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The menace of incomplete data: a review of tuberculosis DOTS data at a tertiary hospital in southern Nigeria

GU Eze, IP Obiebi

Abstract

Background: This paper presents data from a TB-DOTS centre in southern Nigeria in a bid to explore the peculiarities with incompleteness and identify weakness in data management and to proffer solutions to the problem going forward.

Methods: This was a cross-sectional records review of 146 patients seen from 2012 to 2015.

Results: The degree of data completeness reduced progressively in the course of treatment. From 73.3%, initial completeness of AAFB documentation reduced to 37.0% at the second month, and further to 14.4% at the fifth month. Mean weight gain was significant in all TB patients treated (p<0.001), but weight at the beginning and end of treatment course was recorded in just over a third of patients. Data on treatment outcome was not available for 83 (56.8%) of patients. Only 43 (29.5%) were recorded as cured but inference from the incomplete AFB statistics showed the numbers should be higher.

Conclusion: Significant gaps in TB data management create difficulties with program evaluation. Health workers at TB/DOTS sites need to be abreast with record keeping and adapt eTB manager for local use.

Healthcare data is defined as the information used to provide, manage, pay and/or report on the services used across the entire healthcare system. Data quality in healthcare is a large and ongoing problem and poor quality data still restricts the usability of data generated from patient care. Poor quality data comes in different forms: it may be that which is not complete, fictitious or not timely reported, as was the case in an outbreak of infectious disease in the UK resulting in a delay in the health authority’s identification of the presence of an outbreak. In some cases, it may be difficult to determine clearly if the data was incomplete or the patient did not have the condition.

Data management in tuberculosis (TB) control programmes has been documented to be very poor over the years. Poor management of data is a challenge for most of the high TB burden countries and in this paper, data from a TB Directly Observed Treatment Short-course (DOTS) centre in southern Nigeria has been analysed for extent of completeness to identify peculiarities in the weakness of data management and to proffer possible solutions to the problem going forward.

Materials and methods

This study was a cross-sectional review of records of patients seen at DOTS centre of a tertiary health facility in southern Nigeria from January, 2012 to December, 2015 (four years). A total of 146 patients were seen during the period reviewed. The diagnosis of tuberculosis was made on the basis of positive sputum smear microscopy to detect acid fast bacilli (AFB), and/or clinical decision with radiological support as evidence of the disease.

The following data obtained from the case files and treatment cards of TB patients were analysed for level of completeness - socio-demographic characteristics (age, sex, employment status, and educational status); site of tuberculosis (pulmonary or extra-pulmonary); patient treatment category, weight at entry and completion; bacteriological (Sputum microscopy for AFB) and radiological investigations (Chest x-ray), and HIV status. Data from the centre is usually reported to the local government tuberculosis and leprosy control programme officer who in turn reports to the state and the national programme coordinators in that order.

Data collected from patient files were entered into the spreadsheet Statistical Package for Social Sciences version 22 (IBM Corp., Armonk NY, USA) for analysis. Categorical variables were expressed as percentages and continuous variable as means ± standard deviation.
Review Article

Table 1: Characteristics of Patients, Tuberculosis type, Treatment group and Source of Referral

<table>
<thead>
<tr>
<th>Variables</th>
<th>Is all data available?</th>
<th>Male n=88</th>
<th>Female n=58</th>
<th>Total N=146</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Yes</td>
<td>84 (95.5)</td>
<td>54 (93.1)</td>
<td>137 (93.8)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>4 (4.5)</td>
<td>5 (8.6)</td>
<td>9 (6.2)</td>
</tr>
<tr>
<td>Employment Status</td>
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<td>58 (100.0)</td>
<td>146 (100.0)</td>
</tr>
<tr>
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<td>No</td>
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<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Marital Status</td>
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<td>58 (100.0)</td>
<td>146 (100.0)</td>
</tr>
<tr>
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<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
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<td>58 (100.0)</td>
<td>146 (100.0)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Religion</td>
<td>Yes</td>
<td>85 (96.6)</td>
<td>51 (87.9)</td>
<td>136 (93.2)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>3 (3.4)</td>
<td>7 (12.1)</td>
<td>10 (6.8)</td>
</tr>
<tr>
<td>Education</td>
<td>Yes</td>
<td>80 (90.9)</td>
<td>56 (96.6)</td>
<td>136 (93.1)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>8 (9/1)</td>
<td>2 (3.4)</td>
<td>10 (6.9)</td>
</tr>
<tr>
<td>Tuberculosis type</td>
<td>Yes</td>
<td>85 (96.6)</td>
<td>51 (87.9)</td>
<td>109 (93.2)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>3 (3.4)</td>
<td>7 (12.1)</td>
<td>10 (6.9)</td>
</tr>
<tr>
<td>New or retreatment group</td>
<td>Yes</td>
<td>88 (100)</td>
<td>58 (100)</td>
<td>146 (100.0)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Source of referral</td>
<td>Yes</td>
<td>28 (31.8)</td>
<td>19 (32.8)</td>
<td>127 (87.0)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>11 (12.5)</td>
<td>8 (13.8)</td>
<td>19 (13.0)</td>
</tr>
</tbody>
</table>

Notes

Tuberculosis types are pulmonary (PTB) or extra-pulmonary (EPTB)

Retreatment cases: relapse, failure, and transferred-in with status unknown;

Sources of referral: Outpatient, internal medicine, paediatrics, other hospital and self

Table 2: Periodic AFB Results of Patients over the Course of Treatment

<table>
<thead>
<tr>
<th>Variables</th>
<th>Is all data available?</th>
<th>Categories</th>
<th>Male n=88</th>
<th>Female n=58</th>
<th>Total N=146</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial AFB</td>
<td>Yes</td>
<td>Positive</td>
<td>25 (28.4)</td>
<td>23 (39.6)</td>
<td>48 (32.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>35 (39.8)</td>
<td>24 (41.4)</td>
<td>59 (40.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
<td>28 (31.8)</td>
<td>11 (19.0)</td>
<td>39 (26.7)</td>
</tr>
<tr>
<td>AFB at 2nd month</td>
<td>Yes</td>
<td>Positive</td>
<td>3 (3.4)</td>
<td>2 (3.5)</td>
<td>5 (3.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>31 (35.2)</td>
<td>18 (31.0)</td>
<td>49 (33.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
<td>54 (61.4)</td>
<td>38 (65.5)</td>
<td>92 (63.0)</td>
</tr>
<tr>
<td>AFB at 5th month</td>
<td>Yes</td>
<td>Positive</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>12 (13.6)</td>
<td>9 (15.5)</td>
<td>21 (14.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
<td>76 (86.4)</td>
<td>49 (84.5)</td>
<td>125 (85.6)</td>
</tr>
<tr>
<td>AFB at completion</td>
<td>Yes</td>
<td>Positive</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>7 (8.0)</td>
<td>6 (10.0)</td>
<td>13 (8.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
<td>81 (92.0)</td>
<td>52 (90.0)</td>
<td>133 (91.9)</td>
</tr>
<tr>
<td>AFB at conversion*</td>
<td>Yes</td>
<td>Positive</td>
<td>22 (88.0)</td>
<td>21 (91.3)</td>
<td>43 (89.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>3 (12.0)</td>
<td>2 (8.7)</td>
<td>5 (10.4)</td>
</tr>
</tbody>
</table>

Notes

N/A = Not available

* Sputum conversion at second month of treatment

SD. Level of significance was set at 0.05 for measuring associations. Level of completeness was expressed for all tables and the trend of incompleteness identified.

The socio-demographic data was complete except for that on age, religion and education; and the degree of completeness of the data ranged from 93.8% to 100%. Data on distribution of Pulmonary and Extra-pulmonary Tuberculosis among Patients was 93.7% complete. Even though the data on new or retreatment categories was complete, that on the source of referral was 13% incomplete. (Table 1)

The completeness of data from AFB testing progressively reduced from 73.3% for initial AAFB to 37.0% at the end of second month, and then further to 14.4% at the fifth month. There was more than four-fifth (80.4%) reduction in AFB data completeness from commencement of treatment to the end of the second month. The majority of TB patients, who were sputum AFB positive at the onset, had become sputum negative at 2 months of treatment; sputum conversion rate was 89.6% at the second month but 26.7% of patients did not even test for AFB on entry into the programme. (Table 2) The extent of data completeness for chest radiograph, 113 (77.7%) was higher than that for all other investigations for tuberculosis. About Three-quarters, 108 (74%) of all patients were screened for HIV. Among those screened, five (3.4%) were not counselled. There was no miss-
Inferring from those with documented outcome, only 43 (29.5%) (40/58) of females. (Table 4) 

In all TB patients during treatment, p<0.001. Weight gain in males was greater than in females. (Table 5) 

Table 3: Ancillary Investigations for Confirmation of Tuberculosis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Is all data available?</th>
<th>Male n=88</th>
<th>Female n=58</th>
<th>Total N=146</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Radiograph</td>
<td>Yes</td>
<td>64 (72.7)</td>
<td>49 (84.6)</td>
<td>113 (77.4)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>24 (27.3)</td>
<td>9 (15.5)</td>
<td>33 (22.6)</td>
</tr>
<tr>
<td>Mantoux</td>
<td>Yes</td>
<td>10 (13.4)</td>
<td>5 (8.6)</td>
<td>15 (10.3)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>78 (88.6)</td>
<td>53 (91.4)</td>
<td>131 (89.7)</td>
</tr>
<tr>
<td>RVS</td>
<td>Yes</td>
<td>59 (67.3)</td>
<td>49 (84.5)</td>
<td>108 (74.0)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>29 (33.0)</td>
<td>9 (15.5)</td>
<td>38 (26.0)</td>
</tr>
<tr>
<td>Pre-test HIV Counselling</td>
<td>Yes</td>
<td>57 (64.8)</td>
<td>46 (79.3)</td>
<td>103 (70.6)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>2 (2.3)</td>
<td>3 (5.2)</td>
<td>5 (3.4)</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>29 (32.9)</td>
<td>9 (15.5)</td>
<td>38 (26.0)</td>
</tr>
</tbody>
</table>

