Mission report

SUPPORT TO THE MEDICAL AND ENGEREERING DESIGN OF THE MDR ROOM

Albania
3-11 May 2016

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Actual report doesn't necessary reflect the point of view of the above mentioned organizations.

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Abbreviations

BCG	Bacillus Calmette Gurerrin
BSC	Biosafety Cabinet
BSLIII	Biosafety laboratory level III
DST	drug susceptibility testing
GFATM	Global Fund to fight Against Tuberculosis and Malaria
HCW	health care worker
HEPA	high efficiency particulate filter
HIV	human immunodeficiency virus
IC	infection control
ICU	intensive care unit
ID	infectious disease
MDR	multi drug resistant
MOH	Ministry of Health
NRL	National Reference Laboratory
NTP	national tuberculosis program
PPD	purified protein derived
PPE	personal protective equipment
TA	technical assistance
TB	tuberculosis
TOR	terms of reference
UHSN	University Hospital Shefqet Ndroqi
UV GI	Ultraviolet germicidal irradiation
WHO	world health organization

Contents:

Background:

The University Hospital "Shefqet Ndroqi" (UHSN) is currently undergoing a spatial reorganisation that requires the decision of where the drug susceptible and drug resistant TB patients are going to receive inpatient care. Our expertise was requested for the determination of the proper locations to meet medical, clinical and infection control conditions.

Objectives of the mission:

- General objective: to organize the inpatient care for drug susceptible and drug resistant TB patients in the University Hospital "Shefqet Ndroqi"

- Specific objectives: to provide support to design of the hospital spaces for adequate and safe inpatient care of drug-susceptible and drug resistant TB patients that meets the internationally-recommended standards for airborne infection control.

Activities conducted (as in the TOR):

- Provide technical support to design of the MDR room
    - -assessment of actual status of medical and physical condition of the hospital (site visits, protocol review, meeting with the staff) in line with medical criteria for establishment of inpatient TB care
    - -design the standards of operation for treatment of drug-susceptible and drug resistant TB patients taking into account separation of patients with different patterns of drug resistance, separation of staff from patients and limitation of visitors.
    - -develop recommendations for administrative infection control
    - -design the engineering plan to build the MDR TB ward, including mechanical ventilation
    - -develop the cost estimation and operational integrated action plan

Expected deliverable

- The engineering design of the plan of MDR TB room for adequate and safe inpatient care of drug-susceptible and drug –resistant TB patients that meets internationally-recommended standards for airborne infection control, including submission of recommended layout of the MDT-TB ward and preliminary list of civil work required
- List of required equipment to be procured for the MDR TB room
- Development of the standards of operation for treatment of drug susceptible and drug resistant patients
- Recommendations on administering infection control
- Cost estimate and plan of action for establishment of MDR TB room
- Mission report including recommendations

Recommendations:

-To the national partners involved in TB management (UHSN, NTP)

- To organize a respiratory isolation area (airborne isolation area) for the MDR TB patients to be treated in UHSN
- To separate the contagious TB patients from patients with other lung diseases hospitalized in UHSN, in the designated area for airborne isolation
- To improve case detection by testing all TB suspects by cultures and DST; implement rapid methods (GeneXpert, LPA, liquid media cultures and DST) to detect in time MDR TB
- To assure treatment to all TB and MDR TB cases identified; train abroad on MDT TB management two doctors and two nurses
- To develop and implement the TB IC Plan in UHSN, by:
  - Appointment of responsible persons for TB IC, organizing the TB IC Committee; establish clear tasks for each members of the Committee
  - Regular assessment of the risk for TB infection in each department of the Institute
  - Establishment of the budget needed to implement TB IC activities
  - Conducting on regular basis trainings on TB IC for the staff
  - Implementation of the protocols for airborne isolation of the TB cases (criteria of admission and discharge of the TB suspects, infectious TB patients and MDR TB cases in the airborne isolation area)
  - Developing policies on transportation of the infectious TB patients
  - Developing policies regarding visitors in the airborne isolation area
- To implement environmental TB IC measures in UHSN by:
  - Maximizing the use of natural ventilation of the spaces (keep windows opened as much as possible in the airborne isolation area) (strong recommendation)
  - Disinfecting the air using UV light in the airborne isolation area and in other spaces at risk for TB transmission (strong recommendation)
  - Taking into consideration the implementation of simple mechanical ventilation system (air extraction from the patient's rooms in airborne isolation area) in order to create unidirectional airflow and to increase air mixing in the rooms. (optional, weak recommendation)
- To develop and implement a program of respiratory protection in UHSN by:
  - Enforcing the use of FFP2 (N95) respirators for the staff during exposure to potential infecting aerosols for TB (staying in rooms with TB suspects or patients, performing high risk procedures to TB suspects or TB patients) and for visitors when enter in high risk areas for TB transmission
  - Enforcing the use of surgical mask for the TB patients when indoor in the presence of other person

-To the Ministry of Health

- To sustain the project dedicated to the creation of a isolation area for TB/MDR TB patients in the UHSN
  - To assure the needed budget that is not actually covered by the external donors
  - To find a location for the "Orthopaedics of the diabetic leg" department, that is actually functioning in the space that will be dedicated to the isolation area for TB/MDR TB patients

- To improve TB diagnostic
  - Increase availability of consumables for TB diagnosis
  - Implement rapid methods for TB diagnosis (test for GeneXpert, LPA, liquid media cultures and DST)
  - Assure drugs availability for TB and MDR TB cases

-To the other partners (Global Fund, CCM, WHO, French Initiative5%)

- To continue technical assistance for TB control in Albania, especially focused on the monitoring of TB/MDR TB patient's management
- To contribute to the financing of above mentioned activities
- To be flexible in reallocating funds between various budget lines in the Global Fund Projects

TB risk assessment in UHSN

TB situation in Albania seems to be under control, although data on the number of cases may be underestimated due to low diagnostic capacity (limited radiological and bacteriological examinations performed due to the lack of resources).
In 2015, in Albania, there were diagnosed 414 TB cases, out of them 393 new cases and 21 retreatments. Out of the new cases, 275 were pulmonary new cases. Out of retreatments, 18 were relapses, 2 retreatments after failure and 1 retreatment after default. Only 209 cases were microscopically confirmed; cultures were performed only for 129 cases and DST 13 cases.
In UHSN, in 2015 were hospitalized 283 TB cases, out of them 207 were pulmonary TB cases; a number of 155 cases were confirmed microscopically and only 108 in cultures. DST was performed in 13 TB cases.
The TB Hospital in Tirana is located in a former sanatorium, which became the University Lung Disease Hospital in 1982 and from 2008 became a regional hospital, also hosting other medical specializations (cardiology, general surgery). However, it is the only hospital in Tirana with a pneumology department with rooms dedicated for TB treatment. There are plans to start here treatment of the MDR TB patients diagnosed among the country.
The building is still under renovation and extension as a general hospital. Big achievements were noted from our last visit (2011) in terms of renovation: emergency department was moved and modernized; the ambulatory department was furbished at the first floor of the hospital, instead of a TB ward that was relocated at the second floor in other wing. Both, emergency room and ambulatory are modern and functional.
Unfortunately, the rehabilitation of the hospital didn't take into account the need of improvement of the TB infection control measures.
Situation of the TB patients is the same or even worse than at our last visit (2011):

- TB patients are not separated to other patients with different lung diseases or other conditions, even immunosuppressed. We found in the different wards 9 TB patients, under first line treatment, all of them being smear positive (with potential of contagiousity), none of them with the result of drug susceptibility test (potential MDR TB patients).

  -In the first pneumology department, 4 TB patients (2 men and 2 women), all of them smear positive, with advanced forms of tuberculosis, were hosted in 2 separate

rooms (one for men other for women), with own toilets. The men TB room was the very last one on the hallway, but the women TB room was just in the middle of the central hallway, in the proximity of the staff room. However, the patients could freely move to other patient's rooms or to the common spaces. Staff toilet was just near the TB men's rooms. On the ward were hospitalized 6 patients with diabetes.

-In the second pneumology department were hospitalized 2 TB patients, one woman and one man, both smear positive. Because of the lack of beds, in the same rooms with the TB patients were hospitalized patients with other lung diseases (one woman with COPD and two women with pleural effusions of unknown ethology in the same room with the TB woman and 2 men with pleural effusions and one with possible cancer in the same room with the TB man).

-In the third pneumology department, out of 35 patients hospitalized, only one had TB (cavitary, smear positive); he was hosted alone in one 4 beds room; however, the room was just near the nurse's station and the door of the room was largely opened.

-In the surgery department were hospitalized two TB patients, both of them with positive sputum TB bacteriology and with pleural drainage for tuberculosis empyema. One of them was MDR TB patient, transferred from the prison. He was under military supervision, guarded by two policemen's without any personal respiratory protection (only surgical mask). Both patients were hosted in the same room, inside the surgery department. MDR TB patient was ineffectively treated with first TB regimen.

- No infection control plan is in place in any ward nor in the hospital
- Neither infection control committee, nor infection control focal point has been designated.
- No signage in the wards regarding the risk of infection.
- No policy for the visitors (visitors were present in many of the patient rooms without protection or limitations).
- Even if the staff provides patient education, patients' adherence to cough etiquette is poor
- No specific training on TB Infection control for the HCW was organized
- Because of privacy issues, hospitalized patients perform sputum collection in the bathrooms, not accepting to do it on the balconies
- No specific environmental control is in place (mechanical ventilation, fan extractors or UV), natural ventilation being relied upon instead. Each room is equipped with big windows on one side of the rooms.
- No policy on using natural ventilation (some rooms having the windows opened, others closed, as patients wish)
- No policy for respiratory protection is in place; respirators are not available; the staff uses surgical masks sporadically.

Conclusion of the Risk Assessment:

- The risk of TB transmission is high in any of the pneumology and thoracic surgical department, without possibility of limitation of risk area as long as TB patients are mixed in the ward with patients having other lung diseases;
- There is potential of transmission among the patients, from patients to visitors or to medical staff.

- It is urgently needed to identify and set up a dedicated space to hospitalize high TB suspects, contagious TB cases and MDR TB patients. We estimate a need of ≈10 beds in airborne isolation rooms, needed for these categories' of patients.

Of course, we do not neglect and we strongly recommend urgently implementation of rapid methods for TB diagnosis and identification of resistant strains (GeneXpert, other genetic methods, liquid cultures and DST) and proper treatment of all TB cases (including MDR TB), as efficient ways to decrease TB transmission.

