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TB transmission in healthcare settings and improving infection control

Transmission to people with HIV

But what's particularly distressing is that the hospital at Tugela Ferry was the very first in the province to offer antiretroviral therapy, and thus it has served as a magnet to people with HIV in the area. 44 of the 53 were documented as HIV-positive and would have been receiving their HIV care from the hospital.

"This whole issue obviously raises the problem of tuberculosis transmission in congregate settings in hospitals," said Dr Kevin de Cock, Director of the WHO Department of HIV/AIDS, in another session of the conference. "We are congregating patients for ARV services in hospitals where infection control has been neglected over the years."

"Transmission of MDR and XDR-TB really must be addressed to further improve survival for HIV co-infected patients," said Dr Friedland. "I would say quite ominously that in high-prevalence areas, the success of both antiretroviral therapy and TB-DOTS programmes is really threatened by the presence of MDR and XDR TB."

Indeed if people perceive that waiting rooms and in-patient facilities are dangerous places (and in many situations, they clearly are), it could significantly impact on health-seeking behaviour.

These findings also call into question the reliance by many programmes upon the HIV-infected community as outreach workers, adherence counsellors and health workers in settings where they could be exposed to TB. For example, at this year's PEPFAR Implementer's meeting, there was a report that described a programme in India, which is using people with HIV to locate other people from their own communities — which can be particularly useful in settings where the HIV epidemic is not generalised.

But from whence did the programme operate?

The local TB clinic.

Transmission of drug-resistant TB to healthcare workers in South Africa

TB transmission is also a serious problem for professional healthcare workers. At least two of the 52 people in the first KwaZulu Natal survey who died of XDR-TB were members of the hospital staff. According to Dr Friedland, at least four other healthcare workers from the hospital died from suspected XDR-TB.

Elsewhere in South Africa, the burden of MDR- and XDR-TB may not yet be so great, but according to a poster presentation by Dr Karen Shean of the MDR-TB clinic of Brooklyn Hospital and Dr Paul Wilcox of Groote Schuur Hospital, the transmission of MDR-TB is still a very real concern to healthcare workers in the Western Cape.

Cape Town is the epicentre of the TB epidemic in South Africa, with a case rate of over 1000 per 100,000. However, the reported rate of MDR is only 1% of new cases and 4% of retreatment cases (according to the last surveillance — however, given the developments in KZN, these rates could be on rise).

But between 1989 and 2005, 32 cases of MDR-TB transmission to healthcare workers were reported in the metropolitan area. The majority of the cases originated at academic hospitals, and the rest

were scattered throughout the healthcare system. Most of the infected were nurses or assistants. Seventeen successfully completed the up to two-year long course of MDR-TB treatment, eight are still on treatment while seven died of MDR-TB.

But the situation might have been worse had a greater proportion of the healthcare workers been HIV-positive (only four out of 28 who tested were). Drs Shean and Wilcox wrote that the risks "will be further exacerbated by a rapidly growing HIV epidemic with the proportion of TB patients co-infected with HIV increasing." In addition, it is likely much worse wherever MDR-TB or XDR-TB has taken hold. Dr Shean and Wilcox stressed that working with drug-resistant patients carries a greater risk, because "patients who have MDR-TB are infectious for prolonged periods, increasing the risk for nosocomial and/or occupational transmission of *M. tuberculosis* and protection policies need to be urgently addressed."

Transmission of TB to healthcare workers in Nairobi, Kenya

Although MDR-TB and XDR-TB are particularly frightening, many healthcare staff in resource-limited settings are at routine risk of TB exposure. This is especially a problem for staff who are HIV-positive according to Dr Shona Dalal of the US Centers for Disease Control (CDC) who described a study investigating TB transmission at a large referral hospital in Nairobi, Kenya.

In 2004, the annual TB case rate in Kenya was 320/100,000, but in Nairobi it is much higher, 830/100,000, where over 60% of the population lives in slums. Coinfection is common — the HIV prevalence in adult TB patients is 60%.

In March 2005, there were exaggerated reports in the Kenyan press that the risk of contracting TB in the wards of a large referral hospital in Nairobi was eight times higher than in the general public. Concerned about the welfare of the hospital's staff and its ability to retain 4,800 staff members — an especially precious resource in sub-Saharan Africa — the hospital launched an investigation into the problem in collaboration with the National Leprosy and Tuberculosis Programme and the CDC.

The hospital is a large 1,800-bed referral hospital in Nairobi — but overcrowding is common and patients often have to share beds while some sleep in mattresses on the floor. In 2004, a total of over 4,500 cases of TB were diagnosed at the hospital.

In addition to determining the burden of TB among the staff, the investigation ((a chart-review on staff TB cases and a case-controlled study) explored the risk factors for TB disease among the staff.

There were 215 TB cases among staff between 2001-2005, between 34-58 each year which is equivalent to a TB case rate of 645 to a high of 1,115 cases per 100,000 with no apparent trend from year to year. These TB rates were at least twice the national rate — though quite similar to the rate in Nairobi.

