EXECUTIVE SUMMARY

The workshop titled “**Minimizing Bias in Clinical Research Through Directed Acyclic Graphs (DAGs)**” was conducted on **December 3, 2024**, at **Hall C, Ramada Hotel, Islamabad**. Organized as part of the **Global Mental Health Symposium** under the auspices of the **CONTROL Program**, the workshop was designed to enhance researchers' competencies in identifying and mitigating bias in clinical research through the application of Directed Acyclic Graphs (DAGs). The session was led by **Dr. Muhammad Naseem Khan**, Associate Professor of Population Medicine at Qatar University, an expert in causal inference and bias reduction methodologies.

The primary objective of the workshop was to provide participants with a robust theoretical foundation and practical expertise in leveraging DAGs to address methodological biases in clinical research. The workshop content focused on pivotal concepts, including confounding, collider bias, and causal inference, with particular emphasis on distinguishing between association and causation in research contexts. Attendees were guided through the construction, interpretation, and application of DAGs to identify potential sources of bias and to design methodologically sound research studies.

A key highlight of the workshop was the integration of **Dagitty**, an advanced software tool for creating and analyzing DAGs. This report summarizes the proceedings and outcomes of the workshop, highlighting its value in advancing rigorous and unbiased clinical research practices.

INTRODUCTION

Dr. Muhammad Naseem Khan, Associate Professor of Population Medicine at Qatar National University, Doha, Qatar, served as the lead facilitator, while **Dr. Zohaib Khan**, Director ORIC at KMU and Co-lead in the CONTROL Program, moderated a one-day workshop on “**Minimizing Bias in Clinical Research through Directed Acyclic Graphs (DAGs)**.” Held on December 3, 2024, at Hall C, Ramada Hotel Islamabad, the workshop was part of the **Global Mental Health Symposium** organized by the CONTROL Program. The session aimed to provide participants with a comprehensive understanding of the role of Directed Acyclic Graphs (DAGs) in minimizing bias in clinical research.

Key objectives included distinguishing between association and causation, addressing common biases such as confounding and collider bias, constructing and interpreting DAGs to identify causal relationships, and guiding participants on optimal variable selection to mitigate bias. The workshop also offered hands-on practice with the Dagitty tool, enabling participants to apply their learning to real-world scenarios effectively.

Workshop Proceedings:

The workshop commenced at 9:30 AM with a welcome note by Dr. Zohaib Khan followed by the workshop participant's round of introduction. Participants represented a diverse group that



included early- and mid-career researchers, students from the CONTROL program's Master of Health Research (MHR) cohort, and PhD scholars. This was followed by an overview of the workshop's objectives,

which highlighted the critical role of minimizing bias in clinical research to ensure robust and reliable findings.

Dr. Muhammad Naseem Khan, during the first session, focused on distinguishing between association and causation in research, a foundational concept often misunderstood or overlooked. Through illustrative examples, participants explored how misinterpreting these concepts can lead to flawed research outcomes. This segment laid the groundwork for understanding causal relationships and set the stage for more advanced discussions.



Building on this foundation, Dr. Naseem led an in-depth session on recognizing and addressing various types of biases in clinical research. He elaborated on confounding and collider bias, explaining their mechanisms and potential impacts on data interpretation. Real-life examples were shared to solidify these concepts, enhancing participants' ability to identify and mitigate such biases in their work.

A highlight of the workshop was the integration of detailed case studies, such as examining the relationship between proton pump inhibitors (PPI) and pneumonia. These examples



demonstrated how biases, such as confounders and colliders, could distort research findings.

Participants also learned how to apply DAGs to mitigate bias, as Dr. Naseem highlighted strategies for selecting

variables to ensure unbiased results in analyses. Emphasis was placed on identifying variables relevant to the research question, including exposures, outcomes, and potential confounders or mediators. By mapping these variables and their causal relationships, attendees visualized the underlying structure of the data, gaining clarity on how specific variables interact.

Through practical examples, participants explored how DAGs could reveal paths that contribute to bias, such as spurious associations created by confounding variables or distorted relationships caused by collider bias. These visual representations provided an intuitive understanding of complex causal structures, enhancing the participants' ability to critically assess the validity of their research designs.



A dedicated session focused on the distinction between confounding and colliding, two common sources of bias in clinical research. Participants worked with real datasets to identify and differentiate between these two types of bias.

Confounding was explained as a bias introduced by variables that influence both the exposure and the outcome, while colliding was described as a bias that arises when two variables influence a common collider.

Through the use of DAGs, participants visualized these concepts and saw firsthand how they manifest in research data. Examples such as the relationship between lifestyle factors, health outcomes, and socioeconomic status were used to highlight confounding. Similarly, colliding was demonstrated with examples where selection criteria or sampling methods created spurious associations.

Dr. Naseem further explained how to interpret analysis outcomes using DAGs, emphasizing



optimal variable selection for achieving robust conclusions. The session on interpreting analyses reinforced the importance of using DAGs for reliable and accurate results. Participants

explored the differences between confounders and colliders through interactive examples.

Towards the end of the workshop, a practical hands-on session with the Dagitty tool provided participants the opportunity to apply their theoretical knowledge by constructing DAGs for specific scenarios. This interactive exercise significantly enhanced the participants' understanding and confidence in using DAGs for real-world applications.

Discussion and Closing Session:

The workshop concluded with an open discussion and Q&A session. Participants provided valuable feedback, highlighting the practical relevance of the workshop and expressing interest in extended sessions for deeper exploration of DAG applications. Dr. Naseem addressed queries and emphasized the significance of incorporating DAGs into clinical research to minimize bias and improve study outcomes. At the end of the day, certificates were distributed to the participants as recognition of their engagement and learning followed by a group picture and vote of thanks from Dr. Zohaib Khan.



The CONTROL program
GLOBAL MENTAL HEALTH SYMPOSIUM

Venue: Hall C: Ramada Hotel Islamabad

WORKSHOP ON MINIMISING BIAS IN CLINICAL RESEARCH THROUGH DIRECTED ACYCLIC GRAPHS

3 December 2024

Time (HOURS)	Title of the session	Resource person
0930 – 0945	Introduction to the resource persons and workshop participants	Dr. Zohaib Khan
0945 – 0950	Workshop Overview	Dr. Muhammad Naseem Khan
0950 – 1020	Compare and Contrast association and causation.	
1020 – 1100	Explain Bias in Clinical Research	
1100 – 1130	TEA BREAK	
1130 – 1200	Construct Directed Acyclic Graphs (DAGs) for a given scenario and its interpretation.	Dr. Muhammad Naseem Khan
1200 – 1220	Apply the concept of DAGs to mitigate bias.	
1220 – 1240	Interpret analyses in terms of optimal variable selection.	
1240 – 1300	Differentiate between confounding and colliding using real data	
1300 – 1400	LUNCH BREAK	
1400 – 1500	Practical session to consolidate previous learning and use of Dagitty tool	Dr. Zohaib Khan
1500 – 1530	Discussion/Q&A and closing	Dr. Muhammad Naseem Khan