Table 4: Outcomes following tuberculosis treatment: Weight gain and others

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories</th>
<th>Chest radiograph frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Suggestive</td>
<td>Non-suggestive</td>
</tr>
<tr>
<td>Initial Sputum AFB</td>
<td>Positive</td>
<td>35 (31.8)</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>44 (40.0)</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>31 (28.2)</td>
</tr>
</tbody>
</table>

Table 5: Treatment Outcomes of Patients

<table>
<thead>
<tr>
<th>Is all data available?</th>
<th>Categories</th>
<th>Male n=88</th>
<th>Female n=58</th>
<th>Total N=146</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (43.2%)</td>
<td>Cured</td>
<td>23 (26.1)</td>
<td>20 (34.5)</td>
<td>43 (29.5)</td>
</tr>
<tr>
<td></td>
<td>Failure</td>
<td>1 (1.1)</td>
<td>0 (0.0)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td></td>
<td>Transferred-out</td>
<td>4 (4.5)</td>
<td>1 (1.7)</td>
<td>5 (3.4)</td>
</tr>
<tr>
<td></td>
<td>Loss to follow-up</td>
<td>2 (2.3)</td>
<td>1 (1.7)</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td></td>
<td>Dead</td>
<td>3 (3.4)</td>
<td>5 (8.6)</td>
<td>8 (5.5)</td>
</tr>
<tr>
<td>No (56.8%)</td>
<td>N/A</td>
<td>52 (62.6)</td>
<td>31 (53.5)</td>
<td>83 (56.8)</td>
</tr>
</tbody>
</table>

were transferred out, 3 (2.1%) were known to have been lost to follow-up, while treatment failure was recorded to have occurred in only one patient. (Table 5)

Discussion

The data from the TB/DOTS centre of the tertiary hospital studied shows lots of vagaries in the management of data that require prompt intervention to improve the reliability of information.

Socio-demographic data was nearly complete, and that is understandable, as it is obtained during registration into TB/DOTS treatment with a fresh and well-structured data capture tool – the TB treatment card. But a few data were still not available in the categories of age, religion, and educational status. It is likely these were not supplied as they are perceived as sensitive subjects among quite a few persons in this locale. A previous study on factors responsible for omissions in filling questionnaires had identified age and educational status as commonly omitted variables in studies. On subsequent visits, if a centre has a poor filing system for instance, a treatment card used previously may not be readily accessible when data has to be entered; test result slips may get misplaced. Retrieval and proper documentation may pose a problem after this. These same views have been outlined in a publication on disadvantages of manual medical records which also highlighted loss of productivity, poor quality data, and higher cost for data handling.

Since patients were categorised into Pulmonary tuberculosis (PTB) or extra-pulmonary tuberculosis (EPTB) early in the cycle of treatment, and sometimes the diagnosis of a patient poses a dilemma and drug trials even have to be done, it is likely that the few patients whose diagnosis are not captured were among those posing a difficulty with pre-treatment categorisation. A good medical record system should possess a system for preventing incomplete data sets from being stowed away.

The source of referral, though taken at the point of admission into the programme, was incomplete. It is not surprising, as the two-way referral system is not quite functional in our health system. Health workers may not have deemed it important to keep that record as they may have perceived it unnecessary due to the current mode of operation of this health system. It may be that healthcare workers deemed it fit to keep records
of only patients who came with AFB results. But since AFB is such an important test for treatment progress evaluation, and all patients are required to have done it at the stipulated times, it would have been more appropriate to also keep deliberate records of those who did not do their AFB tests instead of leaving blank spaces. With the general pattern of incomplete data, it is difficult to assume that blank spaces represent a true absence of information which is required in the first instance.

Over a quarter of patients, 26.7% were admitted into DOTS treatment without AFB results. Another two-fifths (40.4%) were negative for AFB but also admitted for treatment; meaning that clinicians have accepted that AFB false negative results are rife. Although this is the scenario at many TB-DOTS centres,16 the World Health Organization still maintains that AFB is its standard test for diagnosis of TB.17 The Gene Xpert testing which is currently gaining ground must be given wider coverage so that TB control gains from its greater AFB accuracy.18

The patients who were not screened for HIV may not have consented to screening and there remains a chance that some of them are HIV positive. To prevent this, their position should have been documented as this may aid the TB/DOTS programme with decision making to adopt the opt-out approach for HIV counselling and testing.

As almost a third of TB patients did not have recorded weights for the beginning of treatment, the end, or both; the proportion of unrecorded events may have resulted in an error in the average weight gained and the conclusions reached. It is not easy to tell if there was a systematic withdrawal from treatment services. In which case, patients who were not improving were the ones who withdrew. If such a scenario is true, then the mean weight gain may not have been this large if at all it turned out significant. The TB treatment card provides cells for five periodic weight measurements. Keeping this religiously would have helped establish a trend in weight gains among patients on TB treatment. Although, previous studies have documented improvement in weight following treatment for tuberculosis, this pattern of lost data was not reported.19,20 neither has it been seen in other free-of-charge chronic disease control programmes where there is a closer watch from managers on the data e.g. HIV/AIDS control programme. It is also not seen in the management of hypertension and diabetes for which fees are paid for services. It appears then that it is not necessarily the lack of payment for services that is responsible for poor data management in TB control programmes.21 Rather, it is likely due to the lack of supervision and/or awareness of the importance of data integrity. Apparently, since there is no special allocation of funds for health personnel of TB programmes, the more senior health workers abandon the management of these programmes to lower cadre staff, and do not even provide conscientious supportive supervision to avoid lapses in data entry, the importance of which the lower cadre health workers may not really appreciate.

The proportion of patients who were cured, as recorded at the appropriate section of the card was 29.5%, but an analysis of table 4 which shows the AFB test results for months 0, 2, 5, and at the end suggests that the cure rate far exceeds this value. The initial proportion of patients who did the AFB was 32.9%, more patients did the test in the passing months, likely those who were added to the programme using radiological findings and clinical criteria as is commonly done in other centres especially among HIV-positive patients.22,23 All these patients, though responding clinically to treatment, must have returned with negative AFB results as there was no record of a positive AFB result after the second month. The cumulative values in table 4 should be closer estimates of the real situation with AFB at that DOTS centre even though they would also be a shortfall due to the observed habit of poor data entry.

In the Treatments Outcomes section, Treatment Failure was recorded as an outcome for one patient. Meanwhile, the sputum AFB section showed no positive sputum AFB result at the 5th month. These data were obtained as recorded on both sides of the TB treatment card. Treatment Failure means that a TB patient who started as sputum positive did not become sputum negative throughout the period of treatment.24 The data extracted do not identify anyone to be in that category. This mismatch suggests that the health workers in-charge of record keeping may need to be taught or refreshed on the case definitions in TB management. However, the data on HIV was complete and coherent. This may be because of the fear of HIV and health workers knew they needed to prevent anyone contracting the disease. It may also be because HIV programmes have heightened awareness on ethical issues and the need for complete data. HIV programmes also have a face to their programmes, as their organisations are well known and officers usually seen periodically reaching out for HIV data, and interact with health workers to ensure it is timely and complete for their programme performance appraisals. In tuberculosis DOTS on the other hand, the DSNO who collects data is usually neither assertive nor collaborative, and passively collects the data they are given for submission into the pool of routine data. The DSNOs need to be equipped to engage DOTS workers, find time to bring them up to date on new innovations, and they need to imbue the need for complete data into DOTS workers through occasional supportive supervision or trainings. Incomplete reporting of tuberculosis cases is not peculiar to Nigeria though, it has also been reported in the national tuberculosis control programme in the Netherlands.25

It has been documented that it is difficult to estimate loss-to-follow-up (LTFU) when data collection is poor, and therefore difficult to evaluate programme success and make decisions to improve programme.26 Going forward it may be important to train and retrain health workers who manage TB/DOTS sites. Where possible, ensure each site has a health worker with tertiary education who would better appreciate the import of good data management, and make such a person responsible for data at that site.

When all the proposed have been done, there may still be the need to keep the workers continually motivated, else as humans they may begin to forget the necessary routines again. It may also be necessary to set goals and possibly incentivise good quality data which of course must also be monitored to prevent manipulation. In that case, where manipulation is noticed, there may be a need for pre-stipulated penalties.

It may already be obvious that keeping good data through health workers is quite an onerous task which the TB control programme and its funders may not be willing to take on. A way around this would be to introduce computerised systems for data integrity in TB care, including domest icating the already
existing eTB Manager for local use by expanding and adapting the already existing eTB manager – an online platform for TB data management created by the Management Sciences for Health (MSH) with support from USAID – to include everyday offline use with the store and forward capabilities to enable updating of the online database once the data is exposed to the internet. This database would perform maximally if constraints are placed in the logic sequence during programming to prevent the user from proceeding to a next patient if the mandatory cells in a current patient have not first been completed, especially if there is no skip logic attached to that option. The database being user-friendly would require the direct training of only a few hands per TB/DOTS site. These would in turn cascade the knowledge to their peers and colleagues. This would definitely be more effective on the long-run. Whichever method is adopted, the intended outcome of more precise data must be kept in view as its import to programme success and quality of care in disease treatment cannot be over emphasised.6,28

Conclusion
An analysis of four years of records of TB/DOTS data has highlighted some of the gaps in data management with regard to tuberculosis control. Significant among these were incomplete or missing data, mismatch and wrong categorisation of patient treatment outcomes. All these make evaluation as well as decision making to improve the national programme difficult. It is therefore important to train and retrain these workers who manage TB/DOTS sites on proper record keeping and to upgrade and adapt the already existing eTB manager – an online platform for TB data management created by the MSH.

Author declaration
We acknowledge the efforts of the health workers who made the files and tuberculosis treatment cards available for data collection. Competing interests: none.

Any ethical considerations involving humans or animals: none.

Was informed consent required? No.

We acknowledge the efforts of the health workers who made the files and tuberculosis treatment cards available for data collection.

References
Current concepts in Asthma control: Is it achievable?

GB Ilah and MA Sakajiki

Abstract
Asthma control is the central focus of Global Initiative for Asthma (GINA) guidelines, which is defined as the extent to which the various manifestations of asthma observed in the patient are reduced or removed by treatment. It is determined by the interaction between the patient’s genetic background, underlying disease processes, the treatment that they are taking, environment and psychological factors.