Results of the mission:

-There was established the need of organizing an isolation area not only for MDR TB patients, but for all contagious TB patients that are currently hospitalized together with other non-infectious patients
-There was identified the proper location for the isolation area; this will be able to accommodate up to 14 patients
-The engineering design of the plan of TB / MDR TB isolation area to meets internationally-recommended standards for airborne infection control was established
-Recommendations on infection control measures to be implemented were delivered: we recommend the use of combination of TB IC measures: administrative, environmental (natural ventilation and UV) and respiratory protection; we do not consider mandatory the use of mechanical ventilation and do not recommend it, because of doubts related to construction and maintenance, as well as high cost.
-The recommended layout of the MDT-TB ward and preliminary list of civil work required were developed
-The list of required equipment to be procured for the MDR TB room was established
-The standards of operation for treatment of drug susceptible and drug resistant patients were developed with recommendations on administering infection control
-Cost for establishment of MDR TB room was estimated

Lessons learned:

-There was good coordination between the team members during activities; national consultant, former manager of the Institute (UHSN), was very helpful for all activities organized during the visit; he had good contacts with key people.
-Support provided by the NTP and hospital management was essential for the success of the mission
-Based on the results of risk assessment we could adapt the objective of the mission (isolation room for MDR TB patients that was initially prevue) to the real needs (isolation area for MDR TB patients, but also for susceptible TB patients during the period they are contagious)
-Recommendations need to be realistic, adapted to the local situation and actual reality;
-Sophisticate mechanical ventilation system (even air extraction system) is not realistic to be well implemented and maintained; we recommend the use of safe but simple infection control means (administrative separation/isolation of cases, natural ventilation associated with UV light)

Detailed agenda of the mission:

Tuesday, 3 May 2016

Meeting with the management of the University Hospital "Shefqet Ndroqi" (UHSN)
Participants:

Prof. Perlat Kapisyzi – Director of the Hospital, Head of Pneumology 1 Department
Prof. Hassan Hafizi - former NTP Manager, Head of Pneumology 3 Department
Dr. Donika Mema – NTP Manager
Dr. Anila Aliko – lung physician, TB IC consultant
Dr. Silva Tafaj - Head of the NRL for TB
Dr. Silva Bala, Head of Pneumology 2 department
Mrs. Borana Galanxhi, Head of the Pharmacy
Dr. Cristian Popa, TB IC consultant

Discussed topics:

-Scope and objectives of the mission
-TB situation in Albania and in UHSN
-Situation of TB infection control in UHSN
-Actions to be done to improve TB IC

Conclusions of the meeting:

- Management of UHSN doesn't consider tuberculosis as a high important problem regarding infection control in the hospital. The main argument is that none of the staff contracted TB disease in the last years, despite the lack of any infection control measure. MDR TB only is considered to have epidemiological risk, so they decided to organize a separate area designated only for MDR TB patients. They identified one location for the area of MDR TB patients' hospitalization.
- We raised the issue of TB infectiousness and the risk of airborne transmission of the disease, proved by large number of evidences and we strongly recommended to separate the TB cases from the patients with other lung diseases and to organize an area for airborne isolation of infectious patients, no regard if they have regular TB or resistant TB.
- We offered to have a lecture on TB transmission and TB IC measures for the staff of UHSN.
- The director of the hospital offered his entire support for the mission.

Visit to the Pulmonology wards of the hospital. TB risk assessment.
The results of the risk assessment are included in dedicated chapter

Visit to the Thoracic Surgery ward of the hospital. TB risk assessment.
The results of the risk assessment are included in dedicated chapter

Wednesday, 4 May

Visit to the Epidemiological Department of the NTP
Participants:

- *Dr Donica Mema, NTP manager, administrator of the NTP epidemiological database*
- *Dr. Anila Aliko, former manager of UHSN, TB IC consultant*
- *Dr. Cristian Popa, TB IC consultant*

Collecting updated data regarding TB epidemiology in Albania and TB epidemiology in UHSN in the last year.

Meeting with the Director of the Hospital, Prof. Perlat Kapinsky
Discussed topics:

- the results of the risk assessment in the UHSN that concluded high risk tor TB transmission in the departments where TB patients are hosted (3 Pulmonology wards and the Thoracic Surgery ward);
- It was raised the impossibility to delimitate the risk as far as the TB patients are not separated in one special place. This place should be provided with adequate infrastructure to assure airborne isolation conditions.
- The consultants presented alternatives for isolating the patients and the opportunity to create, together with the MDR TB isolation area a place for high TB suspicions and for contagious TB patients, even with regular TB:
    - ***Variant #1:***

First solution comes in response to the proposal of the hospital management to organize for small number of MDR TB patients an airborne isolation area in the northwestern extremity of the central building. The area is composed of two rooms, one hosting for the moment orthopaedics for diabetic leg, other the archive.

First room (orthopaedics for diabetic leg) is large (7,60/6/2,74m), equipped with toilet (2,40/2,63m). As the total utile area is around 35m^2, it can host a maximum of 3 TB beds. The second room (archive) has around 18m^2 being provided with separate toilet, could accommodate maximum 2 patients. One more small space, a storeroom of 2/1,1m is on the other side of the hallway. The hallway is 1,90m large and 2,63m high.

Inconvenients for arranging this space:

-Small number of patients that could be accommodated (maximum of 4-5 patients)

-Large number (3) of patients in one room

-Lack of auxiliary spaces (nurse's room, clean linen room, dirty linen room, room for collecting dirty cutlery)

-Difficulties to separate entrance for the patients (dedicated access may be allocated or one stair for the access of patients must be constructed if this variant will be preferred)

- ***Variant# II*:**

Using the space where TB lab currently is functioning (first floor, above the emergency area) for setting up an airborne isolation area to accommodate MDR TB patients, but also potential contagious TB patients that are currently hospitalized in the pulmonology ward. This opportunity is possible, as the TB lab will be moved in other location, in a new constructed building.

This alternative has the following ***advantages:***

-Provide separation of infectious patients actually hospitalized in the pneumology wards

-Provide isolation of MDR TB patients in a proper space

-Large space, could accommodate 10- 12 patients with good isolation conditions

-Offers the possibility to insurance ancillary areas needed for the proper functioning of the ward (staff room, clean linen, dirty linen, room for collecting dirty cutlery)

If this variant is chosen, we foresee some ***disadvantages***:

-Lack of separate entrance for the patients (one stair for the access of patients must be constructed)

- Individual toilets must be constructed for each room.

Conclusions of the meeting:

- There is a real need to separate all contagious TB patients (sensitive or resistant TB).
- The space where the TB laboratory is actually functioning, proposed by the expert's team for organizing the isolation area is already designated to other purpose.
- The space initially dedicated by hospital management for the isolation area (two rooms in the north western extremity of the hospital) is not enough to accommodate all the patients in need to be isolated.
- The management of the hospital decided to allocate larger space in the north western extremity of the hospital for the organization of the isolation area, able to accommodate MDR TB patients (2-3 patients per year with an average staying in the isolation area of 6 months)

and the contagious TB cases hospitalized in UHSN (about 150 TB cases, with an average staying in the isolation area of 15-20 days).

Meeting with engineer and architect, regarding the rehabilitation of the building and who will be in charge with refurbishment of the MDR TB department.

Participants:

- *Dr Donica Mema, NTP manager, administrator of the NTP epidemiological database*
- *Dr. Anila Aliko, former manager of UHSN, TB IC consultant*
- *Dr. Cristian Popa, TB IC consultant*
- *Mr Sokol Agaviku, engineer*

Discussed topics:

- Representatives of the company in charge with the rehabilitation of the hospital (including the respiratory isolation area) were positive about organizing the space for respiratory isolation area for TB patients.
- Basic principles for the organization of the space were discussed with the engineer
- A field visit was organized in respiratory isolation space that will be dedicated to the TB patients (sensitive and MDR TB).
- On site measurements were performed together with representatives of the constructor and of the hospital.

Conclusion of the meeting:

- Main constraints were identified and discussed, in order to find solutions (space planning, organization of dedicated circuits for patients, staff, food and materials).
- Main challenge identified was the entrance of the patients, which needs to be totally separated to other circuits of the hospital.

Thursday, 5 May

Visit to the Infectious Disease Hospital "Mother Theresa" – Intensive Care Unit.

Reason for the visit:

- Intensive Care Unit in "Mother Theresa" Hospital was provided by the World Bank, in 2010, with a mechanical ventilation system, designed to assure directional airflow and negative/positive pressure, depending on the requirements imposed by the situation. When it was put into operation, we made an evaluation of the system and we appreciated it as one of the best ventilation system in its class.
- Actual visit was a follow up, designated to see how the system was exploited and if it is still functional. Unfortunately, the results of the visit were disappointing: the system is no more functioning, as it was not maintained: filters were not changed, pipes were not cleaned, and fans have not been reviewed. The management of the facility didn't allocate resources for maintenance of the system.

Conclusions of the visit:

- This case study raises suspicions related to the maintenance of any complex mechanical ventilation system that would be constructed in the TB/MDR TB Department in UHSN.
- Similar situation identified in the micobacteriology and virology laboratory in Public Health Institute confirms difficult maintenance of mechanical ventilation system in healthcare facilities in the country

Lecture on TB transmission and TB Infection Control in Healthcare facilities

- Taking into consideration the lack of information and need of training that we identified during the risk assessment, we obtained the permission and the support of the director of the hospital (UHSN) to conduct a lecture regarding TB transmission and TB IC measures to be implemented in facilities;
- The staff participated in large number and was interested in the topic;

- There were discussions and questions related to the topic.

Friday, 6 May

Evaluation of the new premises where the TB/MDR TB isolation area will be organized.

- Working in the Hospital (UHSN).
- Measurements were taken for all spaces that will be composing the isolation area; Details regarding the placement of UV devices were established.
- There were analysed best solutions for organizing the entrances of the staff and patients.
- Details were discussed with the constructor.

Meeting with the Director of the Institute and agreement on the modifications to the project.
There were established with the management of the Institute details on:

- Separate entrance for the patients, dedicated to the TB/MDR TB isolation area;
- Separate entrance for the staff (from the hospital – hemodynamic department), with controlled access
- The rooms will remain large, in order to have good natural ventilation; they will be able to accommodate up to 14 patients (ideal a total number 9-10 patients) in 4 large rooms
- Disinfection of the air will be assured with UV light;
- if enough funds will be available, a simple system of mechanical ventilation, designed to extract air from the rooms will be installed; this should increase the mixture of the air during the cold season and will create an unidirectional airflow from hallway to the patient's rooms.

Saturday 7 May, Sunday 8 May – working on relevant documents for the mission

Monday, 9 May

Meeting at the French Embassy
Participants:

Mrs. Isabelle Thomas Delic, Attachee de cooperation, French Embassy in Albania
Dr. Cristian Popa, TB IC Consultant
Dr. Anilla Aliko, TB IC Consultant
Dr. Donika Mema, NTP manager
Dr. Silva Tafaj, Head of the Nation Reference Laboratory for TB

Summary of the meeting:

- There were discussed the main objectives of the mission.
- The team presented an update on the actual situation of the project.
- There were discussed
  - Main achievements (setup of the TB/MDR TB department is going on)
  - and challenges (support of the MOH, approval of the GF application, financial constrains).
- Embassy's representative expressed the entire support to the project, including diplomatic attempts addressed to the Ministry of Health.

Meeting at the Ministry of Health, *The* ***Hospital Planning Department***
Participants:

Dr. Petro Mersini, Director of the Hospital Planning Department of the MOH
Dr. Cristian Popa, TB IC Consultant
Dr. Anilla Aliko, TB IC Consultant
Dr. Donika Mema, NTP manager
Dr. Silva Tafaj, Head of the Nation Reference Laboratory for TB

Summary of the meeting:

- There was requested the support of the MOH in the following activities:
  -Supporting the management of TB/MDR TB cases (to increase diagnostic and treatment capacity of the TB cases)
  -Supporting the implementation of the Global Fund activities, by nominalization of responsible person from the MOH
  -Supporting the setup of the TB/MDR TB isolation ward, by:
    - Finding a new location for the service of "Orthopaedics of diabetic foot", that is actually functioning in the future area of the TB/MDR TB isolation ward; the representative of the MOH was very supportive in this direction, mentioning that the decision to move the "Orthopaedics of diabetic foot" service is one of their priorities (will be approved soon); he mentioned that respective service will be moved to other health facility (Hospital for Trauma).
    - Assuring financial support for the organization and maintenance of the hospital
- The representative of the MOH gave us all assurances on support for setting up of the TB/MDR Isolation Ward in UHSN.

Tuesday, 10 May

- ***Final debriefing with representatives of the NTP, NRL, UHSN***
- ***Presenting the findings and main recommendation***
- ***Presenting the layout of the isolation ward for TB/MDR TB***
- ***Analysing deliverables of the mission***

Annexes:

- *The engineering design of the plan of MDR TB room for adequate and safe inpatient care of drug-susceptible and drug –resistant TB patients that meets internationally-recommended standards for airborne infection control, including submission of recommended layout of the MDT-TB ward and preliminary list of civil work required*
- *List of required equipment to be procured for the MDR TB room*
- *Development of the standards of operation for treatment of drug susceptible and drug resistant patients*
- *Recommendations on administering infection control*
- *Cost estimate and plan of action for establishment of MDR TB room*
- *Mission report including recommendations*
- *Recommended layout of the TB/MDT TB isolation area*
- *Risk map of the isolation area; the flow of the patients and staff in the ward*
- *Recommended layout of the UV GI system*
- *Recommended layout of the mechanical ventilation system (optional)*

Deliverable #1

The engineering design of the plan of MDR TB room for adequate and safe inpatient care of drug-susceptible and drug –resistant TB patients that meets internationally-recommended standards for airborne infection control, including submission of recommended layout of the MDR-TB ward and preliminary list of civil work required

The "MDR TB room for adequate and safe inpatient care of drug-susceptible and drug resistant TB patients" will be organized in separated area, in a wing located in the north-western extremity of the University Hospital Shefqet Ndroqi (UHSN).

