A relook at the ventilation measurement method and the correlation to the occurrence of Tuberculosis: A response to a published article.

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Abstract:

The study done in Mumbai which correlates the burden of tuberculosis to architectural parameters in resettlement colonies, published in the Journal Cities & Health (03/2020) is a very useful and timely study. For further studies in this area, a refinement is needed in the measurement and calculation of the Natural ventilation in the built spaces. The study in question uses anemometer to measure the air velocity and Computational fluid dynamics to validate the ventilation, but assumes it to be only wind driven. This article looks at the possibility of more accurate methods and inclusion of infection risk assessment models. (99 words)

Keywords : Airborne Infection Control; Infection Risk Assessment Models; Tuberculosis; Architecture; Tracer gas method; Wells-Riley Model.

Tuberculosis is a deadly disease with alarming numbers in India.[1-3] has a key role to play in prevention of the spread of diseases like Tuberculosis.[4] The study published in Cities and Health journal titled 'Association between architectural parameters and burden of tuberculosis in three resettlement colonies of M-East Ward, Mumbai, India'[5] is a very good effort by the authors and researchers. They have performed this study in Mumbai which is a very densely populated city in India. The spread of airborne diseases, TB in case of the mentioned study, is crucial and has been well studied in relation to the architectural parameters in the said study.

There is one concern that can be pointed out to enhance the scholarship in this study for future studies in India and across the world. The method of measuring ventilation in the households under study needs to be improved for future studies in this area. The study has used two methodologies in combination to find

out the rate of ventilation in the households in question. One method uses an anemometer to measure the wind velocity for 10 minutes in 60 households out of the 4080 households for which the questionnaire based study was done in the study. The velocity was measured in this study, to compare it with the results of the questionnaire based survey and correlate a relation between ventilation and disease spread. The use of only anemometer based wind velocity measurements in this study has certain key problems as they don't account for the leakages in the space and miss out on the ventilation that may happen due to the diffusive movement of the air, in the absence of wind speeds below the measurable rate of the anemometer. Another very important point that may need attention is the absence of any further processing of the air velocity to the probability of infection as has been widely done by the Wells-Riley[6] model based on the ACH(Air changes per hour) of the building. Apart from the above mentioned model, there are multiple other models which can be used for such correlation.[7] The approximate ACH can easily be calculated using the air velocity at the openings of the spaces using a basic anemometer or a vaneometer [8]. A previous baseline study done in 2015 [9] in India also used the air velocity to access the ACH in Tuberculosis facilities in India. They pointed the use of only air velocity measurement as a limitation as other methods of higher reliability like tracer gas method could not be used. The study in question [5] has repeated this that too incompletely as ACH (Air Changes per hour) was not found out. Though the study in question also has listed the study done in South Africa [10] but they have not used the Rudnick Milton Model to correlate the ventilation with the spread of tuberculosis in the households mentioned. Multiple studies performed across the world have performed ventilation calculations based on the Air change rate. [11-12] Even when they measured the air velocity, it was done to eventually find the ACH by calculation. The air changes into a built space have a key role to play in diluting the presence of the airborne particles and have been reliably shown to decrease the probability of infection in the case of Tuberculosis. Other studies have used the Rudnick Milton Equation to find out the probability of infection using the rebreathed air, which is also a surrogate for the ventilation in the space.[13] There are multiple studies [10, 14-15], which have attempted to relate ventilation to the spread of airborne infection and have used the Rudnick Milton Model.

The study in total is a great attempt and is needed in India where very few studies are done with the level of work put in by the authors of the study in question. The observation was submitted to the editor of the journal to which it was published. The editor encouraged and accepted the suggestions, but did not publish the observation as a letter to the editor. The reviewer responded that 'although the method you describe is very accurate, the resources required would be considerable for the number of properties involved in this study, moreover, the method your propose would not have much influence on the overall conclusion. As a highly technical response we do hope you take your response and this expert review and maybe publish in a journal that deals more specifically with these more technical measurement issues, whilst also addressed the comment' But in order to increase the scholarship in this area, it is required to provide further inputs for future studies. Natural Ventilation and its correlation have been done worldwide on the basis of the Infection probability models. The current study could have compared their results to the models in order to strengthen their case and validate their results. On the contrary, in case of different results, they could have used this to contribute further to the models with the inputs they have found in their study. The use of tracer gas method or the Carbon dioxide measurement to calculate the ventilation by surrogate method could also have been used for accuracy, as compared to air velocity measurements or CFD studies where ventilation has been assumed to be only wind-driven.

Notes:

1. The author and the co-author have no conflict of interest.

2. Authors Contribution as per CRediT

Ar. Raja Singh: Conceptualization, Formal Analysis, Writing-Original draft

Prof. Dr. Anil Dewan: Supervision, Validation

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