HIV might have been contributing to the high case rate of the staff, but the majority (66%) of staff TB cases did not have an HIV test result recorded in their medical charts (and only 71 of the staff had medical charts available). Of those who did have HIV results in their charts, 86% were HIV-positive.

Several risk factors, identified by multivariate logistic regression analysis, were associated with TB disease in the case-controlled study:

- Working in a high-risk location was associated with an adjusted odds ratio (AOR) of 2.1 (95% CI 1.1-4.2)

A high risk location was defined as any area in the hospital where TB patients received care including casualty/emergency room —

where confirmed and suspected TB cases and other patients all shared the same crowded waiting areas which had limited ventilation — the general medical wards, and the TB clinic.

“The inpatient medical wards had confirmed TB patients segregated into two rooms, said Dr Dalal. “There were large windows in these rooms, but they were often closed, particularly at night. Sputum specimens were also sometimes collected at the bedside of inpatients.”

- The number of hours spent in the same room as patients per day, AOR 1.3 (95% CI 1.2-1.5)
- The staff member's housing situation was also associated with TB, those living in the slums had an AOR of 4.7 (1.8-12.5), while those living in the hospital-provided low-income housing had an AOR of 2.6 (1.2-5.6).
- Being HIV-infected was the highest risk factor for TB, with an AOR of 29.1 (95% CI 5.1-167)

“HIV is the strongest known risk factor for progression to TB disease once infected,” said Dr Dalal. “For their own protection and to receive appropriate care, it is crucial for staff working in hospitals in a country with a generalized HIV epidemic and high rates of TB to know their HIV status.”

The Kenyan and South African data illustrate “the risk that health care workers of all sorts are facing and we're having increasing difficulties retaining the health work force,” said Dr Alistair Reed, HIV/TB advisor to UNAIDS. He noted that he had heard many healthcare workers express concerns about working around XDR-TB, especially.

Dr Friedland agreed this is potentially a very serious problem.

“One of the great vulnerabilities in this information is the effect that it might have on the healthcare staff, which is already quite stressed and in most circumstances there is insufficient staff to start with,” said Dr Friedland. “One of the great concerns is actually loss of staff. I think the institution of appropriate infection control procedures and HIV testing and education of the staff is very important.”

In another symposium, Dr de Cock also stressed that rapid action on infection control is crucial.

“Providing a safe working environment is going to have to be a priority,” he said, “because we cannot tolerate the impression to emerge that caring for AIDS patients or caring for TB patients is dangerous and is something that people won't want to do. That is something that we just cannot allow to emerge.”

What can be done to strengthen infection control and prevent institutional transmission of TB?

“Many people... have been working for years for this problem and its potential solutions to be recognised,” said Dr Naomi Bock, from the Global AIDS Program at the CDC. “But very little has been promoted internationally for TB infection control.”

Nevertheless, a number of interventions have been proposed that could help strengthen infection control in resource-limited settings (see resources).

These controls are essentially divided into a three level: administrative/work practice, environmental, personal respiratory protection.

Administrative controls

Administrative controls and work practice, especially the prompt isolation and treatment of TB patients, and staff education, are the most effective ways to prevent TB transmission. WHO guidelines

recommend that every facility start with written infection control plan outlining prompt recognition, separation, provision of services, investigation for TB and referral of patients with suspected or confirmed TB disease.

Dr Vaira Leimane, the director of the State Agency for TB & Lung Disease of Latvia (where MDR- and XDR-TB are also problems), Dr Dalal and Dr Friedland listed a number of specific recommendations and practices instituted to improve administrative controls and work practice at their respective facilities. These should be part of any good infection control plan

- Infection control training, education and counseling — all staff should be knowledgeable about signs and symptoms of TB
- Triage coughing patients to separate waiting areas and providing expedited service for TB suspects to decrease their wait times in these crowded settings
- Only collect sputum from individuals suspected of having TB in a designated area away from other patients and staff
- Advise TB suspects about cough hygiene/etiquette on screening and provide them with a face-mask or tissues to cover their mouths and noses
- Appoint an infection control officer to monitor this and other good infection control practice
- Rapidly diagnose and treat TB — and where MDR and XDR are a concern, perform culture and drug susceptibility testing on all tuberculosis cases from the first diagnosis, rather than waiting until they fail
- Set up an isolation ward for infectious TB cases to separate them from other inpatients. Likewise, in settings where MDR- and XDR-TB are risks, set up a separate isolation ward
- Integration and foster communication between the TB and HIV programmes

Environment controls

Environmental controls are essentially any measure that might reduce the concentration of infectious droplets in the air around the healthcare facility. They can include building, setting, facility-orientation issues (and there is some overlap with some of the administrative controls such as setting up isolation wards and where sputum collection is performed) or engineering controls including, such as ventilation (natural and mechanical), filtration, and ultraviolet germicidal irradiation (UVGI).