The long-term goals of asthma management are to achieve good symptom control, and to minimise future risk of exacerbations, fixed airflow limitation and side-effects of treatment. The patient’s own goals regarding their asthma and its treatment should also be identified.

Several factors have been identified which contribute to failure in achieving asthma control despite adequate drug therapy. To assist in assessing asthma control, several validated questionnaires have been developed.

Despite the goal of asthma management is attaining optimal control; majority of asthmatics are not well controlled. Global surveys of asthma care have suggested only 5% of asthmatics meet the goals of asthma management as set out in guidelines.

Global multi centre research should be conducted especially in developing countries on asthma control to assess the impact and adequacy of asthma care in all the regions of the world.

Asthma is a heterogeneous disease usually characterised by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation.1

International guidelines for asthma management indicate that the primary goal of therapy should be optimum asthma control. Asthma control refers to the extent to which the manifestations of asthma can be observed in the patient been reduced or removed by treatment.1 It is determined by the interaction between the patient’s genetic background, underlying disease processes, the treatment that they are taking, environment and psychological factors.1,2

Asthma control ranges from well controlled in which the patient is totally unimpaired and unlimited to extremely poorly controlled.3 Several factors contribute to failure to achieve asthma control despite adequate drug therapy.

Search methods
A literature search on the following words ‘asthma control, factors affecting asthma control, paediatric, childhood, adolescents’ was carried out using manual library research and journal publications on Pubmed/Medline, Google Scholar and EMBASE. Selection criteria for the identified publications were specified by subject matter based on their content of up to date information relating to factors affecting asthma control and asthma control studies. The relevant articles included original articles, case control studies and literature reviews.

The objective was to review factors affecting asthma control and asthma control studies conducted in children and adolescents.

Factors affecting asthma control
It has been shown worldwide that achieving and maintaining paediatric asthma control is difficult.4 The most important step in assessing asthma control is ensuring the correct diagnosis.4 Access to and affordability of essential inhaled drugs, especially corticosteroids and short-acting bronchodilators, have been identified as major challenges to effective asthma control in many countries.4 Factors influencing childhood asthma control may vary from one location to another as environmental, sociodemographic, and household variables differ.

Several factors are associated with poor asthma control ranging from concomitant rhinitis5,6 to poor compliance with medications6,9 or inappropriate inhaler technique.6,7 Others include co morbidities such as uncontrolled sinusitis, untreated gastroesophageal reflux and obesity.5,5,10 Presence of infections may cause asthma exacerbation which may consequently give rise to poor asthma control.11

Home factors contribute to failure to achieve optimal asthma control. Parental smoking or smoking by other relatives within the home, biomass fuel exposure especially cooking with an open flame, aeroallergen exposure and specific parental/caregiver occupations or hobbies.

Global surveys of asthma care have suggested only 5% of asthmatics meet the goals of asthma management as set out in guidelines.12 Lack of use of adequate anti-inflammatory medications has been identified as an important cause of poor asthma control. Evidence has shown that asthma therapy is dominated by the use of short acting reliever medication compared to inhaled corticosteroids (ICS).12

Another compounding factor to poor asthma control is under-diagnosis of the condition. Surveys from South Africa have suggested delay in asthma diagnosis.13 Green suggested another reason for poor asthma control to be the fact that patients and doctors consistently over-estimate control.1
There are many other factors which can affect asthma control. Some of these are highlighted below:

**Smoking**

Children are more vulnerable to environmental tobacco smoke (ETS) than adults. This relates to the fact that children spend more time at home and have an underdeveloped respiratory and immune system. Studies have shown ETS to be associated with respiratory symptoms in children.

Passive tobacco smoke inhalation is a common environmental inciter of asthma in children. In Brazil, passive smoking was present in 43.8% of study population. Kinkelstein et al reported household smokers to be 30%. Smoking by parents of asthmatic children can be as high as 86% regardless of asthma severity even though parents know the effects of passive smoking. Parental smoking is associated with more severe disease and benefits to children are seen if parents stopped smoking after birth, even if the mother smoked during pregnancy.

McGhan et al in Edmonton assessed asthma control in children aged 5-13 years and found 75% of children were rated as having poorly controlled asthma, of which 51% had household tobacco smoke exposure. In another study, Halterman et al reported 15.5% of children in United States were exposed to smoke in the home, with inadequate asthma control seen in 20.9% while 10.7% had suboptimal asthma control. McLeish et al found smoking to be associated with decreased asthma control, increased risk of mortality and asthma exacerbations.

> Twenty-one (19.1%) of the children in a study in Ilesa, Nigeria had at least one family member who habitually smokes cigarette.

**Biomass fuel**

About 3 billion people in the world use solid fuels of which 2.4 billion use biomass fuels as household energy. Use of solid fuels in homes is the most widespread source of indoor air pollution worldwide especially in rural areas. In developing countries, studies on biomass smoke in relation to asthma in children and adults have yielded mixed findings. This exposure may act as an asthma trigger, has been associated with an increased prevalence of asthma and may be a compounder to effective asthma control.

Women and children have largest exposure to indoor air pollution from cooking; exposure from heating may be similar in men and women. Cooking and heating with biomass fuel can be as high as 90% in rural households in sub-Saharan Africa which has been shown to be associated with increase in prevalence of asthma and possible poor outcome.

In another study, 20.5% of all asthmatic children were exposed to a fireplace or wood stove with 24.7% having inadequate asthma control. Limited ventilation of homes is common in many developing countries which increases exposure, particularly for women and young children who spend much of their time indoors.

**Kerosene (paraffin)**

Kerosene has been an important household fuel since the mid-19th century. In developed countries its use has greatly declined because of electrification. However, in developing countries, kerosene use for cooking and lighting remains wide spread. Mohammed et al observed that use of kerosene in Nairobi, Kenya was not associated with asthma exacerbation. Azizi et al in a case-control study of hospitalised asthmatic children in Kuala Lumpur also made similar observation. Evidence of association between kerosene and asthma was found to be inconsistent in a meta-analysis conducted by Lam et al. In Ilesha, Nigeria 82.7% of children studied use kerosene as a source of cooking fuel.

**Pets/poultry**

The presence of pets or poultry in homes may also be associated with asthma control. Studies have implicated furry pets as triggers of asthma attack hence leading to poor control. In a multicentre study by Finkelstein et al, 59% of households had furry pets including 32% cats and 39% dogs. Rosenstreiche et al found allergy to cat dander to be low, while Halterman et al found 39.6% of children with inadequate asthma control to have pets at home.

**Carpets**

Carpets are known to harbour house dust mites and removal of carpets from bedrooms or homes completely have been recommended by studies and guidelines. Finkelstein et al reported 78% of households in United States had bedroom carpeting. However, no strong evidence has been shown to support the removal of carpets from homes to improve asthma control.

**Cockroaches**

Cockroach allergy may be a cause of ongoing airway inflammation with sensitivity to cockroaches being a risk factor for more severe asthma. Two South African studies reported cockroach sensitivity to be up to 40% in allergic children. Lopata et al reported high level of sensitisation to cockroaches in allergic children and adults living in South Africa.

Halterman et al reported presence of cockroaches was seen in 20.4% of homes of children with inadequate asthma control and 13.8% of homes of those with suboptimal asthma control.

**Assessment of asthma control**

Achieving and maintaining optimal asthma control is a major asthma management goal advocated by GINA. It has been shown that despite widespread availability of effective therapies, asthma control often falls short of guideline standards. Clinicians are encouraged to concentrate on assessing asthma control, defined by symptoms, lung function and the presence or history of exacerbations. The Asthma Insights and Reality surveys revealed a shortfall in the level of asthma control worldwide. While the majority of patients can achieve control of their asthma a significant minority cannot. Furthermore, the level of control achieved and time taken to do so depends upon asthma measures utilised with more time required to attain control using composite measures.

Recent evidence suggests that asthma control is clearly achievable in most asthma. When control is achieved, asthmatic patient is able to lead a physically active and normal life. Assessment of asthma control is more valuable than assessment of
asthma severity.\textsuperscript{43} Although assessments of asthma control may be desirable, Green et al\textsuperscript{43} proposes such assessment tools fail to incorporate patient-specific goals of treatment and therefore the desired level of control is seldom reached.

The reasons for poor asthma control may be due to overestimation of control by both physicians and parents coupled with low expectations of achievable control.\textsuperscript{7} Suboptimal asthma control in children and adolescents has been indicated by several surveys.\textsuperscript{44-47}

**Asthma control studies**

It has been shown that complete asthma control is uncommon in children worldwide.\textsuperscript{38} Previous reviews of surveys assessing asthma prevalence and control across the world have concluded that the majority of patients with asthma do not achieve adequate asthma control and under use controller medication.\textsuperscript{7,48,49}

Previous studies have highlighted the lack of asthma control in children and adolescents.\textsuperscript{9,44} Reasons have been shown to include poor adherence to treatment guidelines which may be related to their parents’ insufficient knowledge about the asthma and also influence by parental beliefs and concerns about treatment.\textsuperscript{51,52} However, poor inhaler technique, poor adherence or fear of steroid cannot be excluded as a cause for persistent poor control.\textsuperscript{30}

Deger et al\textsuperscript{11} from Montreal reported 36% of asthmatic children were found to have met at least one of the five criteria of poor asthma control.

Report by Stanford et al\textsuperscript{53} and Liu et al\textsuperscript{44} from the United States showed overall prevalence of uncontrolled asthma was 58% and 46% in adult and paediatric patients, respectively. The result for children was consistent with previously reported rates in primary care settings which ranges between 37%-64%.\textsuperscript{13,55}

A worldwide survey on severity and control of asthma- Asthma Insight and Reality (AIR) survey conducted in 29 countries within North America, Europe and Asia (five regions) showed all the regions performing poorly against the different GINA goals.\textsuperscript{7} All the regions showed most of the patients that were having moderate to severe symptoms believed their asthma to be well or completely controlled; however Africa was not included in the survey.

