

“CONTROL OF TUBERCULOSIS AND GLANDERS” SATREPS PROJECT

NCCD progress report of the project

Period : Jan-Dec 2024

Buyankhishig.B, PI of the SATREPS project,NCCD

Project expected outcomes

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

01 

- The function of Laboratory diagnosis for zoonotic diseases is enhanced in Mongolia through the development of LAMP /immunochromatography-based novel rapid methods (kits) for detecting *M.bovis* and *B.mallei* as well as updating existing disease diagnostic systems.

02 

- The epidemics of tuberculosis and glanders as Zoonotic disease in human are evaluated using molecular epidemiological techniques.

03 

- The epidemics of tuberculosis and glanders as Zoonotic diseases in livestock evaluated using sero-epidemiological and molecular epidemiological techniques, respectively.

04 

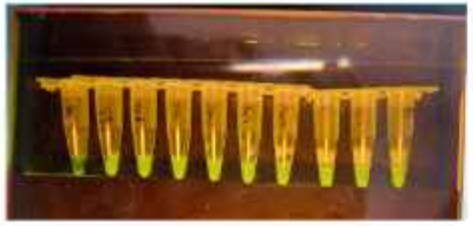
- A platform for One health approach-based disease control is functioning for practical application of research outcomes including risk analyses of tuberculosis and glanders as zoonotic diseases.

Outcome 01

Novel methods for TB diagnosis were introduced.

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

1. Establishment of the LAMP-based gene detection method for *tuberculosis complex* including *M. bovis*
2. IGRA test for detection of tuberculosis infection
3. Next generation sequency (NGS) for *M.tuberculosis complex* including *M.bovis* and drug resistance mutation
4. MGIT DST for novel anti-TB drugs using MGIT TB eXiST
5. Solid LJ medium with pyruvate for detection of *M.bovis*



LAMP assay with pyruvate

IGRA test

NGS Nano pore

MGIT TB eXiST

LJ

Outcome 01

Implementation of the Operational plan in 2024

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

1.2. Establishment of the LAMP-based gene detection method for tuberculosis complex in NCCD.

Inputs	Year	2024				2025	
	Month	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun
1.2.1. To introduce the LAMP-based gene detection method for tuberculosis complex into NCCD.	Plan						
	Revised plan						
	Actual						
1.2.2. To evaluate the sensitivity and specificity of the gene detection method by comparing the test results obtained from conventional methods.	Plan						
	Revised plan						
	Actual						

Implementation : In the analysis of **228** samples to detect M. bovis, both **LAMP** and **NGS** methods were utilized. The findings revealed the **absence of Bovine tuberculosis**, with the BCG strain detected in only 1 sample (0.4%) and ***M.tuberculosis*** detected in 227 samples (**99.6%**). Also for identification of Tuberculosis complex: Genotype MTBC kit were tested 158 strains and 1 BCG strain was confirmed by Genotype MTBC.

Outcome 01

IGRA study results (n=520)

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

QFT-Plus positivity by study groups

Out of the healthy individuals tested with QFT-Plus, it was determined that 48.4% were infected with tuberculosis.

Outcome 01

Preliminary results of the IGRA study among health people (additional study) (n=551)

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

Sex	Study results					
	Positive	%	Negative	%	Total	%
Female	79	36.2	139	63.8	218	39.6
Male	119	35.7	214	64.3	333	60.4
Age group						
10-19	2	16.7	10	83.3	12	2.2
20-29	42	26.4	117	73.6	159	28.9
30-39	86	40.0	129	60.0	215	39.0
40-49	48	43.2	63	56.8	111	20.1
50-59	17	38.6	27	61.4	44	8.0

In the IGRA study using Quantiferon-TB Gold Plus, out of 551 relatively healthy individuals tested:

- ✓ 60.4% were male
- ✓ 39.6% were female
- ✓ The average infected rate all age groups was 35.9%
- ✓ The highest prevalence was in the 40-49 age group (43.2%)