The engineering design and plan is presented in Annex #6

Reasons why the specified area was chosen:

- Area is isolated, far from most frequented circuits of the hospital, in uncluttered part of the hospital
- It is possible to organize separate circuits for patients and for the staff and other materials (food, linen, medical commodities) through different entrances in the building and ward
- Area is large enough to accommodate the needed number of patients, in safety conditions
- Space is proper for using natural ventilation
- Location needs minimum investments
- It was considered not hard to change the actual destination of the space to respiratory isolation area; for the moment, in that area are functioning the service of orthopaedic treatment for the diabetic foot (in one room) and the archive (in the other 4 rooms); for the archive, there were plans to remove in the new constructed building. For the service of orthopaedic treatment of diabetic foot, there are plans to be removed to other location, probably in other hospital.
- Management of the hospital agreed with the allocation of the area for respiratory isolation ward.

Estimation of the need regarding the number of beds for the isolation area (TB/MDR TB room)

-It is estimated that 1 or 2 MDR TB patients are identified and will need treatment each year; with an average staying in the hospital of about 6 months, 1 hospital bed should be enough to accommodate 2 patients during one year.
Maximum capacity for MDR TB patients can increase to up to 6 beds at one time, located in two rooms (one room for men and one for women), meaning a maximum capacity of 12 MDR TB patients per year.

-For the sensitive TB patients and high TB suspects in need of isolation, the average period of staying in the isolation area is estimated to be around 20 days (after that period, they can be moved on pneumology department, being no more contagious).

For 75% occupancy rate of the beds, the minimum of 8 beds dedicated to the regular TB patients can accommodate a number of about 108 cases per year, which we consider enough for the estimated need of the hospital. If a number of 12 beds will be used for the regular TB patients and high TB suspects, the isolation capacity is increasing to a maximum number of 165 cases per year.

According to the needs, there will be flexibility in allocating the beds for regular TB or MDR TB, as they are separated in different rooms.

Description of the area that will be dedicated to the MDR TB room for adequate and safe inpatient care of drug-susceptible and drug resistant TB patients

The area is located at the first floor, in the northwestern wing of the building.
Beneath the chosen area, in the basement, there is for the moment the lavatory and some administrative areas, which will be removed. Above the area, at the second floor, there is a medical department (cardiology).
The entrance from the hospital is from "hemodynamic department" (where coronarography is performed) and the entrance from outside is currently done on a secondary staircase of the building that may be dedicated to the TB/MDR TB ward. The access to the staircase is currently possible only after passing the basement of the building, but it is not difficult to make direct access from outside to the staircase. The staircase will be dedicated only to the MDR TB patients, as it will be blocked above the 1th floor.
The area that will be dedicated to the TB/MDR TB patients is composed by central hallway (24m length/1,85m width); on the left side of the corridor are located the rooms that will be dedicated to the TB and MDR TB patients, on the right side the rooms for the staff and one store-room.
The rooms for the patients:

Room #1 is large (5,5/5,8/2,70m ≈ 32,5m^2 ≈ 88m^3), provided with it's own toilet (2,30/2,66/2,70m); the room was initially provided with a balcony, which was closed with windows. Actually, the balcony (1,80/6,08m) is included into the room and it could function as a kind of interior loggia or veranda for the patients. According to the dimensions, it can accommodate up to 4 patients (optimum 2-3 patients, and in case of high demand up to 4 patients).

Room #2 is also large (5,5/5,8/2,70m ≈ 32,5m^2 ≈ 88m^3), also provided with own toilet (2,11/2,50/2,66m) and with the former balcony that became an interior loggia.
According to the dimensions, it can accommodate up to 4 patients (optimum 2-3 patients, and in case of high demand up to 4 patients).

Room #3 is the smallest (3,62/5,25/2,70m ≈ 19m^2 ≈ 51,31m^3), also provided with own toilet and interior loggia (former balcony). According to the dimensions, it can accommodate up to 2 patients. It is optimum for short-term isolation area for TB or MDR TB suspects.

Room #4 is the largest (7,8/6/2,75m ≈ 46,8m^2 ≈ 126,3m^3), with a toilet (2,83/2,40/2,70m) that was built inside the room, in one corner. Room has large windows, and, according to its dimensions, it can accommodate 3 – 4 TB patients. Probably it will be dedicated to MDR TB patient(s).

The staff room (room #5) is located on the right side of the corridor; it is large (3,87/6,24/2,7m), provided with its own toilet; it can be divided in two spaces for different staff categories: doctors and nurses.

There is a small space -room #6 (2/1,10/260m), also located on the right side of the corridor, which could be used for storing materials.

Total surface of the area that will be dedicated to the TB/MDR TB is occupying about 350m^2, meaning a volume of ≈1000 m^3; Area dedicated to the patients will be larger than 150m^2 (an equivalent of ≈ 400m^3).

During the cold season, heating of the air will be done by the central heating system by radiators (that are already installed). Because of high ventilation required (natural or mixed mode), the dimensions of radiators should need to be increased.

Ventilation of the air will be natural, assured through windows; simple air extracting mechanical system could be designed to increase the ventilation of the spaces in the cold season and to assure directional airflow from the hallway to the patient rooms (that would have "more negative pressure" than the other part of the building).

Recommended layout of the MDR TB ward

The TB/MDR TB ward will be composed by 4 rooms for patients, on the left side of the central hallway and two rooms for the staff on the right side of the central hallway. The number of patients that will be accommodated is up to 14, corresponding to the actual needs of the hospital. One or two rooms (according to the needs) will be dedicated to the MDR TB patients. The other rooms will be used for TB/MDR TB suspicions and for contagious sensitive TB cases during isolation period.
The staff area will separate the patient area by the hallway, which will be provided with UV light radiation, functioning as a "filter" in between the two areas. Both patient rooms and staff rooms will be provided with continuous UV radiation.

There will be separated entrances in the ward for patients and staff:
-Patients will have access from the interior hospital's court in the staircase and from the staircase to the rooms, passing the hallway.
-Staff will have access, from the hospital (from the central hallway corresponding to the "haemodynamic" department); the door will be secured from each sides by electronic card and/or key, allowing the access only to the staff dedicated to the isolation area.
-Visitors, when allowed (only with respiratory protection) will enter the building through the patient's entrance. However, we recommend organizing outside to the building of an open space dedicated for visits.

One ***sputum collection booth*** should be constructed inside the ward (preferably in the staircase or at the end of the hallway), with exhaust fan to outside. Otherwise, sputum must be collected outside the building (special area to be delimited, providing privacy to the patients). Sputum collection is not allowed inside of the rooms or toilets.
Sputum collection booth will be provided with an exhaust fan, able to extract up to 20ACH (extraction capacity = volume of the booth x 20); it will be exhausted to outside, on the top of the building, to at least 9m far from any air income (window or air inflow); inside the collection booth will be placed an unshielded UV lamp, 30W, able to disinfect the air inside the room in the time between two patients; *The UV fixture will be functioning only when nobody is inside the collection room, never in the presence of the people inside!*

Consideration regarding environmental Infection Control measures to be implemented in the TB/MDR TB Ward

Based on previous negative experiences with mechanical ventilation systems in eastern European countries and particularly in Albania (see the ventilation system in Infectious Diseases Hospital Mother Theresa, ICU department, that is no more functioning because it was not maintained or in the laboratory in the Public Health Institute, where ventilation system is also no more functioning), we consider that simple is better than complex from both a cost and maintenance perspective.
Even with good negative pressure isolation, with air direction designed to keep contagion in the patient room, studies show a plume of air being dragged by personnel into and out of isolation rooms. Still, we don't want rooms actively pumping contaminated air into corridors or adjacent rooms.
The fundamental elements of airborne isolation is adequate air disinfection defined as >/= 12 ACH with some effort to keep air within the room - that is, directional airflow into the room.

Choice #1 (that we strongly recommend, as being realistic to be implemented), would be cheaper, effective, but unconventional, based on germicidal UV with air mixing (low velocity paddle fan) that may add the equivalent of about 17 ACH to the natural ventilation. Installing upper room UV with air mixing in both the patient rooms, staff rooms, and adjacent corridors would produce a safe environment for patients and workers. It too requires good design, good fixtures, and scrupulous checking and maintenance to be sure it is working as intended. A problem with UV light is that the expertise to plan and install and maintain a system is hard to come by at the moment. At least 2.7 m ceiling height is required to be able to place fixtures with the bottom 2.1 m from the ground. Simple low-velocity ceiling fans are required. Windows need not be closed since natural ventilation and UV equivalent ventilation should be additive.
The design of the UV system is attached in **Annex #6** using only one model of louvered upper room UV fixtures with horizontal flow of radiation, placed on the lateral wall of the room**.**

Choice #2 Maintaining simple negative pressure in the rooms, although not as

difficult as multiple pressure gradients, still requires frequent monitoring with smoke sticks, tissue paper, flow meters, or built in continuous pressure monitoring to maintain an exhaust volume that exceeds intake flow rates. Of course, for a fully mechanical system, all windows must be closed. A simple air-handling unit may be designed to provide 12 ACH and negative pressure only. The retrofit would require ductwork and a mechanical blower system.

Choice #3 would be a combination of mechanical ventilation (mixed mode) and UV-G radiation, but that requires expertise and maintenance of two systems.

Design of the system for air disinfection using UV-G light with air mixing, additional to natural ventilation (details for the Choice #1)

Upper room UV devices with horizontal flow of radiation, which are placed on the lateral wall of the room should be the best choice, as they are easy to be installed and maintained, safe for people staying in the room and efficient. They provide horizontal flows of radiation, which may create narrow "curtain" of radiation at the highness where are installed. Each 30W device covers a surface of 20m^2. They may be used in the patient's rooms and in other spaces inhabited by people (staff's rooms).

Fig 1: Louvered upper room UV fixture, 254nm, with horizontal flow of radiation, that are placed on the lateral wall of the room

"Open light" UV fixture (unshielded UV device) should be used only when nobody is inside the room, as it does not assure protection to the people nearby. One unshielded UV fixture (30W) will be placed into the sputum collection booth, in order to disinfect air in the time between two procedures.

Fig 2: Type 4 UV fixture (unshielded UV fixture)

- *Optimal placement of the UV devices in the TB/MDR TB isolation ward should take into consideration:*

-Placement of upper room UV devices with horizontal flow of radiation which are positioned on the lateral wall of the room in:

- Each patient's room, to cover 20m^2 each fixture; in the rooms they may be installed over the door or on lateral wall, over the patient's beds
- Staff rooms (one device per one room)
- On the hallway

In addition to the UV fixtures, in each patient room, in staff area and on the hallway will be mounted one low velocity paddle fan (9 units).
Proposed layout of the UV system is presented in Annex #8.
An UV-C meter for254um wavelength will be needed to monitor UV level Î

Maintenance of the UV fixtures
-Cleaning of the fixture is performed at least once each three months; UV lamp is cleaned with alcohol 70% (no water or detergent).
-UV light level is measured with a UV meter during installation process, then quarterly. Level of radiation has to be <0,4uw/cm^2 at 1,70m height, in the patients room (proving the safety of UV light in the room) and >100uw/cm2 at the height of the lamp, at 1 m distance from the lamp and >20uw/cm2 at 2 m distance from the lamp, at same height.
For the measurements is needed an UV-c meter
-Changing of the UV lamp is performed after facing the lifetime of the lamp (18.000 hours) or when intensity of UV radiation is <100uW/cm^2 at 1 m from the lamp, measured at the height of the device.