The AIR survey found the current level of asthma control in children is poor and falls far short of the goals in the GINA guidelines.\textsuperscript{7} Only one in 20 children with asthma in Western Europe (5.8%) met all the GINA criteria for asthma control.\textsuperscript{48}

Other surveys have found high levels of inadequate asthma control in the Patient Outcomes Management Survey (POMS) in New Zealand, 90% of children had sub optimally controlled asthma\textsuperscript{49} and 31% of children in the Hunair Study had moderate or poor asthma control.\textsuperscript{50} Good asthma control was present in 25.7% of asthmatic children in a Switzerland study.\textsuperscript{57}

Total or partial control of asthma symptoms was obtained in 85% of children seen at a paediatric reference centre in Brazil using the GINA guidelines.\textsuperscript{17} Assessing quality of life with asthma control study, reported 40% of children were having uncontrolled asthma. They concluded that quality of life appears to be directly related to asthma control, being better when asthma is well controlled.\textsuperscript{58}

A cross-sectional survey at the Asia-Pacific region\textsuperscript{49} comprising 8 countries showed the region fall short of goals specified in international guidelines for asthma management.\textsuperscript{58} Adachi et al\textsuperscript{60} from Japan revealed 70% of adults and 60% of children with asthma reported some limitation on activities of daily living.\textsuperscript{60}

It was also found that pulmonary function tests had never been done in 50% of adults and 80% of children.\textsuperscript{60} There was a large gap between subjective perception of asthma control and objective findings in patients with severe asthma which showed many Japanese asthmatics underestimate severity of their condition.\textsuperscript{50} The study revealed only 5% of asthmatics met goals of asthma control which suggests asthma management in Japan falls far short of goals stated in the guideline.\textsuperscript{60}

Green\textsuperscript{61} highlighted several barriers that lead to poor asthma control in children and adolescents in Johannesburg, South Africa and reported 55.7% as having controlled asthma. Good adherence to medications was found to be associated with good asthma control, however none of the home factors were found to be associated with poor asthma control.\textsuperscript{62}

A study of asthmatics and their practitioners was conducted in South Africa\textsuperscript{12} which showed half of the patients classifying themselves as being not controlled, while the doctors classified only 33% of patients as being not controlled. This study suggests that asthma still appears to be relatively poorly controlled in South Africa.

Most studies done in Nigeria on asthma control were conducted in adults\textsuperscript{49,63,64} than children.\textsuperscript{24,65} Despite current management guidelines, asthma care is still inadequate in Nigeria and the level of asthma control is not optimal due to several factors.\textsuperscript{63,64} Poor delivery of asthma care had a direct relationship with level of facilities and resources available in the hospitals.\textsuperscript{53} Desalu et al\textsuperscript{63} found that more than 70% of the tertiary hospitals studied lacked the basic infrastructure of asthma care like asthma clinics, asthma clinic registers and nurse educator. Furthermore, there was lack of attendance of asthma care training course by doctors.\textsuperscript{53}

A study in Nigerian adult asthmatics\textsuperscript{48} revealed 82.9% of patients had poor control with only 2.9% having total control. Additionally, more than half of the patients who perceived their asthma to be well or totally controlled were objectively assessed to be poorly controlled.\textsuperscript{48} More than half of the patients used short acting β2 agonist alone and only 20% used ICS which showed level of asthma control was below guideline recommendations.\textsuperscript{48}

In a survey of asthma patients in Ilorin, Nigeria, Desalu et al\textsuperscript{66} observed poor control among 69.0% of the patients with a significant association between poor inhaler technique, under-utilisation of ICS and the use of systemic steroids with uncontrolled asthma. Ozoh et al\textsuperscript{68} demonstrated poor control among 52% of patients in Lagos, Nigeria. These studies highlight inadequate facilities and inappropriate medications used to manage asthmatics in Nigeria. An asthma control study of children in Enugu by Ayuk et al\textsuperscript{69} reported only 16.7% of the children were well-controlled.

Kuti and Omole\textsuperscript{70} and Kuti et al\textsuperscript{44} reported from Ilesa, Nigeria 83.7% of the studied children had well-controlled asthma, while 17.3% had suboptimal asthma control which was partly controlled in 10.0% and uncontrolled in 7.3%. This may be a
reflection of the fact that most of the children had mild intermittent asthma.

Results from the various studies may have varied due to differences in environment, sample sizes, methodology and asthma control assessment tools used.

Conclusion

From the various reports highlighted in this review, it has been shown that globally, majority of asthmatics are not well controlled. There are multiple factors that can affect asthma control which can be modified by making the right diagnosis, identification of trigger factors, treatment of co-morbidities, adherence to treatment and the availability of medications. In addition, educating patients and their families.

Furthermore, there is need to regularly assess asthma control and manage trigger factors appropriately especially in children in order to achieve and maintain optimal asthma control. Clinicians should routinely assess asthma control in their clinics as this would ensure optimal care.

Global multi-centre research should be conducted especially in developing countries on asthma control to assess the impact and adequacy of asthma care in all the regions of the world.

Author declaration

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Any ethical issues involving humans or animals: None
Was informed consent required? No.

References


Assessment of asthma control in pulmonary consultation in Ouagadougou, Burkina Faso

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Abstract

Background: Despite the recommendations now in force for the management of asthma, evidence suggests that many asthmatic patients still have their disease uncontrolled. 

Objective: to assess asthma control and to identify the factors associated with uncontrolled disease among the patients received for consultation in the department of Pneumology in Ouagadougou, Burkina Faso.

Patients and methods: We conducted a cross-sectional study from 02/01/2015 to 01/31/2016 in the department of Pneumology of Yalgado Ouédraogo University Hospital in Ouagadougou. All asthma patients seen during this time frame participated in this study. The 2014 GINA criteria were used to assess the asthma control status.

Results: One hundred and two asthmatic patients were included (76 women and 26 men) with a mean age of 38.7 ± 18.6 years. Asthma was found to be well controlled in 26.5% of cases, partially controlled in 34.3% of cases and uncontrolled in 39.2% of cases. The following factors were found to be associated with an uncontrolled asthma: age >36 years (p = 0.002), low level of education (p = 0.04), allergic rhinitis (p = 0.01), overweight (p = 0.03), duration of asthma ≥ 10 years (p = 0.04), therapeutic non-compliance (p = 0.00).

Conclusion: Asthma was insufficiently controlled in our study. A tremendous emphasis must be put on not only on the therapeutic education of asthma patients, but also on a better management of comorbidities.

Asthma remains a public health problem worldwide. It is a chronic inflammatory airway disease that affects all age groups, with expensive care. An estimated 300 million people worldwide are living with asthma. The overall prevalence varies from 1-18% depending on the country. This prevalence is reported to be increasing in many developing countries, with the annual global mortality attributable to asthma estimated at 250,000. If asthma cannot be cured, its appropriate management can provide optimal control with positive effect on the patient’s quality of life. The management of asthma is based on a global approach combining drug treatment and treatment of modifiable risk factors as well as non-pharmacological therapies and strategies. Several international guidelines regarding the assessment of asthma control exist but those of the Global Initiative for Asthma (GINA) are the ones that have introduced the notion of control in the follow-up of the patient with asthma since 2006. GINA recommends focusing patients’ monitoring on asthma control, evaluating this control at each follow-up visit, and adapting the maintenance therapy accordingly. Thus, the goal of our study was to assess asthma control and to identify the factors affecting this control, as evidenced in the department of Pneumology in Ouagadougou, Burkina Faso.

Patients and methods

A descriptive and analytical cross-sectional study was conducted over a twelve-month period (1 February 2015 to 31 January 2016) in the pulmonary department of Yalgado Ouédraogo University Hospital (CHUYO). This department is one of the two reference departments specialised in low respiratory diseases in Burkina Faso. It is the largest in terms of the numbers of patients attending the facility and its capacity of reception of the patients.

The study included all known asthmatic patients (registered for at least one year), aged at least 15, regardless of gender, who were treated in our department during the study period. The diagnosis of asthma was based on a history of characteristic symptom patterns and an evidence of variable airflow limitation, from bronchodilator reversibility testing or other tests as recommended by GINA 2014.

Patients who refused to participate in the study or did not meet our inclusion criteria were not taken into account; as well as patients with comorbidity with repercussions on respiratory function such as cardiopathy or other associated lung diseases such as bronchial dilatation, bronchodysplasia, or chronic obstructive pulmonary disease (COPD).

The data were collected on a survey card during an interview at the end of the consultation, following an explanation of the questionnaire to each patient and after obtaining his or her agreement. The questionnaire helped collect sociodemographic data, the age of onset of illness, asthma symptom control elements as recommended by GINA 2014, comorbidities, risk factors for exacerbations and causes of therapeutic non-adherence and non-compliance.

Asthma control according to GINA 2014 is based on the absence of daytime symptoms, nocturnal awakening symptoms, need for rescue medication and limitation to daily activities. The level of control of the symptoms of asthma was deemed:

- Well controlled when there were no criteria
- Partially controlled when 1-2 criteria applied
- Uncontrolled when 3-4 criteria were attested.
In our study population, 85.3% and 68.6% of our patients. Exposure factors in the environment at respectively 89.2%, 85.3%, cars, dust, cockroaches and mouldy bits were the most common. 58.6% had a monthly income of less than US$90. Emissions from automobile and smoke were the main sources of air pollution. 88 patients (86.3%) were living in the city of Ouagadougou, 74% of patients were under inhaled corticosteroid and long-acting β-agonist in combination (dry powder inhaled) and 27 (26.5%) were under inhaled corticosteroid (pressurised metered-dose inhalers). As regards the patients who knew how to use the devices, their proportion what established at 86.3%.

A notion of smoking was found in 38 patients (4 active and 34 second-hand smoking). Atopic disorder was attested in 86 patients (84.3%). The comorbidities were dominated by allergic rhinitis (70.6%), GERD (37.3), overweight (24.5%), and obesity (20.6%).