Industrialized countries often demand the engineering solutions that are often complex and expensive (exhaust fan systems and filtration), while people in resource-limited settings are simply told to open the window.

- Improve the air circulation

Nevertheless, studies have shown that opening the window/natural ventilation can indeed dramatically improve ventilation and air circulation in a facility, but obviously the efficacy of this approach would be dependant upon the layout of the building and the size and orientation of the windows — and the time of day or year.

“However, at night the windows are closed,” said Dr Friedland. “It's cold in South Africa at night much of the year, and whatever is accomplished by ventilation during the day, is probably offset by what happens at night.”

Back in the pre-antibiotic days no TB ward or sanatorium would have contemplated shutting the windows at night – ventilation and fresh air was a paramount part of the treatment regime in

sanatoria, because it protected against re-infection and protected staff too.

● Outdoor waiting areas

At the referral hospital in Nairobi, they are considering setting up an inexpensive covered outdoor waiting area for patients and casualty.

● UV lights

The jury is still out about how effective this strategy would be in areas with high humidity, but some researchers at the TB meeting recommended installing ultraviolet lights, which can kill or inactivate microorganisms like *M. tuberculosis* if there is sufficient exposure.

New findings were presented from a study in Lima, Peru (which is very humid) that found that UV lights significantly reduced airborne transmission to guinea pigs breathing contaminated air near the ceiling of an HIV/TB ward, compared to guinea pigs exposed to the same air without UV irradiation. 15 UVI guinea pigs vs 55 non-UVI guinea pigs became TB-infected ($p < 0.001$).

Though this approach wouldn't be foolproof, it might be more practical and affordable than many other engineering controls or reconstruction. The CDC guidelines describe how these lights could be installed and properly maintained.

Personal infection protection

The final infection control measures involve personal respiration protection, including wearing masks and, if someone is HIV infected, avoiding high-risk locations for TB transmission.

Surgical masks do not provide sufficient protection to inhale through. Respiratory masks should be made available because they have the capacity to filter particles 1 micron in size and so can protect from inhaling infectious droplet nuclei.

However, debate about the effectiveness of the respirator masks and how long as respirator mask can be used.

“

We've done some work in Russia,” said Dr Paul Jensen of the CDC, “where we had folks use respirators for extended periods of time, record both the chronological time that they had the respirator and also the hours of usage of the respirator. We used both the European certified respirators and the U.S. certified respirators. What we found was two things. One is for extended periods of time, of the several hundred respirators, only one failed the certification test for filtration efficiency and it just barely failed. So from the standpoint of the filter, it's not going to be an issue.”

“The weak point of most respirators [is] the strap. What we found was about 20-percent of the people when we refit tested them, failed the fit test. The reason they failed the fit test is because that respirator wasn't tight enough against their face. We did find a few people that did innovative things, like they kept tying knots on the strap, a couple people used shoelaces so they could pull it up tighter. That worked great.”

“I've tried to wear these masks and many of you have, and if you have a big nose like me, it's a real problem to wear for more than 20 minutes or an hour,” said Dr. Friedland.

But again, the most important personal infection control issue is learning one's HIV status. For staff, Dr Dalal and Dr Friedland both described trying to encourage the staff to get tested for HIV — and to redeploy them if necessary.

“Interventions to increase acceptability of HIV testing in an environment that is supportive and confidential should be

considered. Staff who are HIV-infected should be offered optional reassignment away from areas of high TB exposure,” said Dr Dalal.

To learn how best to encourage HIV testing among healthcare workers, Dr Dalal and colleagues held some focus groups on where they would be comfortable to be tested.

“In terms of how to improve testing for HIV, I think the idea is to get places where they can have a confidential environment that's secure and in a location where they are comfortable to go and have it on their own. The suggestion has been self-testing,” she said. “But I think those answers have to come from the staff themselves, so having focus groups or having discussions where they are providing the input would probably be the best way to go.”

Political infection control

Dr Friedland proposed one more category of infection: political. All the press attention has made this a bit easier he said.

Dr Moll, who at one point had complained on South African television about the lack of Ministry of Health support for improving infection control, now has only good things to say today — about the local provincial Department of Health at least.

But it shouldn't come as a surprise that this is a touchy issue. Governments don't want to hear that their public health infrastructure needs to be rebuilt, remodeled or refurbished — and without public pressure and press attention, these things are unlikely to happen.

The task of advocating for an increased budget for infection control is made more difficult because there is a paucity of data clearly demonstrating the effectiveness of many of the infection control measures aside from administrative controls. Most of the interventions and guidelines are little more than common sense. Many of these interventions need to be validated by operational research in the field — so advocating for an increased research budget might be one place to start.

Resources

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about HATiP

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The newsletter is edited by Theo Smart (Cape Town) and Keith Alcorn, NAM's Senior Editor (London).

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