Considerations regarding an additional air-handling unit for patient's rooms designed to provide 12 ACH and negative pressure only (optional, not mandatory)

Simple ventilation system using an air extractor designed to create "negative pressure" in the room and directional airflow may be added to the UV-G disinfection system. This should increase the efficacy of environmental measures, but it would increase the cost of rehabilitation and we have concerns regarding the capacity to maintain the system. This is the reason why we present it as alternative, but we do not consider as compulsory to add additional ventilation system, considering it as facultative; it may be added anytime if funds are identified.

Designed for the TB/MDR TB isolation area, air extracting system must be able to exhaust a total volume of 5000m^3 air/hour (400m^3 air x 12 ACH). Exhaust ductwork from the bedrooms and the associated toilet must be "dedicated", in the sense that the system may serve only the bedroom suite, meaning that 4 individual air extractors, one for each room, are needed (each air extractor with exhaust capacity of about 1200m^3 air/hour. The system requests air handling units, piping system, air fixtures (diffusers, grills); air must be exhausted to outside, at minimum 9 m far from any air intake (window, air inlets, equipment stacks). Separate systems for each room suite is needed because of the risk of air mixing between the rooms in case of pipes communication. However, all devices must work simultaneously, to avoid pressure differences between the rooms and consequent air movement.

Outflow diffusors and grills will be installed at the superior part of the walls (or on the ceiling), above the patient's beds, in order to increase the movement of the air from the

floor to the superior part of the room (increasing the efficacy of the UV light by transferring the air through the "curtain" of UV radiation). In order to avoid any interference of the exhaust with air suppliers, it is recommended to place the outflow on the top of the building (at least 9 m from any air supplier is requested).

Only as estimate, simple exhaust system for the patient's rooms may cost about 5.000 Euro for each room suite; one possibility should be to install exhaust system only in one or two rooms, dedicated to the MDR TB patients, according to the available budget, but we do not recommend this, because of the possibility to create movement of the air from the other patient's room to the corridor because of negative pressure created.

The cost of maintenance is around 10% of the initial cost of the ventilation system per year (one additional cost of about 500 Euro/room/year.

Estimation of the cost of ventilation system (simple extraction system), for each unit (4 units for 4 suites room/bathroom are needed):

-cost of the diffusors, grills – 1000Euro
-cost of the exhauster (engine, fan) - 2000 Euro
-cost of the pipes (80Euro/1m pipe) – 2000 Euro
Total cost of 1 unit = 5.000 Euro
Total cost of the exhaust system (4 units) =20.000Euro

Proposed layout of mechanical ventilation system, including calculation of airflow volume per each room is provided in Annex #9

Doors:

In order to assure the transfer of air from the hallway to the rooms and from the room to outside, the doors of the patient's rooms should be provided at their inferior part with unidirectional grills (fig 5), allowing the air to pass only from the corridor to the room and never from the room to the corridor. Grills must have a surface of ≈50/20cm, equipped with louvers that are gravitationally closed, but may open to the room, when negative pressure inside the room.

Fig. 5 Unidirectional grills for the inferior part of the doors

Grill for air inflow:

Similar grill, but with higher dimension (about 4 times higher than the door's grill) will be added instead of one window, at the outside extremity of the corridor, allowing the access of air from outside to the hallway; this will provide necessary air inflow to the ward when the exhaust system is working. Inflow air heating may be taken into consideration.

Windows:

The windows in the patient's rooms must be design to allow maximum natural ventilation; all glass surfaces to have possibility to be opened. Windows must be able to be locked in the open position, for this being preferable to permit horizontally swinging.

Other special conditions for the patient's rooms:

- Installing oversized radiators will increase heating capacity; this will lead to the use of natural ventilation (open the windows) during the winter or will cover the heat loss if exhaust ventilation will be used.
- Each patient bed will be provided with a source of oxygen, power supply (220V), individual light, individual alarm system connected to the staff room; this may be facilitate by using of individual panel mounted on the wall, at the head of each patient.

General recommendations for maintenance of the ventilation system, if it will be choice:
-Ensure employees receive proper training on the maintenance equipment.
-Training on how to properly conduct maintenance and clean equipment should be included in any new employee's on boarding process. When purchasing the equipment, ask vendors to provide on-site training as part of the purchase.
-Have a maintenance plan for the ventilation system; assure annual revision of the ventilation system.
-Maintain an operating log; these logs help track information related to the system's operation; monitor temperature, air direction. When reading outside the norm occurs, maintenance or repairs may be needed.

Preliminary list of civil work required:

1. The management of the hospital and the ministry of health will analyse and approve the plans of rehabilitation and construction of the TB /MDR TB isolation ward
2. Identification of the funds needed for rehabilitation (Global Fund, CCM, MOH, other donor's)
3. Selection of the company that will perform rehabilitation.
   The Company will analyse and make in details the plans of rehabilitation.
4. Any approvals needed for the construction will be obtained (fire protecting, construction authority) if needed
5. The Ministry of Health will identify a new location for the "orthopaedic treatment of diabetic leg"
6. The space will be released for starting the works
   - The archive will be moved in new location
   - The room dedicated to "orthopaedic of the diabetic leg" will be moved to the new location identified by the MOH
7. Entrances to the ward will be organized:
   - Limited access door, secured by electronic card will be installed at the entrance, at the passage from the hospital
   - New entrance will be organized for the patients, from the exterior court to the staircase and afterwards to the hallway and patient rooms.
   - Access will be limited to the staircase: access to the elevator will be restricted at the firs floor, screen (or doors with limited access) will be installed at the ground floor and second floor on the staircase
8. The staff area will be divided in two spaces (one for nurses, one for doctors);
9. Sputum collection booth will be constructed on the staircase or at the end of the hallway.
10. Heating system of the ward to be analysed, taking into considerations increased ventilation
11. Electric installation of the building is rehabilitated in order to facilitate and to support the installation of the UV system and new electric devices
12. Additional medical devices to be installed (oxygen supply for each bed or at least for half of the beds, eventually individual aspiration for one or two beds – if requested for surgical cases as pneumothorax or for other procedures of aspiration)
13. Facultative installation of the exhaust ventilation in the patient's rooms (it may be addressed to one or to more rooms)
14. Windows in patient's rooms may be changed with others that may allow better ventilation (all surfaces operable, at least a part of the windows may be opened horizontally (swinging), allowing their blocking to *open* position if natural ventilation or on *close* position if mechanical ventilation
15. Walls, ceilings and floors are rehabilitated
16. Doors in need to be changed will be changed with new other; doors in patient's room will be provided with grills allowing unidirectional circulation of the air only from the corridor to the patient's room.
17. UV fixtures to be installed in the patient rooms, hallway and staff rooms
18. Furniture to be placed in the rooms

Deliverable #2

List of required equipment to be procured for the MDR TB room

No.	Equipment	Number of units	Estimated price (Euro)	Estimated cost
		Furniture		
1	Hospital beds	14	400	5600
2	Bed mattress	14	150	2100
3	Table for hospital room	4	150	600
4	Chairs for hospital room	18	20	360
5	Nightstands	14	100	1400
6	Wardrobe	4	100	400
7	Sofa for staff room	1	150	150
8	Wardrobe for medical instruments	1	300	300
9	Office for staff room	2	200	400
10	Office shelf	1	100	100
11	Office chair for the staff	2	80	160
12	Stretcher for patient transportation	1	450	450
13	Wheel chair for patient's transportation	1	150	150
14	Negatoscope	1	100	100
15	Infuzion stand	4	100	400
16	Chair for harvesting	1	300	300
17	Trolley for linen transportation	1	250	250
18	Shield (fender)	1	150	150
19	Table for medical instruments	1	450	450
20	Table for food transportation	1	350	350
Total cost furniture				14.170
		Electronics, appliances		
21	LCD TV, LCD wall mount	5	200	1000
22	Refrigerator	5	200	1000
23	Computer, LCD	2	350	700
24	Printer	2	100	200
25	Bed head console	14	600	8400
Total cost electronics				11.300

TB IC devices				
26	Louvered upper room UV radiation devices, 254nm, 30W, with horizontal flow of radiation, for lateral wall mounting	20	340	6800
30	Unshielded UV radiation device, 30W (for sputum collection room)	1	100	200
31	UV-C meter 254nm	1	2000	2000
32	Low velocity padle fan	9	150	1350
Total cost UV system				10.350
33	Sputum collection booth	1	1500	1500
34	Mechanical ventilation system (exhaust system)	4	5000	20.000
Total cost of ventilation system				20.000
Refurbishment of the building (doors, windows, hitting system, electric system...)				
35	Entrance doors (limited access door), organization of the entrance, patient's rooms doors (with unidirectional grills)			4.000
36	Changing windows (patient's room, staff room)			3.000
37	Organization of staff area (walls, toilet rehabilitation)			1000
38	Rehabilitation of the ceiling, walls, floors in patient room, hallway			4000
39	Rehabilitation of the electric system			3000
40	Rehabilitation of the heating system	1	2500	2500
41	Other (oxygen pipes, plumbing...)		1500	2500
Total cost of refurbishment				20.000
Total estimated cost of the equipment and refurbishment				57.320 (Euro) (77.320 including ventilation system)

Note: costs are only estimative, they may vary according to the local market

Deliverable #3

Standards of operation for treatment of drug susceptible and drug resistant patients

Patients hospitalized into the Isolation Ward for TB/MDR TB may belong to one of the following categories:

1. ***Sensitive TB patient (bacteriologically confirmed, with known result of drug sensitivity test or genetic test showing sensitivity to rifampicine +/- isoniazide)***, which is hospitalized in UHSN needs to be isolated during the period they are contagious. He will be placed in the isolation ward, in one room dedicated to such cases, according to the sex.
   Admission of the patient to the isolation ward may be done directly from other departments/hospitals, where he was diagnosed as a TB case or from the departments of UHSN, if he was diagnosed here. Patients are admitted directly to the TB/MDR TB isolation ward, without passing through other services (emergency room, registration, information desk…). They are equipped with surgical masks during the transportation, until they reach the room.
   Patients may start treatment as soon as they are admitted to the TB/MDR TB isolation ward or before the admission. They may leave their room only equipped with surgical mask when indoor. They will be also instructed to wear surgical mask anytime someone (medical staff, cleaning staff, visitors) enters into the room.
   Sensitive TB patients will be isolated in the TB/MDR TB isolation ward for at least two weeks. After two weeks of treatment, they can be moved in other areas of the hospital, in departments where patients are not contagious, eventually mixed with other patients, only if they:
   -are receiving proper treatment (entire drug regimen, full dosage)
   -are well tolerating the treatment (they did not experience adverse events that could induce interruptions of the treatment)
   -have good clinical evolution under the treatment.
   Sputum bacteriology (smear conversion to negative) is not compulsory condition for interrupting the isolation, as there are studies showing that TB patients loose their contagiousity before sputum becomes negative, average after 2 weeks of proper treatment. However patients with negative sputum microscopy or with extrapulmonary TB may be discharged anytime from isolation.
   Decision of placement under isolation or interruption of the isolation is the responsibility of the lung physician treating the patient on the ward or who approved the admission of the patient in the hospital.