Control and non-control factors of asthma: Our study showed that 26.5% of asthmatics were well controlled, 34.3% partially controlled and 39.2% uncontrolled. Adherence to treatment was investigated and 37.3% of the patients were found to be non-adherent. The cost of treatment was the leading cause of non-adherence and non-compliance (59.8%) followed by geographic access to healthcare facilities (34.3%). Table 1 divides patients by causes of non-adherence to and non-compliance with treatment. Factors associated with uncontrolled asthma were age >36 years (OR = 5 [1.8 - 13.7], p = 0.002), low level of education (OR = 3.72 [1.1 - 16.9], p = 0.04), allergic rhinitis (OR = 3.1 [1.2 - 8.1], p = 0.02), and non-adherence to treatment (OR = [4.3 - 196], p = 0.00). Other factors associated with uncontrolled asthma are summarised in Table 2.

Discussion
Our study focused on the control of asthma in patients treated in the Pulmonary Department of CHU-YO. Biases and limits could have been introduced, such as selection bias (the Pulmonary department being a specialised medical department, admitted patients could be those with hard-to-manage asthma), unavoidable prevarication bias and memorisation bias. However, our study showed that the proportion of asthma consultations accounted for 24.04% of all consultations in the Pulmonary Department of CHU-YO. These findings show that asthma is really a public health problem, particularly in light of the fact that it is a chronic disease requiring constant monitoring let alone its prohibitive treatment cost for many. The prevalence of the condition is estimated in the literature from 1-18% depending on the country. This prevalence is reported to be increasing in a number of countries, particularly those in the developing world.1

Our study revealed that asthma was well controlled in 26.5% of cases, partially controlled in 34.3% of cases, and not controlled in 39.2% of cases. Other authors in Africa, including Bennani in Algeria, Ndiaye in Senegal, and Aissa in Tunisia5,6 found uncontrolled asthma in respectively 74%, 96.67% and 90% of their patients. In France, 6 out of 10 asthmatics are reported to be partially or not controlled.7 We found through the analysis of these data that asthma remains insufficiently controlled.

The factors associated with uncontrolled asthma in our study were comorbidities, living environment, and non-adherence to treatment.

Adherence to treatment was defined as the degree to which a patient correctly follows medical advice. The method we used to assess adherence was self-report measures. Adherence to inhaled therapy, based on the 12 months observation period, was defined according to the percentage of prescribed inhalers dispensed to the patient and classified as follows: Complete adherence (> 80%), and low adherence (< 80%).

The collected data were typed and analysed using the software Epi Info in its version 7.2.1.0. The Pearson Gross Chi2 test or Fischer’s exact test were used for comparison of categorical variables when needed while quantitative variables were handled with the student test. Mean values were presented with the standard deviation as the dispersion index. The associations between the variables were considered statistically significant with the probability threshold of 0.05.

Results
Sociodemographic data and lifestyle: During our study period 1,784 medical consultations were held in the Pulmonary Department of the CHU-YO, including 429 for asthma or 24.04% of consultations. A total of 102 patients were included in our study (Figure 1). Seventy-six patients (74.52%) were female and 26 patients (25.5%) were male. The average age of the patients was 38.7 ± 18.6 years with extremes of 15 and 82 years. Eighty percent (80%) of patients were living in the city of Ouagadougou and 73.5% of them had at least high school education level while 17.6% never attended school. Eighty-eight patients (86.3%) included in the study did not have social security coverage and 58.6% had a monthly income of less than US$90. Emissions from cars, dust, cockroaches and mouldy bits were the most common exposure factors in the environment at respectively 89.2%, 85.3%, 85.3% and 68.6% of our patients.

Medical history and comorbidities: In our study population, 46.2% of patients were known to have been asthmatic for at least ten (10) years. The average duration of disease progression was 13.45 ± 13.4 years. Eighty-five patients (83.3%) reported being regularly followed medically. All patients were under inhaled short-acting β-agonist as needed. Seventy-five patients (73.5%) were under inhaled corticosteroid and long-acting β-agonist in combination (dry powder inhaled) and 27 (26.5%) were under inhaled corticosteroid (pressurised metered-dose inhalers). As regards the patients who knew how to use the devices, their proportion what established at 86.3%.
Moreover, the vast majority of our patients were exposed to cars gas emission (89.2%), dust (85.3%), cockroaches (85.3%) and mouldy bits (68.6%) as has already been pointed out. These factors are recognised as important factors in triggering asthma attacks.\(^8,9\)

About ¾ of patients were women. This female predominance is classically found in the literature.\(^6,10\) Asthma in women has specificities modulated by hormonal life. In terms of age, we found an average of 38.7 years. Our analysis also showed that age >36 years is significantly associated with uncontrolled asthma (OR = 5, p = 0.002). Although the general treatment regimen differs little from that of young asthmatics, a whole series of events complicates the management of asthma when the subject is getting older.\(^11\) Older patients, having mostly several debilities, and thus being polymedicated, would have more difficulties to be compliant with their treatments. The chronicity of the disease could also be one reason. Moreover, in our study, an evolution duration of the disease greater than or equal to ten years appeared as a factor favouring uncontrolled asthma (OR = 2.5, p = 0.04).

In general, these patients would therefore not be observant of treatment. Therapeutic compliance in chronic diseases has always been a subject of study and of major concern, with asthma being one of the greatest preoccupations for this problem. These chronically ill patients, with good knowledge of their symptoms, would no longer be quick to visit healthcare facilities. They would therefore be more inclined to practicing self-medication, resulting in poor control of asthma. For adherence to be optimal, it is required that the patient accepts the idea of a treatment and that he or she adhere to the doctor’s recommendations. Hence the interest of talking about therapeutic adherence.\(^12\)

Therapeutic adherence refers to the willingness and thoughtful approval of the individual to manage his or her illness.\(^12\) It is the degree of acceptance of the patient with respect to his or her therapy. However, this adherence can be fluctuating and subject to psychosocial and motivational factors that can hinder it and consequently affect compliance.

There are a number of factors now identified in the literature that hinder or improve care practices.\(^12,3\) Adherence to treatment was therefore investigated during our interrogation by empathic

<table>
<thead>
<tr>
<th>Causes of non-adherence and non-compliance</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Cost</td>
<td>61</td>
<td>59.8</td>
</tr>
<tr>
<td>Geographical access to healthcare facilities</td>
<td>35</td>
<td>34.3</td>
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<tr>
<td>Forgetfulness / confusion</td>
<td>31</td>
<td>30.4</td>
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<tr>
<td>Complex therapeutic regimen</td>
<td>26</td>
<td>25.5</td>
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<tr>
<td>Misunderstanding instructions / inappropriate explanations</td>
<td>24</td>
<td>22.5</td>
</tr>
<tr>
<td>Difficulties in accessing a specialist</td>
<td>16</td>
<td>15.7</td>
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<tr>
<td>Fear of side effects</td>
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<td>15.7</td>
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<tr>
<td>Fear of discrimination</td>
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<td>11.8</td>
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<tr>
<td>Thinking that treatment is unnecessary</td>
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<td>7.8</td>
</tr>
<tr>
<td>Several of inhalers</td>
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<td>2.0</td>
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<tr>
<td>Denial of asthma and its treatment</td>
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<td>0.98</td>
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### Table 1: Distribution of patients by causes of non-adherence and non-compliance to treatment

<table>
<thead>
<tr>
<th>Variables</th>
<th>Patients</th>
<th>Uncontrolled asthma, n (%)</th>
<th>OR [CI 95%]</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Asthma duration</td>
<td></td>
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<tr>
<td>&lt; 10 years</td>
<td>55</td>
<td>36 (65.4)</td>
<td>2.5 [1.1–6.9]</td>
<td>0.04</td>
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<tr>
<td>≥ 10 years</td>
<td>47</td>
<td>39 (83)</td>
<td></td>
<td></td>
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<tr>
<td>Atopic disorder</td>
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<tr>
<td>No</td>
<td>16</td>
<td>08 (50)</td>
<td>3.5 [1.1–12]</td>
<td>0.03</td>
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<td>Yes</td>
<td>86</td>
<td>67 (77.9)</td>
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<td>Tabagism</td>
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<tr>
<td>No</td>
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<td>43 (67.2)</td>
<td>2.6 [0.9–8]</td>
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<td>Yes</td>
<td>38</td>
<td>32 (84.2)</td>
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<td>Regular physical activity</td>
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<td>Yes</td>
<td>47</td>
<td>32 (68.1)</td>
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<tr>
<td>Allergic rhinitis</td>
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<td>No</td>
<td>30</td>
<td>17 (56.7)</td>
<td>3.1 [1.2–8.1]</td>
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<td>72</td>
<td>58 (80.6)</td>
<td></td>
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<td>Overweight</td>
<td></td>
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<tr>
<td>No</td>
<td>77</td>
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<td>5.4 [1.3–37]</td>
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<tr>
<td>Yes</td>
<td>25</td>
<td>23 (92)</td>
<td></td>
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<td>GERD</td>
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<tr>
<td>No</td>
<td>66</td>
<td>46 (69.7)</td>
<td>1.8 [0.7–5.1]</td>
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<tr>
<td>Yes</td>
<td>36</td>
<td>29 (80.6)</td>
<td></td>
<td></td>
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<tr>
<td>Regular follow-up</td>
<td></td>
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<td></td>
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<tr>
<td>No</td>
<td>17</td>
<td>16 (94.1)</td>
<td>7 [1.1–56]</td>
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<tr>
<td>Yes</td>
<td>85</td>
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<td>38</td>
<td>37 (97.4)</td>
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<tr>
<td>Yes</td>
<td>64</td>
<td>38 (59.4)</td>
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<td>88</td>
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<td>Yes</td>
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<td>Social security coverage</td>
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<tr>
<td>Yes</td>
<td>14</td>
<td>11 (78.6)</td>
<td></td>
<td></td>
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</tbody>
</table>
questions, as recommended by GINA.3

We estimated that only 38 patients (37.3%) were adherents; and this negatively influenced the control of asthma to a considerable extent (OR = 25, p = 0.00). The most common causes of non-adherence and non-compliance were the high cost of drugs (59.8%), difficult geographical access to healthcare facilities (34.3%) and forgetfulness (30.4%). The complexity of the proposed treatment regimen (25.5%), misunderstanding of instructions, and even inappropriate explanations (22.5%) as well as difficulties in accessing a specialist (22.5%) were also noted as causes of non-adherence and non-compliance.