Outcome 02

NGS study

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

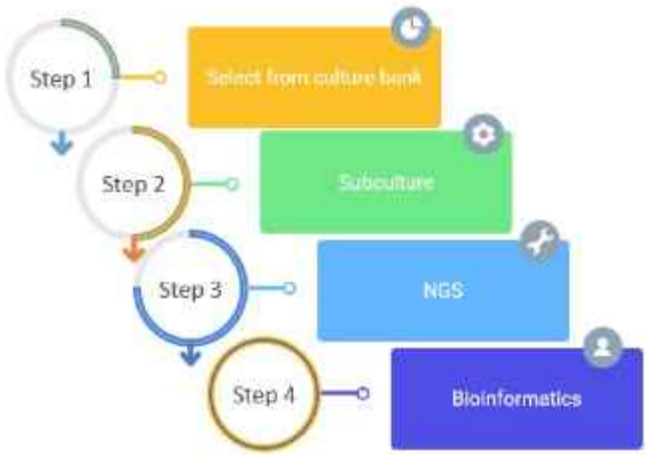
- The extensive research being conducted on tuberculosis tribe types, variants, and drug resistance in Mongolia. The use of advanced technologies such as Illumina and Nanopore for Next-Generation Sequencing (NGS) is crucial in identifying genetic characteristics and patterns within the samples.
- The application of Epi2me software for data analysis demonstrates a comprehensive approach to studying the epidemiology and genetic makeup of tuberculosis strains over the years.
- RIT – NGS using illumina in 1005 extracted DNO of *M.tuberculosis*
- NCCD – we have tested 961 strians for NGS using ONT and data analysis.
- This time I will present the research results conducted on isolated cultures in the past 5 years relevant to our research.

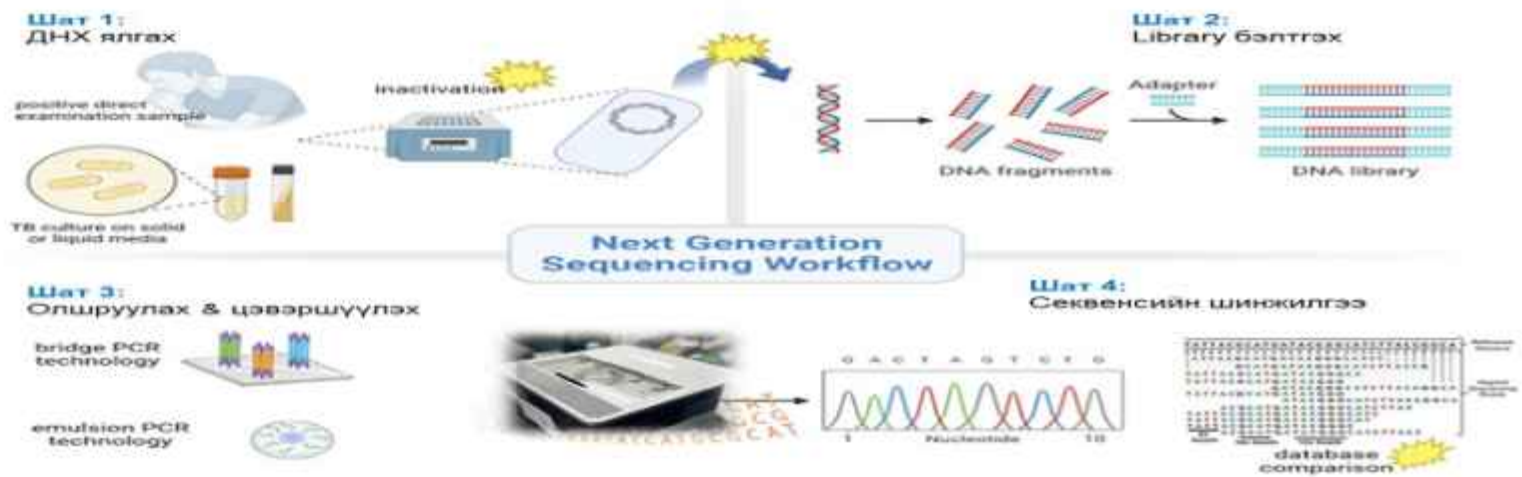
Outcome 01

Oxford Nano pore technology installation and drug-resistance characterization of Mycobacterium tuberculosis using a ONT