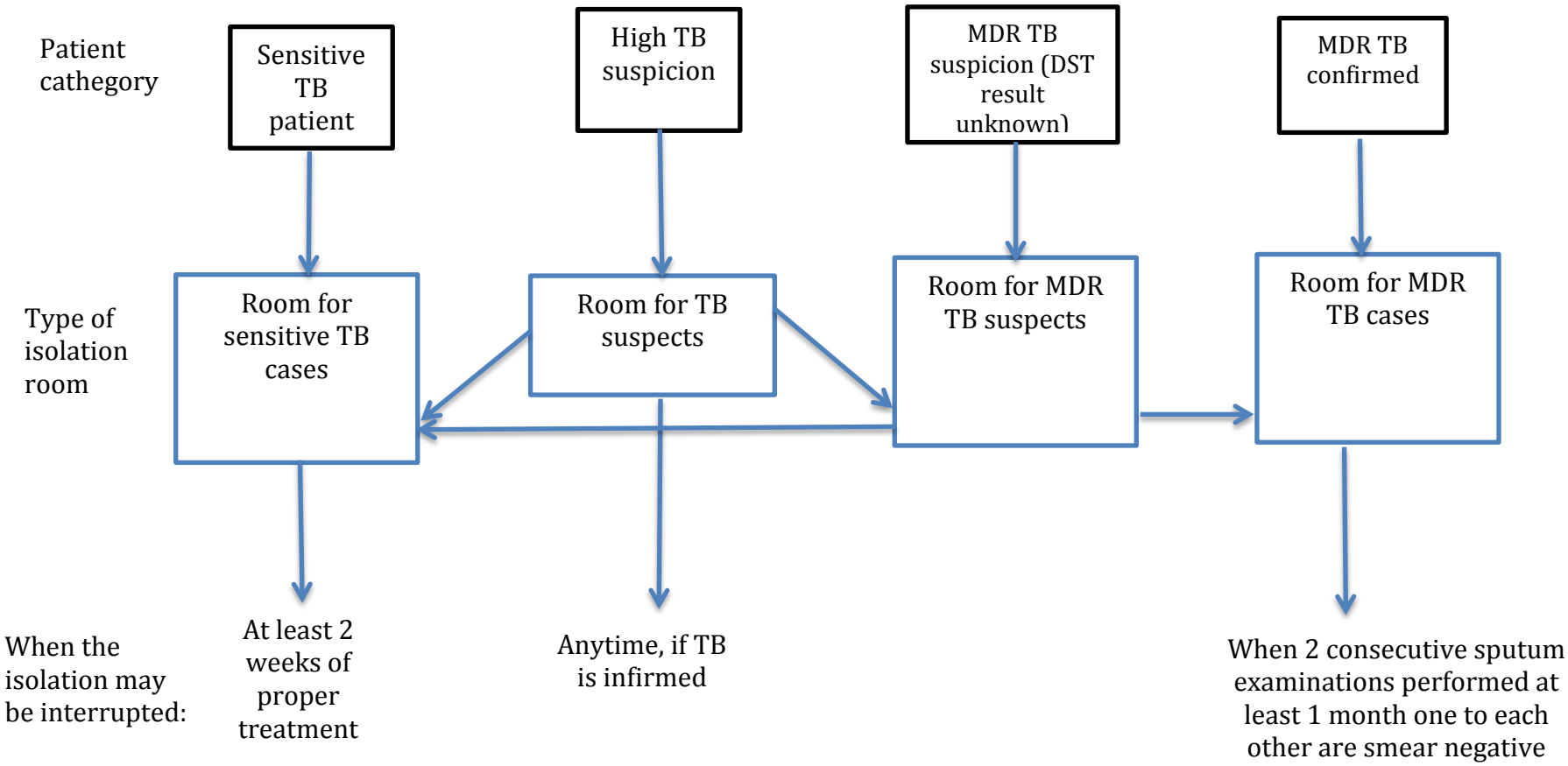
2. ***Patients with high suspicion of tuberculosis*** (clinical and radiological) have to be considered as potential contagious and placed in the isolation area for TB/MDR TB patients, in separate room, until the results of the sputum microscopy and genetic test confirms the diagnosis of tuberculosis. Same precautions as for contagious patients are to be taken (wear of surgical mask during transportation or in the presence of any person in the room, limitation of transportation of the patient if they

are not absolutely necessary, limitation of the contact with other patients or visitors).
If tuberculosis is confirmed, the patient remains hospitalized in the isolation ward for TB/MDR TB patients, being moved in other room, according to his bacteriological status regarding drug sensitivity (sensitive / resistant or unknown).
Discontinuation of the isolation is possible as soon as the diagnosis of tuberculosis is infirmed. In this situation, the patient may be transferred to the wards with patients that are not contagious, according to its pathology.

3. ***Patients diagnosed with pulmonary tuberculosis (bacteriologically confirmed), but with unknown results of the susceptibility test or without known results of genetic test*** are to be considered potential MDR TB patients and placed into the isolation area, in separate rooms, until the result of the susceptibility test or genetic test will be known. All efforts must be done to rapidly identify (or exclude) potential resistances; the easiest way to do this is using the GeneXpert method.
After identification of resistance pattern, the patients will be placed depending on their category:
-if no drug resistance is identified, the patient will be placed in the room with sensitive TB patients and treated accordingly
-if resistance to rifampicin or MDR (isoniazid + rifampicin) is proved, the patient is placed in the MDR TB area

4. ***Patients with known MDR tuberculosis or with rifampicin resistance identified by GeneXpert method*** are placed in special rooms for MDR TB patients, according to their sex.
Decision of admission of the patient in the isolation area for TB cases is the responsibility of currant lung physician.
Admission of the MDR TB patient in the isolation ward may be done directly from other departments/hospitals, where was diagnosed or from one ward of UHSN, if diagnosis was performed here. Patients are admitted directly to the TB/MDR TB isolation ward, without passing through other services (emergency room, registration, information desk…). They are equipped with surgical masks during the transportation, until they reach the room.
Patients may start treatment as soon as they are admitted to the MDR TB isolation ward. They may leave their room only equipped with surgical mask when indoor. They will be also instructed to wear surgical mask anytime someone (medical staff, cleaning staff, visitors) enters into the room.
Discontinuation of the isolation for the MDR TB cases (dischargement from the isolation area) is admitted only when 2 sputum examinations taken after at least one month each to other are smear negative. In this situation, the patient may continue the treatment in the ambulatory, or in other hospital for lung diseases, being considered as being not contagious. However, sputum has to be checked every month. If from different reasons, the physician considers that the patient has to continue as inpatient the treatment, he will stay in the separation room for MDR TB cases during entire hospitalization period.

Scheme of placement of the patient in different rooms in the TB/MDR TB isolation ward



Deliverable #4
Recommendations on administering Infection Control

1. Assign responsible commission for infection control (the TB Infection Control Commission – TB IC)

Infection control is the responsibility of every person working in a health facility and requires teamwork. To ensure that TB IC measures are successful, commitment from health managers is necessary.
The manager/head of the facility should establish the IC commission and provide adequate resources for effective functioning of the IC program.
The facility manager and the managers of different sections of the facility should be made aware of the risks of TB transmission to themselves, their staff, visitors and patients, and how it can be prevented. A copy of the facility IC plan should be available for staff reference in each department of the facility.

A TB IC commission should be formed to coordinate TB-IC activities of the different sections of the facility. This commission should be integrated in the Nosocomial Infection Commission. TB IC commission is a multidisciplinary group, which consists of the epidemiologist, the coordinator of TB activities in the facility, the head of each department, and professional nurses from each clinic section. Including in the TB IC commission of the facility manager and representatives of the administrative and accountability services, the authority of the commission is increasing, as its chances to monitor and to contribute to budget elaboration.
If the health facility has a general plan for nosocomial infections, TB IC plan will be integrated in it.
The responsibilities of the IC commission can include, but are not limited to:

- To produce and update, at least yearly, the facility TB IC plan.
- To review own surveillance data and identify areas for intervention.
- To develop facility policies for the prevention and control of infection.
- To assess and promote improved practice at all levels of the health care facility.
- To meet regularly (at least quarterly) to monitor the implementation of the TB IC plan and to suggest modifications if needed. To keep minutes of the meetings.
- To ensure continuous TB IC training for all staff.
- To ensure budget for IC activities.
- To ensure provision of protective equipment.

These responsibilities should be extended if necessary.

Train at least two persons in the facility on TB infection control!

2. Periodically perform TB risk assessment in the facility

Risk assessment includes analysis, collection and review of surveillance data and in-depth facility description, including:

- incidence of TB in the community during the year, TB evolution during last 5 years

- the number of infectious TB patients who presented at the health care facility, number of patients with symptoms of infectious TB who were identified or treated in the facility
- the types of patients investigated/treated in the health care facility (immunosuppressed, comorbidities)

Risk assessment determines the types of interventions that will help form the TB-IC plan for the facility. The risk in different departments of the health care facility may differ, according to the procedures performed, number and type of patients, number of visitors. Other risk factors are the type of clinical focus (TB, M/XDR-TB, HIV, general services, etc.), the number of beds, the number of employees and disease prevalence in the community.

After the baseline risk assessment, risk should be reassessed at least annually because of the possible changes in services and procedures, the use of spaces, and the epidemiologic situation.

Any epidemiologic event (outbreak, TB case identified in staff, increase of TB incidence in the population) requires reassessment of the measures included in the IC plan or of their implementation, including risk assessment of the facility.

a.

b. TB infection risk map

The TB Infection Risk Map for Health Care Facilities focuses on a typical patient's experience on his or her road to recovery as a hospitalized patient and highlights potential infection risks at the various stages of his or her stay. The map can be helpful to the management of health care facility, as it provides a quick reference guide to IC measures, allowing assessment of those already in place and opportunities to investigate areas for improvement, as well as enabling them to identify existing problems.

3. Develop and update of a budget included Facility TB Infection Control Plan

Development of the TB-IC plan or integration of the TB infection control measures in the plan existing in the facility is among the responsibilities of the nosocomial infections commission/TB-IC commission.

TB-IC plan needs to be updated at least once yearly or anytime is neede, based on the yearly facility TB-IC assessment. Updating of the TB-IC plan is another responsibility of the facility TB-IC commission. Copies of the updated TB-IC plan need to be made available to all staff through the management of their departments.

Development of the budget for the TB-IC plan should be done in collaboration with the Finance & Planning staff of the facility, after the interventions are drafted and prioritized; If the facility currently does not have extra funds to allocate for TB-IC, the budget needs to be developed nonetheless, and the budgeted TB-IC plan can be used by the facility management for advocacy to secure the funds, when such an opportunity is present.

4. Reorganize the facility areas

Rethink the use of available spaces and consider renovation of existing facilities or construction of new ones to optimize implementation of controls.

- Organize separate isolation area for TB/MDR TB cases.
- Separate staff areas from patient areas with additional doors in the halls as needed and reallocate the different sections within the building.
- Create anterooms before entering high-risk areas, i.e. isolation wards, laboratories, sputum collection points indoor, between staff and patients areas.
- Create multiple separate waiting areas for different patients; big waiting areas can be subdivided for the separation of different groups of patients. Construct open-air sheltered or half-open spaces – with a roof to protect patients from sun and rain – to function - during the appropriate spring and summer months as waiting areas, sputum production & collection points and daytime recreational areas. (TB-IC Implementation Framework, p. 33)
- The laboratory should be divided into "functionally clean" and "potentially contaminated" areas, with the clean areas reserved for administrative and preparatory work. (Tuberculosis Laboratory Biosafety Manual, WHO, 2012)

5. Organize TB-IC staff training

All staff of health care workers (clinical, paramedical staff, administrative staff and others like drivers, cleaners, cooks etc.) must receive training on transmission, prevention, signs and symptoms of TB, as well as on the facility's infection prevention and control plan. Students and residents will be included in the training program.
Facility TB-IC training should reflect the recommendations in the national policies and guidelines for TB-IC. At the same time, in order to result in behavioral change, training should be:

- Adjusted to the training needs to different cadres.
- Based on adult learning principle.
- Reinforced in the workplace.

Training needs assessment

- Analyze tasks of each cadre of employees in relation to TB-IC.
- Identify required employees' knowledge, relevant skills and desired behavior targets which will reduce risks of transmission and infection at your facility.
- Identify the current level of knowledge and skills among the employees and identify behavior that needs to be modified.
- Translate required improvements in knowledge, skills and behavior into concrete training objectives.

Adult learning principles mean that the training should:

- Build on existing knowledge and experience of the training participants, already identified during training needs assessment.
- Relate training to concrete examples and situations/cases from your facility/department.
- Motivate by explaining how the learning will improve participants' concrete life situations in relation to personal health and safety.
- Involve participants actively, use different methods - discussions, small groups work, let employees participate in parts of actual IC assessment or risks assessment. Training can be given in short sessions over a number of days. Participants have the opportunity use new skills and apply new knowledge

step-by-step. Before the next session feedback from their practice can be asked and any arising questions addressed.