Our data accord perfectly with those found in the non-compliance and non-adherence literature.1,4,13,14,15 To overcome the difficulties noted, education seems to be a key factor which serves as an interesting and even unavoidable lever healthcare providers need to encourage patients to adopt favourable attitudes towards their therapeutics and to induce them to autonomously manage their illness and their treatments. The establishment of personal action plans for the self-management of the patient’s illness and the improvement of the doctor-patient dialogue is necessary.1 We believe that it is right to take these assessments into account, and to urge asthma patients to come together in an association, similar to those already existing in our country for other chronic diseases (diabetes, chronic renal failure). They will thus be able to advocate to health authorities for the introduction of social security coverage, or a subsidy for the costs of treatment (especially since 86.3% of our patients did not benefit from social security coverage and 58.6% had a monthly income of less than US$90).

Other comorbidities were associated with uncontrolled asthma in our study, including allergic rhinitis (OR = 3, p = 0.02), and overweight (OR = 5.4, p = 0.03). GERD was present in 37.3% of patients. In this respect, our data do not differ from the already existing literature.3,4,16,17,18 GINA recommends the management of comorbidities of asthma patients as they may contribute to the burden of symptoms, reduce quality of life, lead to drug interactions, and possibly contribute to poor asthma control.1

Conclusion
Asthma is found to be insufficiently controlled in the majority of patients in our study. Several factors are incriminated, including non-modifiable risk factors (such as age, gender, atopic disorder) and modifiable risk factors that are more relevant to patients’ disease behaviours. Thus, in order to improve these levels of asthma control, we argue that the key is to be found in the therapeutic education of asthmatic patients and better management of comorbidities.

Author declaration
Competing interests: none.
Any ethical considerations involving humans or animals: none.
Was informed consent required? No.

References
In the developing world, households are using biomass fuel for cooking and heating this leads to high concentration of toxic pollutants indoor causing several respiratory diseases. The aim of this study was to assess the association between biomass fuels and chronic bronchitis among women leaving in a rural district of Rwanda.

Methods: A prospective study was conducted for a period of 15 months between March 2015 and May 2016 and all patients willing to participate were recruited from test villages selected randomly in the district of Gisagara. Obtained data were compared with those from control villages from the district Huaye. 448 women aged 20 years and above were recruited for the study, among them 302 were using biomass fuel for cooking and there was a control group of 146 age-matched women who were using either liquefied gas petroleum or had not been cooking the last 3 years.

Results: Out of 448 women recruited for the study, 12 (2.6%) were excluded for various reasons, among them 298 (68.3%) were using biomass fuel for cooking and 138 (31.7%) belonged to the control group. Using our case definition of chronic bronchitis the overall prevalence was 10.7% of all participants. Chronic bronchitis was significantly associated with cooking indoor (OR: 8.14; 95%, CI 3.45 to 16.84), age (OR: 2.32; 95% CI 1.93 to 3.59) and education level (OR: 1.66; 95% CI , 0.90 to 3.11).

Conclusion: This study showed that cooking indoor with biomass fuel, age and the level of education are the main risk factors for chronic bronchitis.

In the developing world, households are using biomass fuel for cooking and heating this leads to high concentration of toxic pollutants indoor causing several respiratory diseases including acute respiratory infections, chronic bronchitis, asthma, chronic obstructive pulmonary disease (COPD) and lung cancers. Recently, reports from WHO showed that over seven million deaths every year are caused by air pollution, this makes it one of the most important health risk factor worldwide. Household air pollution is the fourth-leading cause of premature death in the developing world. Indoor air pollution from the burning of solid fuels kills over 1.6 million people, predominantly women and children, each year. Exposure to indoor air pollution from the combustion of biomass fuels constitutes a significant public health hazard affecting predominantly poor communities in developing countries. A large number of recent studies have shown that lifestyles and indoor air pollution contribute to the development of allergic diseases and chronic bronchitis, in addition women exposed to heavy indoor smoke are three times exposed to chronic bronchitis compared to those using cleaner fuels.

In Rwanda, most households still resort to the use of wood, charcoal, grass and crop residues for cooking. One third of the households cook in the same house that is used for sleeping. There is an increase in obstructive lung diseases such as chronic bronchitis, unfortunately there is no data on the role of indoor pollution as a cause of chronic bronchitis in the country. This research had focused on women because as in many other developing countries, exposure levels to biomass fuels in Rwanda may be much higher among women who tend to do most of the cooking and among young children who stay indoors and who are often carried on their mother’s back or lap while cooking.

The study had provided the prevalence of chronic bronchitis and respiratory symptoms in the studied community, thus solving the problem of lack of data in the country.

The relationship between the exposure to chronic biomass combustion and chronic bronchitis in a rural district of Rwanda was critically studied and obtained data will be useful for health policy makers to set up preventive measures and new strategies for reducing indoor pollution and all resulting health problems.

Material and methods
From March 2015 to May 2016, recruitment of participants was done in the District of Gisagara located in the Southern Province. This district has a total population of 322,506 inhabitants and 98.4% are living in rural area. At the district level, the main source of energy for cooking used by the private households are firewood, charcoal and grass/leaves. For a period of 15 months, using a multistage stratified sample design, 448 women aged 20 years and above were recruited for the study, among them 302 were using biomass fuel for cooking and there was a control group of 146 age-matched women who were using either liquefied gas petroleum or had not been cooking the last three years. All sectors of Gisagara district were listed (13 sectors in total) and six sectors were randomly selected. From each selected sector, firewood was also randomly chosen and all women aged ≥20 years willing to participate were selected for the study. Following the same procedure, the control group was mainly recruited in the district of Huaye (Tumba and Ngoma sectors) more urbanised and located in the direct neighborhood of Gisagara District. Included women were nonsmokers defined as those who had never smoked or...
And 138 (31.7%) belonged to the control group. Within the latter, 89 (64.4%) women had not cooked for the last three years and 49 (35.6%) were using gas for cooking. Mean age for both groups was 32.2 years (range 20-83 years). The main respiratory symptoms was cough found in 59.7% of women using biomass fuel and in 14.3% of control cases, wheezes were found in 5.2% of all participants.

Using our case definition of chronic bronchitis the overall prevalence was 10.7% of all participants. The difference between the test group and the control group in the prevalence of chronic bronchitis was highly significant (p<0.0001).

Regarding respiratory symptoms, our study did not show a significant difference between women who were cooking using firewood and those using charcoal or other types of biomass like grass/leaves and agricultural residues. There was a strong association between chronic bronchitis and using firewood compared to other types of biomass fuel, charcoal was the least biomass fuel associated with the disease (OR, 1.02; 95% CI, 1.13 to 1.29). Among those using biomass fuel, charcoal was used by 12% of participants the majority was using firewood (84%). A separate kitchen was present in 32.1% of households and 51.8% were cooking in the living room whereas 16.1% were cooking outdoor (Table 1).

The majority of women in both groups had been cooking for a period ranging between 5 and 30 years and we noted that the prevalence of chronic bronchitis was higher among women who had been cooking for more than 10 years (13.2%) compared to those who used biomass fuel for a period <10 years (4.2%). The lowest prevalence of chronic bronchitis was found among women who had not cooked for the last three years or never cooked (1.8%). 2.2% of respondents using gas for cooking had chronic bronchitis. We also found a significant association between chronic bronchitis and the level of education, women with the lowest level of education had the highest prevalence of chronic bronchitis (OR: 1.66; 95% CI , 0.90 to 3.11).

There was a strong association between cooking indoor (in the living room or a separate kitchen) with chronic bronchitis. A short version of the European Community Respiratory Health Survey (ECRHS) questionnaire on chronic bronchitis was used after translation in the local language by a professional translator.

Chronic bronchitis was defined using the commonest definition used in epidemiological studies as the presence of cough and expectoration for at least three months for two consecutive years.12

Data analysis was done using the Statistical Package for Social Sciences version 20 (SPSS, Chicago, IL, USA). The Pearson Chi square test was used for tests of independence between the main explanatory variable and other variables. A t test was used for continuous variables. Multivariate logistic regression analysis was conducted to estimate the odds ratio (OR) and 95% confidence interval (CI) of respiratory symptoms and diseases. A two-tailed p value 0.05 was considered as statistically significant.

### Results

Out of 448 women recruited for the study, 12 (2.6%) were excluded for various reasons (2 died, 5 did not signed their consent and 5 left the region), we remained with a total of 436 women among them 298 (68.3%) were using biomass fuel for cooking and 138 (31.7%) belonged to the control group. Within the latter, 89 (64.4%) women had not cooked for the last three years and 49 (35.6%) were using gas for cooking. Mean age for both groups was 32.2 years (range 20-83 years). The main respiratory symptoms was cough found in 59.7% of women using biomass fuel and in 14.3% of control cases, wheezes were found in 5.2% of all participants.

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There was a strong association between cooking indoor (in the living room or a separate kitchen) with chronic bronchitis. (p<0.001) (Table 2).

### Discussion

In developing countries, cooking with biomass fuel as a cause of chronic bronchitis have been reported by many authors but few studies were conducted on the African continent.13,14,15 The aim of this study was to evaluate the prevalence of chronic bronchitis among women cooking with biomass fuel in the Southern province of Rwanda. To our knowledge this is the first study conducted in the country with a special focus on women. Findings from this research showed a prevalence of 10.7% with...
a strong association with firewood and cooking indoor. This prevalence is almost similar to other studies conducted in Africa, Asia and Latin America.16,17,18,19 Slight differences observed may be linked with many factors including the biomass fuel used, ventilation of the cooking area, cigarette smoking, the house type... In this study, most of houses were built with mud and the roof made of corrugated sheets with a poor ventilation and this may have increased the degree of exposure to toxic smoke.

Cooking indoor was significantly associated with chronic bronchitis, this finding is in agreement with many other authors20,21,22 who reported that long-term cooking indoor is the most important risk factor for chronic bronchitis. Continuous inhalation of toxic substances from biomass smoke (Particulates matter, CO, hydrocarbons...) leads to a severe irritation of the lung mucosa and defect of the mucociliary system causing respiratory symptoms such as cough and wheezes.23 In our study many women were cooking in the living room, houses were poorly ventilated and few had a chimney.