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ



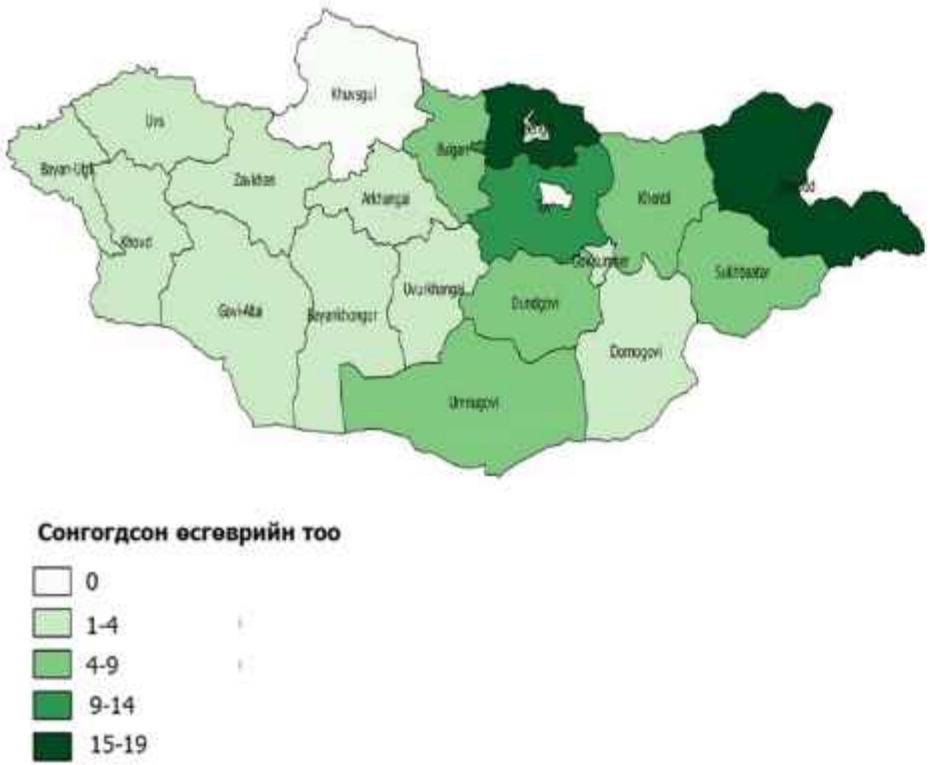


In this study covered 553 isolated strains in 2020-2024. The performance of drug resistance detection was evaluated using conventional and NGS using Nanopore technology. We recently presented at the RIT meeting.

Outcome 01

Results of gDST, pDST and NGS

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ



Number of analyzed NGS by ONT in 2024

Year	Number of tested NGS	%
2020	114	21
2021	94	17
2022	173	31
2023	115	21

Number of comparable gDST and pDST

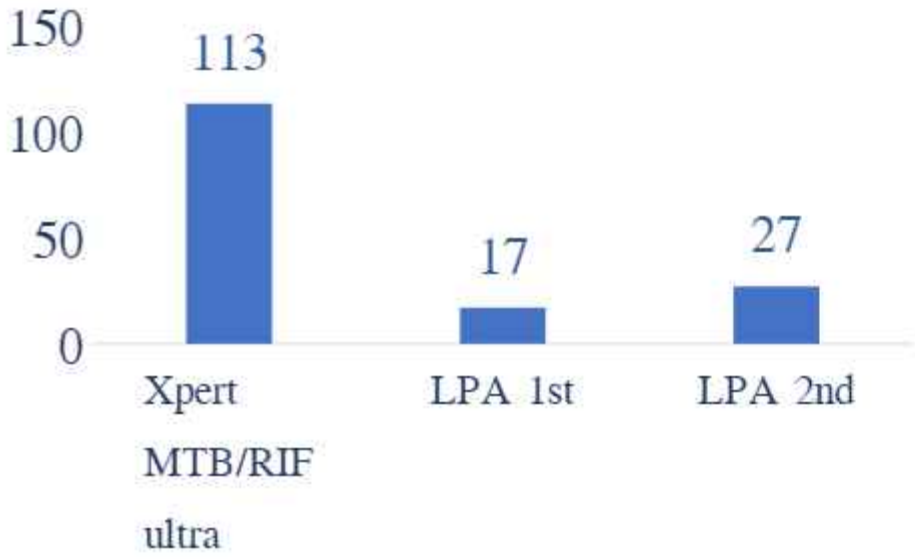
Year	Number of tested NGS	%
2020	8	7%
2021	14	12%
2022	8	7%
2023	58	50%