- Provide safe learning environment, especially to cadres of employees who have less experience participating in trainings and seminars or have lower knowledge in the topic.
- Try to accommodate the training within normal working hours, suitable for the schedules of different cadres of employees.
- Reinforce training in the workplace
- Training participants should understand clearly what would be expected from them in terms of application of TB-IC training in practice in their workplace. Most skills or information without being put to practice in the first 6 weeks following the training are forgotten.
- Actual change of behavior and application of new skills and knowledge by employees should be rewarded. There are many ways to reward employees, which include encouragement and positive feedback from supervisors, contests for an 'infection control champion' of the month at a facility or a department, management letters of appreciation, encourage inter and intra-departmental gatherings and sharing of experiences.

6. Organize staff TB surveillance

Collaboration with the contracting labor medicine provider for the surveillance of the TB spreading among the personnel of the facility

- TB screening of all staff is done routinely (annually).
- In case there were registered TB cases among the members of the staff, the personnel screening shall be repeated after 6 months.
- Consider developing specific questionnaires to staff screening.

7. Participate in research efforts

Operational research efforts are usually planned, prioritised and budgeted within the national TB-IC plan. Facility's participation in research can help:

- Evaluate the effectiveness of specific IC measures at your facility.
- Assess the impact (for example, by detecting TB infection or disease in health care workers).
- Identify problem areas to be addressed and find possible solutions.

8. Monitor and evaluate TB-IC activities

Monitoring -

- Routinely collecting and interpreting information, using TB-IC indicators, to be aware of the TB-IC situation at the facility and to take corrective steps, if required.
- Usually done by the IC commission or delegated to facility departments' TB-IC responsible persons.

- Performed on a continuous basis.

Evaluation -

- Systematically determining if TB-IC at the facility - including managerial activities, administrative and environmental controls and personal respiratory protection - minimizes the risk of infection in an effective and efficient way.
- Used to inform decision making; adjust TB-IC plan, policies and activities; provide feedback to stakeholders.
- More time consuming than routine monitoring, more comprehensive, also evaluating the effectiveness of the facility TB-IC plan and policies.
- Can be done by IC commission or external parties at least once a year.

TB-IC indicators are measures of process, outcomes, and/or impacts for TB-IC activities. One important indicator may be relative risk of TB in staff, defined as

Responsibility of the facility management and the IC commission is to make sure the TB-IC activities are regularly monitored and evaluated by

- Establishing a system for monitoring and evaluation describing methods and tools, frequency, reporting format and how results of M&E will be used for decision making.
- Developing TB-IC indicators.

9. **Organize the triage of TB suspects**, which means to promptly identify, separate and fast-track people with TB suggestive symptoms includes:

- Training the staff in the ambulatories and emergency rooms to check for and recognize TB symptoms:
    a. cough longer than two weeks;
    b. fever;
    c. night sweats;
    d. weight loss.
- Reducing to the minimum time spent in the areas (waiting areas, admissions, wards) used by TB suspects and infectious patients known to have TB.
- Placing the TB suspects or infectious patients known to have TB in well-ventilated spaces.

10. Educate on cough hygiene

- Training and reminders (posters, leaflets) for visitors, TB suspects and TB patients concerning cough etiquette
- Insuring means to contain the infectious aerosols (surgical masks, paper napkins)
- Placing in high visibility places educational materials about cough hygiene.

11. Establish the infectious patient circuit in the facility

- The TB suspect or infectious TB patient shall wear a surgical mask while being transferred from one department to the other and during the medical investigations and hospitalization formalities.

- The movement of the patient shall be limited, avoiding the crowded spaces or spaces, populated with persons receptive to TB infection.

12. Reduce the diagnostic delay

- Carrying out investigations in parallel rather than in sequence.
- Minimizing the time of obtaining the bacteriological results, including communication of the sputum smear result in maximum 24-48 hours, preferably on the same day.
- It is urgently needed to implement rapid diagnostic methods (genetic tests, liquid media culture) and to follow the algorithm of rapid testing use, recommended by the national guidelines.

13. Improve infection control during sputum collection

- Collecting sputum in specially designed well-ventilated rooms.
- Instructing the patient how to collect sputum.
- Presenting the sputum collection procedure – a poster with steps/instructions - in the sputum collection room/area.
- Training the staff supervising the collection to follow the respiratory protection measures.
- Limiting the sputum induction procedures due to the production of infected aerosols and cough persistence after the procedure. If these cannot be avoided, they shall be done in specially designed well-ventilated place, while applying supplementary measures (respiratory protection for staff, UV light).
- Using special disposable containers, with filleted lid and large enough opening for sputum collection.
- Using special transport containers, with lid and handle, easy to disinfect, in order to store and transport products to the laboratory.

14. Organize patients' isolation and separation in wards

- A patient with TB suspicion, in need of hospitalization, shall be placed into an isolator until establishing their bacteriologic status; each ward shall have at least one space of this type (isolation room), preferably with only one bed or place the suspect in the ward for TB/MDR TB isolation area, in separate room.
- Within the wards, TB patients shall be placed in separate rooms from those having other diseases.
- The extra-pulmonary TB cases and those with sputum smear negative results do not need isolation.
- Patients with positive sputum smear results shall be placed separately (separate rooms, in the TB/MDRT TB isolation ward) from those with negative sputum smear results.
- Patients suspect of or confirmed to have drug-resistance (mono-resistance, poly-resistance, MDR, XDR) shall be hospitalized in separate spaces, according

to the resistance range, in order to avoid nosocomial cross-transmission of the stains.

- TB patients with positive sputum smear results shall be served their meals inside the rooms and will not be allowed in the common areas.
- Patients with positive smear results, MDR-TB patients and XDR-TB patients shall be placed in rooms with as few beds as possible; studies showed that the reduction of the number of beds in the room represents the most efficient administrative infection control measure of nosocomial TB transmission.
- The movement of the infectious patients within the health facility shall be limited.
- Isolation shall be stopped:
    - After at least 2 weeks (according to the proposed national policy and national TB-IC plan), for patients with positive evolution, in the absence of any resistance suspicion;
    - After the sputum smear becomes negative, for the patients with suspicion of drug-resistance or with confirmed resistances (including MDR-TB and XDR-TB)
- Patients with HIV/TB co-infection who are smear positive shall be hospitalized and treated in TB sections/wards, not in the infectious diseases sections/wards, as the risk to infect susceptible person in these departments is high, and the isolation is usually not posible.
- TB treatment has priority compared to the antiretroviral (ARV) treatment.

15. Infectious patients' transportation

The transportation of smear positive TB patients or TB suspects shall be done in ambulances equipped with supplementary infection control measures (increased ventilation, separate place for the patient, respirators for the other persons, surgical mask for the patient).

- Infectious TB patients shall be transported individually, wearing a surgical mask, and not together with patients with other diseases.
- Inform the staff in case of transportation or interdisciplinary consult of the infectiousness of the patient, in order for the staff to apply respirator protection measures.
- Contagious patients shall walk outside their rooms, inside the health facility or in other departments only if needed and only wearing a surgical mask.

16. Rapid initiation of treatment

- Anti TB treatment shall start as soon as possible after hospitalization.
- Anti TB treatment shall begin with at least four anti-TB medicines.
- Resistance spectrum will be determined as soon as possible after initiation of the investigations.
- In case of known drug-resistances from previous investigations, the treatment shall be initiated based on the sensitivity spectrum.

- For the known multidrug-resistant cases it is recommended to organize one MDR consilium, that may analyze situation before admitting the patient for treatment.

17. Reduce the time within the health facilities

- Ambulatory treatment is recommended to patients with negative sputum smear results or extra-pulmonary TB.
- Duration of children's hospitalization shall be limited to the period necessary to establish the diagnostic and treatment initiation.
- Reduction of the period spent in the TB facilities should be backed up by optimum organization of the ambulatory treatment – directly observed treatment (DOT).

18. Organize management of the infectious TB cases without therapeutic resources (palliative care)

- TB patients with limited therapeutic resources (wide drug-resistance spectrum, severe co-morbidities, and chronic cases with negative therapeutic prognostic) preferably shall be isolated at their place of residence.
- These patients and their families need to be educated about TB, TB transmission and infection control at home and in the community.
- In case there are contacts with increased receptivity (children, immunosuppressed, PLHIV) and the isolation at the place of residence cannot be ensured, it is recommended to hospitalize the patient.
- It is recommended to identify health facilities with beds, fulfilling the isolation conditions and insuring the TB infection control for the palliative care of patients without therapeutic resources.

19. Restrict visitors' access in the ward with TB patients

- There shall be limited visitor access in the ward with sputum smear positive TB patients and MDR TB.
- It is forbidden for children, immunosuppressed visitors or immunosuppressed staff to access the wards treating TB patients.
- If the visitors' access to TB wards is absolutely necessary, they shall be informed about TB transmission and will wear fitting respiratory masks, the windows of the rooms shall be open and the patients shall wear surgical masks.
- Visits shall take place according to an established visiting policy, preferably in designated areas (outdoors or well-ventilated places).
- Visitors (as well as staff and patients) shall be informed by means of signage – printed information and signs, placed where they can be easily seen, with information about the risk to contract the disease, restricted areas and protection measures.

20. Ensure cleaning and disinfection of surfaces

- Even if TB is not transmitted through contact, cleaning and disinfection of surfaces - if absent - may favor TB transmission.
- Select and use disinfectant with known efficacy for *Mycobacterium tuberculosis.*
- Create and following standard operating procedures (SOP) outlining a disinfection program in the high-risk departments/areas.

ENVIRONMENTAL CONTROLS

21. Improve ventilation in the wards

Ventilation is the process of air movement and is preferably done in a controlled manner; insuring adequate space ventilation is essential for airborne infections prevention. The World Health Organization recommends adequate ventilation implementation as a TB infection control measure with proven efficacy.
Objective of ventilation is to ensure sufficient air changes per hour (ACH) and control airflow direction to reduce the risk of TB exposure.
In the medical practice there are used the following ventilation types:

- Natural ventilation
- Mixed-mode ventilation
- Mechanical ventilation

In choosing a ventilation system (i.e. natural, mechanical, or mixed-mode) for healthcare facilities, it is important to consider local conditions, such as building structure, climate, building byelaws and regulations, culture, cost and outdoor air quality. Any ventilation system must be monitored on a regular basis/schedule and maintained in the case of mixed mode or mechanical ventilation. Adequate resources (budget and staffing) for maintenance are critical. The current WHO ventilation standard for an airborne precaution room is at least 6ACH for the existing buildings and 12 ACH for the new constructed.

a) Natural ventilation

Represents the ventilation created by means of natural conditions (wind, temperature); it is done using doors, windows and ventilation apertures.
In a good scenario, natural ventilation can insure a high number of air changes per hour and an efficient dilution of the infecting particles, at low costs.
Disadvantages of natural ventilation are that it is difficult to forecast and control and even impossible to use during the cold season.
In healthcare facilities effective natural ventilation should be achieved by proper and systematic operation:

- Maximize natural ventilation by increasing the size of the opening of windows and locating them on opposing walls.
- Use natural ventilation as much as possible in all health care facilities that are not provided with mechanical ventilation.
- In order to create airflow, it is recommended to fix some ventilation grills on the wall opposite to the window (above the door or at the inferior part of it).
- In case of using thermopane windows, it is compulsory to design them such the opening to be large enough.

- Ventilation of each space has to be periodically monitored and evaluated; to measure the ventilation there are used special equipment: smoke tube (watching the smoke column one can establish the air flows direction), vaneometers (mechanical devices measuring air speed), meters (in order to establish the openings and room)
- A space with good enough ventilation is defined by[1]:
    - A number of air changes higher than 12 ACH
    - 160l/s/patient for airborne precaution rooms
    - 80l/s/patient for new health care facilities and renovations
    - 60l/s/ patient for general wards and outpatient departments
    - 2,5l/s/m^2 for corridors and other transient spaces without a fixed number of patients.

b) Mixed ventilation

Mixed ventilation refers to improving natural ventilation by use of mechanical ventilation.