Aging was associated with Chronic bronchitis, further analysis showed that the prevalence of chronic bronchitis among women aged >30 years was less than 4.5% compared to 13.2% for those aged ≥30 years. Tasleem Ahkatar et al.24 in India had observed an increasing of chronic bronchitis with increasing age. This shows that the duration of exposure to biomass fuels plays an important role in the development of chronic bronchitis, long-term exposure to toxins negatively affect the mucociliary system of the lung resulting in chronic airways inflammation.25 In this study, for practical reasons, we used questionnaires with a face to face approach to maximise the response rate, limitations that we did not monitor the daily time for cooking and we did not measure the level of indoor pollution using appropriate devices.

Majority of respondents in this study were using firewood for cooking simply because charcoal is expensive compared to other biomass fuels. Charcoal does not produce smoke this explains why it is preferred over wood for cooking in many parts of the world. Wood burning produces lot of smoke and tend to release products of incomplete combustion, also known as particulates, that are harmful to humans when inhaled.25

The level of education was associated with chronic bronchitis, there is no clear explanation for this finding, however we can speculate that women with a higher level of education may be more informed about the danger of cooking indoor thus taking protective measures. This finding is different to the study conducted in Nigeria by Umoh V. et al26 who found that education attainment did not play a significant role in chronic bronchitis and argued that majority of participants had less than six years of formal education. In our study majority of subjects in the control group had completed secondary school and few had a university degree.

This is the first study conducted exclusively among women in Rwanda, however our sample size does not allow generalisation of our findings at the national level, further studies with larger samples are needed to complete our findings. In conclusion, this study shows that cooking indoor with biomass fuel, age and the level of education are the main risk factors for chronic bronchitis.

Acknowledgment
We thank the University of Rwanda for funding this research and all the population of Gisagara District for the immense cooperation.

Author declaration
Competing interests: none.
Any ethical considerations involving humans or animals: none.
Was informed consent required? No.

References
Diagnostic and therapeutic utility of indigenous technique of pleuroscopy in undiagnosed cases of exudative pleural effusions

B Shah, MS Raghuwanshi, T Surana, S Khosla, A Julka and HG Varudkar

Abstract
Background and aims: In developing countries, there is a shortage of resources and skilled manpower, despite a large number of patients. To overcome these problems, an indigenous technique of pleuroscopy has been developed in our institute. In this technique, medical thoracoscopic is done by using a set of patented conduits and a fibre-optic bronchoscope. In this study, we describe our experience with this technique of pleuroscopy in undiagnosed cases of exudative pleural effusion.

Methods: 156 undiagnosed cases of exudative pleural effusion were conducted over a period of two and half years. Indigenous technique of pleuroscopy, permitted thorough exploration of the pleural space, permitting multiple biopsies to clinch the diagnosis.

Results: The appearance of pleura showed as inflamed/red-denred pleura in 29 (18.6%) cases, thin transparent adhesions in 31 (19.9%), thin transparent loculations in 26 (16.7%), thick loculations in 12 (7.7%), hard pleural surface in 11 (7%), large nodules/masses in 13 (8.4%), small milliary seedlings or sago grain appearance in 18 (11.5%), scattered masses or nodules in 13 (8.4%) and broncho-pleural fistula in 3 (1.9%) cases. Histopathological analysis showed chronic inflammation in 40.8% (58), Tubercular lesions in 25.4% (36) of patients. There were three cases each of Primary Aspergillosis and malignant mesothelioma, and the rest 26.9% (42) were malignant metastasis in the pleura. The diagnostic yield of pleuroscopy pleural biopsy was 91% (142). Follow-up chest x-rays after six months showed significant reduction in residual pleural thickening (RPT).

Conclusion: The Indigenous Pleuroscopy technique is an efficient procedure and has good diagnostic and therapeutic yield for undiagnosed exudative pleural effusions. It also reduces morbidity, complications, disease progression, and has a significant role in reduction of RPT.

Interventional Pulmonology is a rapidly expanding field, and has become centre of attraction for pulmonary physicians in recent past years. Medical thoracoscopic is one of them. This procedure was described for diagnostic purpose by Jacobaeus in 1910 and was subsequently used in the management of tuberculosis.1

There are conventional thoracoscopes, video assisted thoracoscopes (VATS) and later semi-rigid versions. Each one has advantages and disadvantages. Use of a fibre-optic bronchoscope (FOB) in the pleural space has been reported previously. Due to its inherent physical properties, it is difficult to control the movements, resulting in improper outcomes. The indigenous pleuroscopy technique has been devised, developed and used on patients by the authors to offer the solution to these problems (Patent Application No 1066/MUM/2012 published on 14/12/2012; and Application No 1400/MUM/2012 published on 16/11/2012). It has been designed to combine the flexibility of the flexible fibre-optic bronchoscope and the rigidity of conventional thoracoscopic. Thus all the advantages of flexible as well as rigid scopes are exploited in this technique.

In the present study, efforts are made to pinpoint the accuracy of diagnosis and subsequent effects on residual pleural thickening with the indigenous technique of pleuroscopy on patients in undiagnosed cases of exudative pleural effusions.

Material and method
This study was conducted in the Department of Pulmonary Medicine of a rural medical college of central India, between January 2014 and June 2016. Ethical clearance was obtained from the Ethics Committee. Patients were included in this study with the following criteria: aged over 15 years; having exudative pleural effusion diagnosed on the basis of Light’s criteria. Cases with an absence of adequate pleural space, bleeding tendencies, or patients not giving consent were excluded from study. Other contraindications for pleuroscopy included hemodynamically unstable, arrhythmias and intractable cough.

All the study patients were investigated with complete blood count including BT/CT, platelet count. Vascular access was achieved with intravenous cannula inserted in the upper limb opposite to the side of pleuroscopy. Patients were positioned in lateral decubitus with effusion side up. Arm on the side of pleuroscopy was positioned above the patient’s head and a sand bag was positioned under the chest to widen the space, which allowed better access. The procedure was conducted under local anaesthesia and conscious sedation. Intramuscular 1ml atropine and 2ml Voveron were given prior to procedure. Chest wall was draped with sterile cloth after cleaning the skin with spirit and 5% povidone iodine. The skin, subcutaneous tissue, intercostal muscle and parietal pleura were anaesthetised with 10ml 2% lignocaine to achieve local anaesthesia. During the procedure intravenous midazolam 1mg diluted with 1 ml of normal saline was given as required to achieve adequate sedation. We used only single port for visualising and taking pleural biopsy. The site of incision was chosen where diagnostic needle aspiration
yielded free fluid. A 1cm to 1.5cm-long skin incision parallel to the line of intercostal space was given using sterile surgical blade. A blunt dissection of subcutaneous tissue and the intercostal muscles, parietal pleura with artery forcep was done and after the puncture of parietal pleura a finger was passed in pleural cavity to assess adhesions.

The pleuroscopy conduits are specially designed medical grade stainless steel tubes with specially angulated body, beveled patient end, appropriate viewer’s end, air tubes, non-traumatic edges, smooth inner surfaces and detachable handles. The following are the varieties of conduits in this technique:

1. Simple basic conduits (SBC): This device is used to drain pleural contents, irrespective of loculi. The SBC was inserted in the stoma to aspirate maximum fluid. After assessing the pleural cavity with finger, the SBC was replaced with SSC, and then a video fibre-optic bronchoscope (Olympus BF Type 1T150 with Olympus CV-150 light source) was passed through it. An assistant held the conduit in place and schematic inspection of short radius parietal pleura was done and then, as described above, the conduits were used in a serial manner one after another to see all parietal, visceral, costal and diaphragmatic surface. The biopsy of abnormal area was obtained with usual biopsy forceps (Olympus EndoJaw Alligator Jaw-Step Fenestrated with and without Needle). Pleural bite was taken under vision with forceps. Pleural fluid and biopsy was collected and sent for analysis. Adhesions were gently broken using indigenous pleuroscopy conduits (SCC, PPCi, PPCr).

We have done following therapeutic interventions:

1. Opening of loculi: PPCi is very useful in opening loculi by blunt dissection under vision thus removing all the pleural contents, irrespective of loculi.
2. Adhesiolysis: In case of thin adhesions and loculations, blunt dissection was done with conduits itself.

After the procedure completed, bronchoscope and the conduits were removed and suitable chest tube was inserted. Chest drain was connected to under water-seal. Post-operative management was done in ward as usual. Once the lung had expanded and drain output had decreased to less than 50ml per 24 hours, the chest drain was removed and a chest x-ray done.

To study residual pleural thickening (RPT) follow-up chest X-ray posteroanterior view done six months after pleuroscopy. RPT was defined in a posteroanterior chest radiograph as a pleural dome.\(^{14}\) RPT was divided in four groups as 0-2mm, 3-5mm, 6-9mm and ≥ 10 mm. RPT was compared between x-ray at the time of removal of intercostal drainage tube and after six months.

## Results

173 patients with undiagnosed exudative pleural effusion were enrolled during the study period. Of these, three had bleeding tendencies, 10 did not give consent and one was hemodynamically unstable. The remaining 156 patients (72.4% males and 27.6% females) were found to be suitable for further study.