Use mixed mode ventilation:

- In health facilities where natural ventilation can't achieve an optimal air change/hour (6 ACH);
- In high risk areas for TB transmission (emergency rooms, isolation rooms for TB suspects, rooms for smear positive TB patients, isolation rooms for MDR TB suspects, spaces for procedures that can induce aerosols in TB patients – sputum collection rooms, bronchoscopy rooms, spirometry.

The placement of the fans should take into account what the specific rooms are used for and the need to create negative (in "contaminated" areas, with patients or infecting pathological products) or positive pressure (in spaces destined for the staff).

Use of fans is compulsory when the windows are closed (during the night and the cold season), in crowded spaces or with multiple sources of bacilli.

c) Mechanical ventilation

Mechanic ventilation implies the use of some complex devices (ventilation systems) controlling the air inside the building or in different parts of it. It functions by generating positive or negative pressure, the airflow being directed from the area with positive pressure to that with negative pressure.

It is recommended in areas with high risk of TB transmission, where the natural or mixed ventilation does not insure an optimum air changes rate (rooms with MDR or XDR TB patients, laboratories for cultures and DSTs).

Advantages of mechanical ventilation consist in the efficient control of air direction and temperature within the room, may be used in all types of climate and also insures a constant number of air changes.

The disadvantages of mechanical ventilation consist of increased construction and maintenance costs, the need of good technical expertise from design to using phase, difficult acceptance by patients.

During the functioning of the mechanical ventilation, it is compulsory that the doors and windows to be closed.

Ventilation in the room can be determined:

-measuring the dilution of a gas (requires special equipment)

[1] According to WHO - Natural Ventilation for Infection Control in Health-Care Settings, Annex B, recommendation #2

-dividing the flow of air in the room (air velocity at the level of the openings multiplied by the section of the opening – window, grille) to the volume of the room; the report between the flow of the air and volume of the room is the number of airchanges per hour (ACH)
ACH=flow of air exchanged per hour / volume of the room
ACH= (air velocity at the level of openings x opening section) / volume of the room

22. Use ultraviolet germicidal irradiation in high risk areas

UV radiation with 254 nm wavelength has bactericide action upon microorganisms, including Mycobacterium tuberculosis. It is used as additional environmental measure when ventilation is not enough for TB infection control. The medical devices generating this type of radiation have the generic name of UV lights or bactericide lights. In practice, there are used several types of UV lamps in order to air decontamination and rooms and surfaces sterilization.

- UV lamps with direct radiation (unshielded), used inside rooms for air disinfection, outside the working hours and in the absence of people.
- UV lamps with radiation directed to the upper area of the room (upper room UV GI), which thanks to a protection shield reflects the UV radiation towards the ceiling, where it creates a decontaminating layer. The natural movement of the air towards the ceiling decontaminates the entire air volume within the rooms. This type of devices can be used in the presence of people in the room.
- Mobile UV lamps, which can be placed in different points of the rooms, according to the existing needs.
- UV lamps used inside biosecurity cabinets.
- UV lamps used in ducts for air decontamination inside the ventilation systems.
- Air cleaning devices using the UV light in an enclosed system ("air purifiers")
- The use of UV radiation needs technical expertise for purchase, installation and monitoring the functioning.

Shielded UV radiation is used in spaces with high risk of TB transmission (waiting rooms, the emergency room, crowded hallways, rooms with contagious patients, spaces with insufficient ventilation) and has to function permanently (24 hours/day).
In case of UV use in the presence of humans, it is compulsory to measure the irradiation level with an UV-meter; the maximum admitted dose for the 254nm UV radiation is 6000uJ/cm2 for 8 hours (0,2uJ/cm2/s).
UV lamps maintenance consists of:

- Measure of intensity of UV radiation with an UV-meter if this is available (an efficient lamp shall produce an UV radiation with the intensity of 100uJ/cm2/s at one meter away from the source);
- Cleaning of the UV lamp with alcohol at least every two months (cleaning with water and detergent can lead to the formation of one layer on the surface of the lamp, decreasing its efficiency).
- Change the UV light after the number of hours recommended by the producer.

Efficiency of UV radiation increases with the adequate ventilation of the space (air mixing) and decreases in humidity conditions.
In order to establish the number of UV lamps needed, the surface of the rooms shall be taken into account, one lamp covering 20m^2.

Monitoring the unshielded lamps use shall be done by an hourly chart, which includes also the date of lamp cleaning. UV lamps shall be included in the equipment service contract.
Specifications for the acquisition of the UV lamps:

-to generate UV light with the wavelength of 254 (253,7)nm

-to be provided with a shield or with a guide system of the UV radiation designed to provide a level of radiation less than 0,2-0,4uJ/cm2/s in the lower part of the room (under 1,80m, permitting the presence of the people inside the room) and a high level of radiation in the higher part of the room (over 1,80m), for an efficient germicidal effect.

-for each 20m2 of the room is needed one 30W UV lamp

Devices for air disinfection ("air purifiers")

Air disinfection devices ("air purifiers") function on the principle of air decontamination while inside, where it is heavily radiated with a high dose of UV radiation or is filtered with HEPA filters; their efficiency is usually limited by the reduced air volume which can be filtered and especially by the impossibility of mixing the entire air volume in the room. Usually, the air around the device is re-circulated, and the air from the remote areas of the room, less ventilated, is not decontaminated

RESPRIATORY PROTECTION

23. Develop a program for respiratory protection

The objective of personal respiratory protection is to minimize the entrance of potentially infecting particles in the respiratory ways, using mechanical barriers in the way of the airflow.

The respiratory protection represents one of the most efficient prevention measures of TB infection control among the staff. The respiratory control measures consist of:

- Use of respirators (FFP2 or FFP3) by the persons entering the infected environment (protects the person wearing the mask);
- Use of surgical masks by patients, in order to limit the dispersing of infectious aerosols (protects family and friends, other patients and visitors, medical personnel, the community).

The infection control plan should contain a respiratory protection program, specific for the degree of risk. Recommended elements of a respiratory protection program:

a) The use of respirators.

Respirators should be used:

- By the medical staff (nurses, doctors), caretaking staff, technical staff, ambulance drivers, the visitors and anyone else entering the environment with high TB infection risk.
- In the emergency rooms, the consultation cabinets, radiology department, functional investigations, in the presence of potentially infectious patients;
- In the TB laboratories it is recommended to wear respirators in case all the other TB infection control measures are not ensured.

b) The spaces where wearing a respirator is compulsory shall be marked with attention signs; these spaces are the rooms of the TB suspects and sputum smear positive patients, M/XDR-TB wards, bronchology department, triages.

c) Technical specifications of the equipment:

- Classification of respirators is done according to their capacity to efficiently filter the particles with the dimension of 0.3 microns (particles of these dimension having the highest capacity to pass the filter).
- The respiratory protection masks accepted for TB infection control must fulfill FFP2 and FFP3 standards (EC benchmarks) equivalent to N95 and N98 respectively (US benchmarks).
- Respirators fulfilling standards lower than FFP1 / N90 are not efficient against TB infection.

d) Mode of use:

- Application and use of respirators shall be done according to manufacturer's recommendations.
- It is important to ensure good respirator fitting, because the air entering between the face and the respirator leads to the respirator's inefficiency.

e) Checking the respirator efficiency:

- Checking a respirator's efficiency shall be done by determining the fitting it ensures (performing a fit-test).
- The fit test can be done by either quantitative fit testing (hard to perform, requiring special equipment – particle counter) or by qualitative fit tests.
- In practice qualitative fit tests are used (Bitrex test or sucrose test). The principle of a qualitative fit tests is: in case of respirator inefficiency the subject will taste the bitter (Bitrex) or sweet (sucrose) taste depending on the substance used.
- Factors, which can influence the fitting of the respirator and lead to the respirator efficiency, are: incorrect use, face form and dimensions, facial features (e.g. beard, scars, excessive use of make-up and foundation).
- Before the first use, every person using a respirator should be fit tested, and then re-tested periodically (annually), after the appearance of facial changes (scarring, substantial weight gain or loss) or after changing the type of a respirator used. Each TB facility has to have access to the fit test.

f) Duration of use:

- Although the manufacturer's technical specifications foresees that the respirators are disposable, for TB reuse by the same persons is accepted, because TB is exclusively airborne and is not transmitted by direct contact.
- If the respirator is intact, filter efficiency is not affected by a high number of uses, it is the decreasing of the fit which is the primary factor limiting the number of uses.

g) Storage of respirators:

- It is recommended to store respirators together with the rest of the equipment (gowns) in a well-ventilated space, in low humidity conditions.

- When not in use, a respirator could be covered in a paper napkin.
- In order to keep the filter intact, the respirator may not be bent/punctured/soiled.

h) Equipment life expectancy:

- Normally, an average duration of respirator usage of two weeks is accepted, but in case of intensive use, this duration can be shorter. For staff using the respirator every day, 2-3 respirators /month are needed.

i) The use of surgical masks:

- Surgical masks shall be used by pulmonary TB suspects, sputum smear positive patients, MDR-TB or XDR-TB patients, when these are indoors and in the presence of other persons (patients, medical staff, visitors).
- Outside the buildings wearing of surgical masks by patients is not compulsory, except during the transportation in an ambulance or in other means of transportation.
- Enough surgical mask are to be provided for the patients (average 10 masks during the hospitalization period)

j) Training in the area of respiratory protection:

- Healthcare workers and patients as well should be trained in the correct use of the respiratory protection equipment.
- The patients shall be explained the reason for using the respiratory protective equipment.

k) The waste management for the respirators

- Waste management for the respiratory equipment is done according to the rules of the facility for infectious waste management. However, the respirators or surgical masks used for TB are not dangerous for the TB transmission.

l) It is recommended to continuously monitor the implementation of the personal respiratory protection program in each department/area of the facility:

- Number of respirators for each employer per month
- Number of fit tests performed per year
- Number of trained person on TB IC