The results are shown in tabular form under six headings: quantity of fluids; type of fluid; isolation of organisms; pleural

### Table 1: Sex-wise categorisation of all patients based on quantity of fluids

<table>
<thead>
<tr>
<th>Fluid quantity</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>19</td>
<td>12.2%</td>
<td>12</td>
</tr>
<tr>
<td>Moderate</td>
<td>68</td>
<td>43.6%</td>
<td>21</td>
</tr>
<tr>
<td>Large</td>
<td>26</td>
<td>16.7%</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>72.4%</td>
<td>43</td>
</tr>
</tbody>
</table>

### Table 2: Differentiation on basis of type of fluid

<table>
<thead>
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<th>Type of fluid</th>
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<th>Female</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Seropurulent</td>
<td>17</td>
<td>10.9%</td>
<td>24</td>
</tr>
<tr>
<td>Purulent</td>
<td>22</td>
<td>14.1%</td>
<td>9</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>13</td>
<td>8.3%</td>
<td>8</td>
</tr>
<tr>
<td>Straw coloured</td>
<td>61</td>
<td>39.1%</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>72.4%</td>
<td>43</td>
</tr>
</tbody>
</table>

### Table 3: Detection of organism

<table>
<thead>
<tr>
<th>Type of organism detected</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus species</td>
<td>18</td>
<td>11.5%</td>
<td>7</td>
</tr>
<tr>
<td>Streptococcus species</td>
<td>15</td>
<td>9.6%</td>
<td>4</td>
</tr>
<tr>
<td>Pseudomonas species</td>
<td>4</td>
<td>2.5%</td>
<td>0</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>29</td>
<td>18.6%</td>
<td>14</td>
</tr>
<tr>
<td>Aspergillus species</td>
<td>2</td>
<td>1.3%</td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>1</td>
<td>0.6%</td>
<td>0</td>
</tr>
<tr>
<td>Mixed growth</td>
<td>10</td>
<td>6.4%</td>
<td>4</td>
</tr>
<tr>
<td>No organism detected</td>
<td>34</td>
<td>21.8%</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>72.4%</td>
<td>43</td>
</tr>
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</table>
appearance on pleuroscopy with indigenous technique; histopathological diagnosis obtained with indigenous technique of pleuroscopy; and status of residual pleural thickening before and after indigenous pleuroscopy.

In assessing the quantity of pleural fluid, Nironov et al categorised effusions occupying less than one-third, one-third to two-thirds and greater than two-thirds of the hemithorax as ‘small’, ‘moderate’ and ‘large’, respectively.13

Table 6 shows initially there were more patients with shadows of pleural thickening in 3-5mm, 6-9mm and ≥10 mm group in x-ray taken at the time of ICD (Inter-costal Drainage) removal which decreases significantly (p =0.043 by chi-square test) after six months of pleuroscopy. Patients from more pronounced group of thickened pleural shadows shifted towards minimal thickened group (0-2mm) in follow-up x-ray after six months.

Discussion
We have presented the data of 156 patients who underwent pleuroscopy with the indigenous technique in undiagnosed cases of exudative pleural effusion. We included patients for pleuroscopy in whom initial diagnostic work-up with pleural fluid analysis and three pleural fluid cytology did not give any diagnosis.

In our study, we have 113 (72.4%) males and 43 (27.6%) females, with the majority of patients having had symptoms for between 15 days and two months. These patients also took treatment before our intervention, so the effects of treatment may also persist in some cases like tuberculosis and other infections.

For our technique, it is mandatory that there should be some free fluid for entry of the conduits and assures the safety of the procedure which indicates one had reached to the pleural space. After entering that area, further exploration and intervention is possible even in complicated pleural effusions to drain all the loculi. Thus, our technique has an added advantage.

Table 2 reveals that the straw-coloured fluid was predominant finding in undiagnosed cases of exudative pleural effusions in our study. Straw-coloured fluid is so far commonly equated to tubercular etiology. The corroboration with other investigations it has been found that straw-coloured fluid was associated with even non-tubercular diseases.

We have got various range of organisms detected in pleural fluid in which Mycobacterium tuberculosis was commonest organism and rest are enumerated in Table 4. Although maximum sample (30.1%) showed no organism detected. This result may be due to many patients being already on treatment previously or may be due to non-infective pathology.

We have got diversified range of pleural appearance with indigenous technique of pleuroscopy and every case was different. We tried to classify pleural appearance and finding in different categories in which pleuroscopy appearance of pleura showed: inflamed/reddened pleura in 29 cases (18.6%), thin transparent adhesions in 31 cases (19.9%), thin transparent localizations in 26 cases (16.7%), thick localizations in 12 cases (7.7%), hard pleural surface in 11 cases (7%), large nodule/masses in 15 cases (8.4%), small milliary seedlings or sago grain appearance in 18 cases (11.5%), scattered masses or nodules in 13 cases (8.4%), and broncho-pleural fistula was observed in 3 cases (1.9%).

While doing pleuroscopy the feel of pleura varied from soft to relatively subjective feeling appreciated with the touch of biopsy forceps. It can be either due to calcification, thick fibrosis or malignancies. Adhesiolysis and opening of localizations were done which optimised the success of procedure with proper drainage of pleural fluid and faster re-expansion of the affected lung.

The yield of thoracoscopic pleural biopsy was 91% (142/156). Similar experience with medical thoracoscopy has been described from other centres. Kendall et al reported yield of thoracoscopic pleural biopsy to be 83% in their study of 48 patients. Tscheikuna et al described their experience from Thailand (n=86) and thoracoscopy was diagnostic in 95% of 34 patients. Ng et

Table 4: Gross appearance of pleura on pleuroscopy

<table>
<thead>
<tr>
<th>Pleural finding</th>
<th>No. cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflamed/ reddened pleura</td>
<td>29</td>
<td>18.6</td>
</tr>
<tr>
<td>Thin transparent adhesions</td>
<td>31</td>
<td>19.9</td>
</tr>
<tr>
<td>Thin/ transparent localizations</td>
<td>26</td>
<td>16.7</td>
</tr>
<tr>
<td>Thick localization</td>
<td>12</td>
<td>7.7</td>
</tr>
<tr>
<td>Hard pleural surface</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Large nodules/masses</td>
<td>13</td>
<td>8.4</td>
</tr>
<tr>
<td>Small milliary seedlings/Sago grain appearance</td>
<td>18</td>
<td>11.5</td>
</tr>
<tr>
<td>Scattered masses or nodes</td>
<td>13</td>
<td>8.4</td>
</tr>
<tr>
<td>Brocho-pleural fistula</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 5: Histopathological diagnosis obtained with indigenous technique of pleuroscopy

<table>
<thead>
<tr>
<th>Histopathological results</th>
<th>No. cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Inflammation</td>
<td>58</td>
<td>37.2</td>
</tr>
<tr>
<td>Tubercular lesions</td>
<td>36</td>
<td>23.1</td>
</tr>
<tr>
<td>Metastasis in the Pleura</td>
<td>42</td>
<td>26.9</td>
</tr>
<tr>
<td>Primary Aspergilosis</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Mesothelioma</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Non-specific/fibrotic changes</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 6: Residual pleural thickening before and after indigenous pleuroscopy

<table>
<thead>
<tr>
<th>Pleural thickening</th>
<th>No. cases (post-op)</th>
<th>No. cases (+6 months)</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2mm</td>
<td>84</td>
<td>110</td>
<td>Increased</td>
</tr>
<tr>
<td>3-5mm</td>
<td>39</td>
<td>35</td>
<td>Decreased</td>
</tr>
<tr>
<td>6-9mm</td>
<td>23</td>
<td>12</td>
<td>Decreased</td>
</tr>
<tr>
<td>≥10mm</td>
<td>10</td>
<td>3</td>
<td>Decreased</td>
</tr>
</tbody>
</table>
could achieve diagnosis with thoracoscopic pleural biopsy in only 45.5% (10/22) patients. In a majority of patients in our study, pleuroscopy guided pleural biopsy yielded diagnosis in undiagnosed exudative pleural effusion revealed the results as chronic inflammation followed by metastasis in the pleura. 42 cases were diagnosed as pleural metastasis, three cases of mesothelioma and three cases of primary aspergillosis. The cases of mesothelioma and aspergillosis which were diagnosed after indigenous pleuroscopy were on anti-tubercular treatment on the basis of ADA (adenosine deaminase) and lymphocytic predominance. These results are indicative of diagnostic efficacy of indigenous pleuroscopy. The yield is comparably higher because of combination of diagnostic modalities including smear examination, conventional culture, CBNAAT and histopathological examinations.

On moving towards its therapeutic spectrum with indigenous pleuroscopy, we found most of the patients with exudative pleural effusion had thin to thick adhesions between parietal and visceral pleura and most likely would be responsible for building up of loculations if not broken. Indigenous pleuroscopy was used efficiently in breaking of these thin to thick adhesions with minimal to no bleeding. Multiple loculations in chronic cases of exudative pleural effusion, indigenous pleuroscopy showed satisfactory results with expansion of lung and clearance of loculations and pleural fluid. In cases showing nodular lesion biopsy from diseased site was easily taken because of proper manipulation of bronchoscope with conduits. The result obtained with the indigenous technique after biopsy was 91%, comparable with most other studies such as Munavvar et al., Wang et al., Blanc et al., Law et al., Tscheikuna, Diacon et al., and McLean et al. Indigenous pleuroscopy showed convincing results in diagnostic and therapeutic spectrum of interventional pleuroscopy. As we can see after pleuroscopy in already diagnosed cases of exudative pleural effusion, it changes the previous diagnosis and course of treatment in 30.8% (48) of total patients undergoing pleuroscopy. If we look towards therapeutic spectrum of indigenous pleuroscopy, it showed dramatic results after adhesiolysis and breakage of loculations which were easily and convincingly performed. It reduces the chances of residual pleural thickening and causes rapid expansion of the affected lung after pleuroscopy.

RPT of exudative pleural effusion is one of major complications which leads to reduction in forced vital capacity (FVC) and total lung capacity (TLC). On comparing thickness of shadows of pleural thickening at the time of removal of intercostal drain tube with RPT after six months of pleuroscopy, we found significant decrease in RPT in follow up chest x-ray after six months in all pre divided groups. No cases have shown increase in residual pleural thickening after pleuroscopy. A variety of complications associated with thoracoscopy have been described in the literature such as subcutaneous emphysema, air leak, haemorrhage, empyema, shock, and chest wall seeding by malignancy. We had no such complication with this indigenous technique of pleuroscopy although some patients presented with complaints of residual pain after removal of ICD, which got relieved in subsequent follow-up visits with analgesics and physiotherapy.

**Conclusion**

Medical pleuroscopy with the indigenous technique is an efficient procedure and has good diagnostic and therapeutic yield in patients with undiagnosed exudative pleural effusions. It reduces morbidity, complications and disease progression and plays a significant role in reducing residual pleural thickening.

**Author declaration**

Competing interests: none.

Any ethical considerations involving humans or animals: none.

Was informed consent required? No.

**References**