Deliverable #5
Cost estimate and plan of action for establishment of MDR TB room

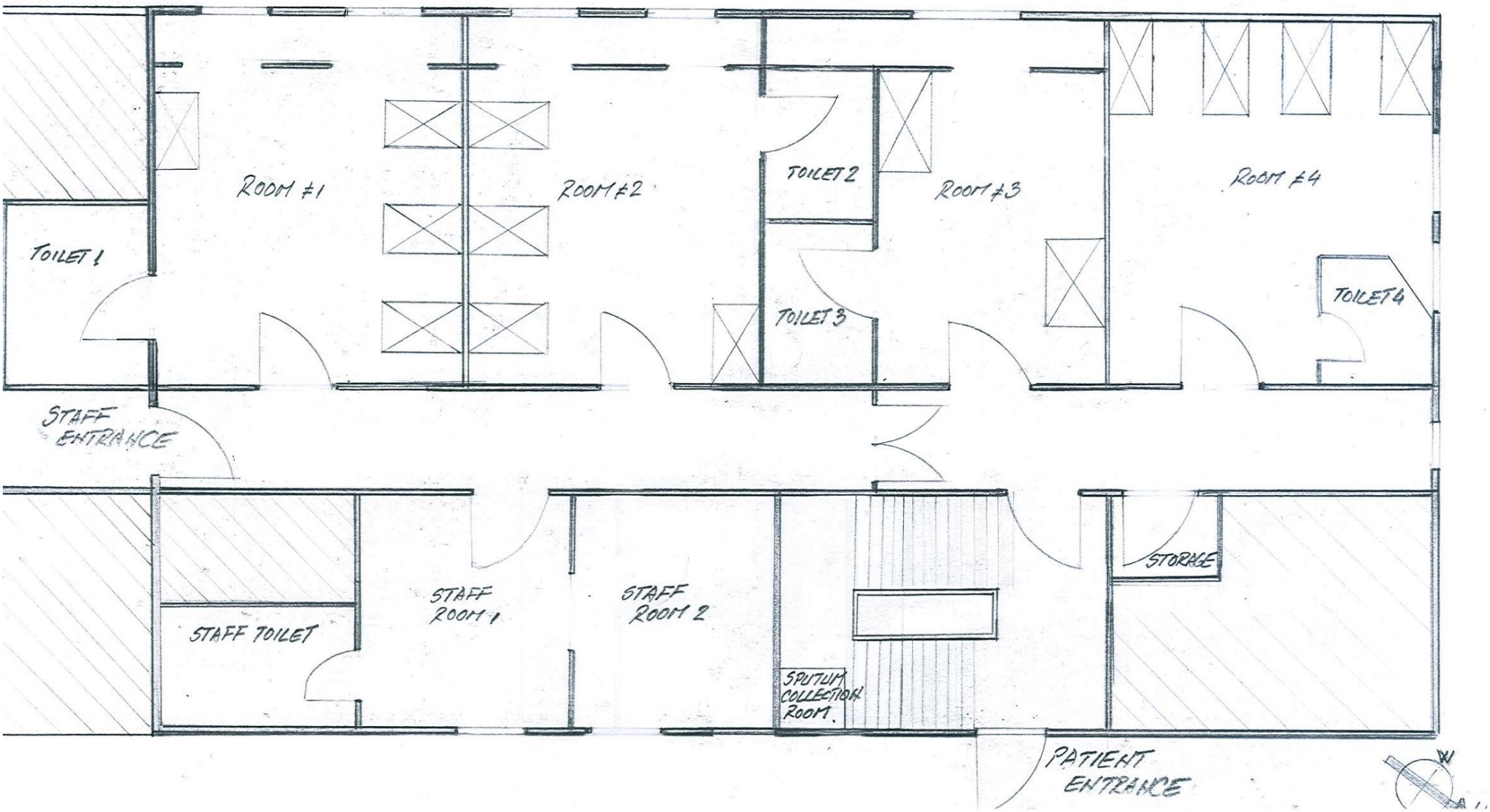
Cost estimate for establishment of TB/MDR TB isolation ward

No.	Expense category	Estimated cost (Euro)
1	Building refurbishment	20.000
2	TB IC activities	
	• UV system, sputum collection booth	11.850
	• Mechanical ventilation system (optional)	20.000*
3	Furniture	14.170
4	Electronics, appliances	11.300
	Total	**57.320** 77.320* (including ventilation system)

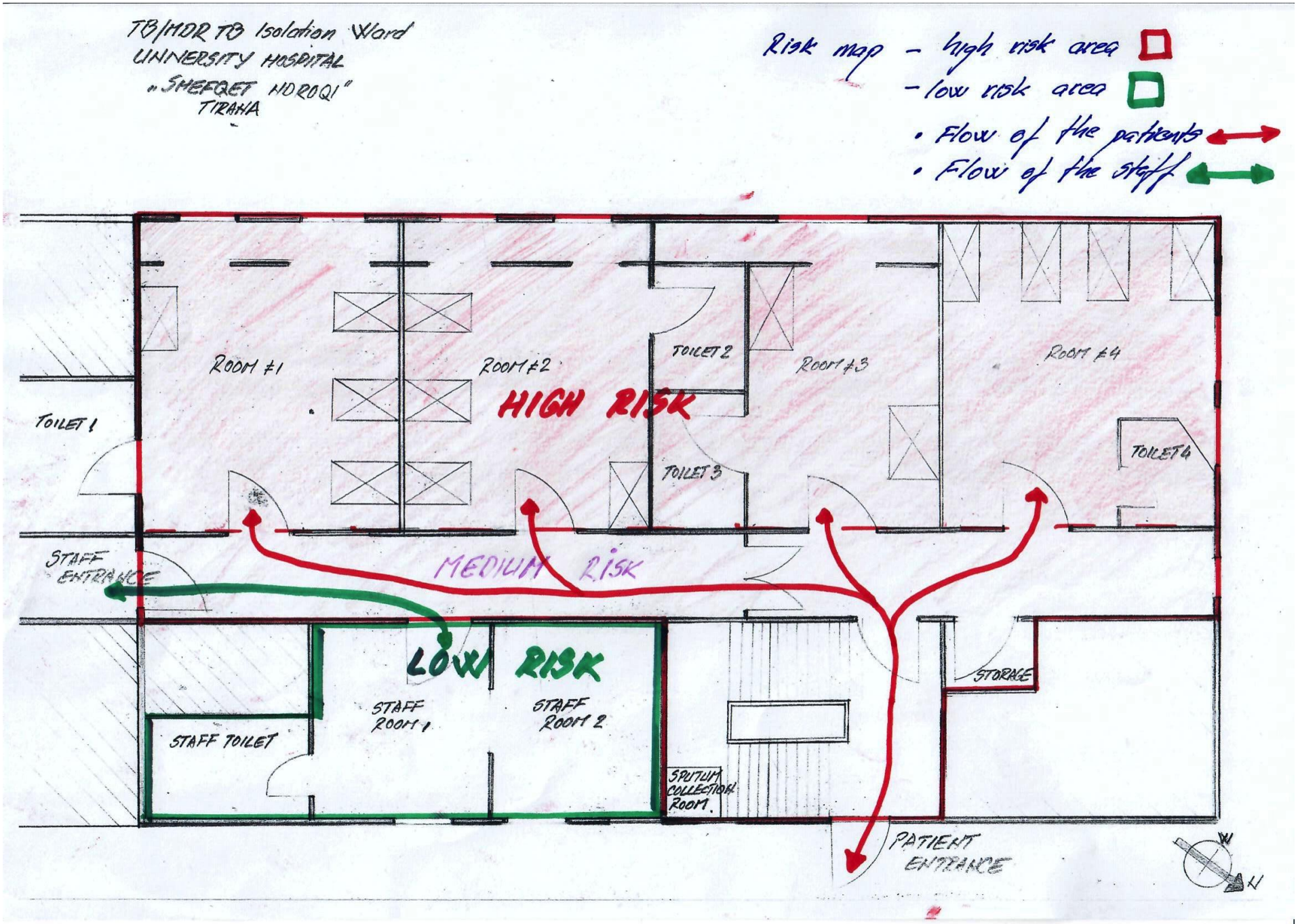
Action plan for establishment of TB/MDR TB isolation ward

No.	Activity	Description of the activity	Indicator	Responsible	Term of implementation
1	Creating the premises for establishment of the TB/MDR TB isolation ward	Analysing and approval of the rehabilitation plan	Rehabilitation plan approved	UHSN, MOH, NTP, CCM	July 2016
		Identification of the funds for rehabilitation (budget reallocation of GF funds, other sources)	Funds for rehabilitation available	NTP, UHSN, MOH, GF, CCM	July 2016
		Preparing the space for rehabilitation -Movement of the Orthopaedic diabetic leg -Movement of the archive	Space prepared for works	UHSN, MOH	July 2016
		Selection of the company for rehabilitation	Company selected	NTP, UHSN, MOH	September 2016
2	Rehabilitation of the space designated to the TB/MDR TB isolation ward	Refurbishment of the building	Company working into the building	Construction Company, UHSN, NTP	October 2016
		TB IC special dedicated activities (UV system, ventilation system)	UV system installed Ventilation system installed Sputum collection booth installed	Construction company, UHSN, NTP	October 2016
		Providing rooms with furniture and electronic equipment	TB patient's rooms ready for accommodating	UHSN, NTP, MOH	November 2016
3	Finalizing of the works	TB/MDR TB isolation ward functional, ready to be used	Reception of the work done	UHSN, NTP, MOH, GF	December 2016
4.	Evaluating of the results of the project (TB/MDR TB isolation ward safety and functionality)	Monitoring of the use of the ward	10 patients hospitalized in the TB/MDR TB isolation ward	NTP, MOH, GF	February 2017

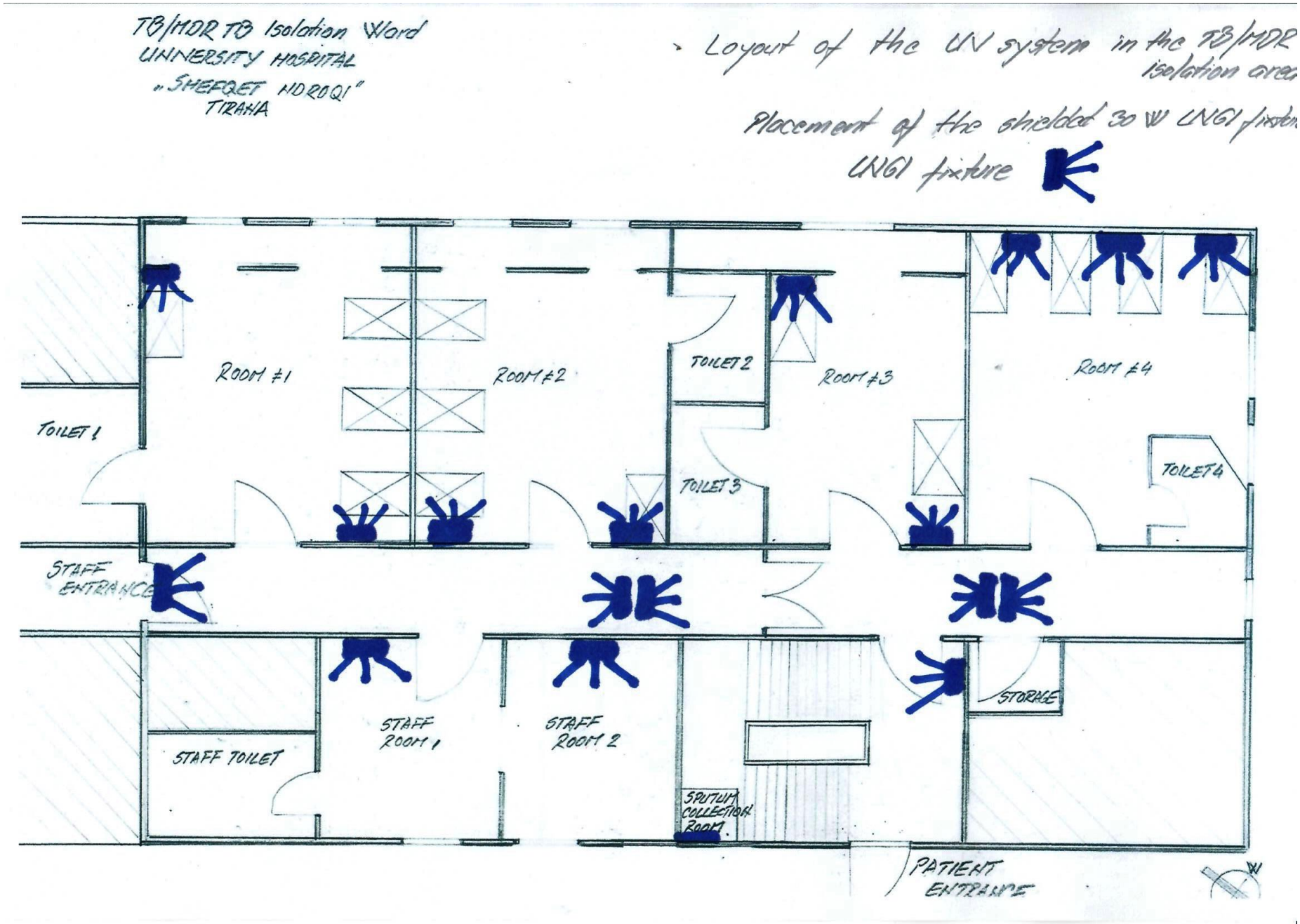
Annex #6: Recommended layout of the MDR TB isolation area



Annex # 7 Risk map of the TB /MDR isolation area



Annex 8: Recommended layout of UV GI: (in blue is marked recommended position of the UV GI fixtures)



Annex 9 Mechanical ventilation layout with airflow rates calculation