Outcome 01

Results of gDST, pDST and NGS

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

Number of tested mDST (n=157)



Number of tested pDST (n=115)

DST method	Drugs	N
1,2 line DST		20
1st DST		5
SIRE	1st line	62
SIRE+new drug		4
Subtotal		**91**
1,2 line DST		20
2nd DST	2nd line	1
Subtotal		**21**
New drugs		23
SIRE+new drug	New drugs	4

Outcome 01

Comparison of results on MGIT AST and NGS

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

FLD

Drug and Resistance		MGIT	NGS	Agreement
H	S	61	60	99%
	R	30	31	
R	S	78	79	99%
	R	13	12	
E	S	83	78	95%
	R	8	13	
S	S	28	24	96%
	R	63	67	

SLD

Drug & resistance		MGIT	NGS	Agreement
CPM	S	21	20	95%
	R	0	1	
KM	S	21	21	100%
	R	0	0	
AM	S	21	21	100%
	R	0	0	
OFX	S	21	21	100%
	R	0	0	

tlyA.p.Met1fs;tlyA.p.Ala161fs

Novel drugs

Drug & resistance		MGIT	NGS	Agreement
BDQ	S	27	25	92.5%
	R	0	2	
Dlm	S	27	27	100%
	R	0	0	
Mfx	S	22	22	100%
	R	5	5	
Lzd	S	27	27	100%
	R	0	0	
Clz	S	0	26	96,3
	R	0	1	

Rv0678.p.Gly78Arg
Rv0678.p.Ile67fs

Impact of the project

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН
ҮНДЭСНИЙ ТӨВ

- Next-generation sequencing (NGS) technology has been introduced in Mongolia's TB sector, improving laboratory and human resource capacity.
- NTRL performance of pDST, gDST and NGS was sufficient.
- It has become possible to compare with similar studies from other countries around the world and future national research.
- The database has seen an increase in genomic data for the strains.
- The susceptible and resistance to all types of anti-tuberculosis drugs have been determined simultaneously.

Outcome 02

Sharing project information and distribution the study results

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

- The SATREPS project in Mongolia has yielded some positive results in the field of infectious diseases. The publication in the National Journal of Infectious Diseases will be helped raised awareness and share valuable information with the public.

Published articles

1. **DETERMINATION ON NOVEL ANTI-TUBERCULOSIS DRUGS RESISTANCES USING MGIT TB EXIST**

Baasansuren Erekhembayar[1], Oyunchimeg Ganbold[1], Bayasgalan Banzai[1], Oyuntuya Tumenbayar[1], Tsetsegtuya Borolzoi[1], Buyankhishig Burneebaatar[1], Mitarai Satoshi[2]

2. **THE RESULTS OF RISK ASSESSMENT OF *M. BOVIS* IN MONGOLIA**

D.Naranzul[1], D.Gantsetseg[1], B. Ochirdar[1], S.Undarya[1], E.Uyanga[1], P.Nasanjargal[1], S.Tserendalai[1], V.Batbaatar[2], B.Buyankhishig[1], O.Batbayar[1], D.Bayarbold[3]

Outcome 02

Researchers were presented study results in an International conference

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

- The first conference was held on February 21, 2024, with a total of more than 50 participants.
- Thirteen project research results were presented by the researchers (NCCD- 8 presentations).

Outcome 02

International conference

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

- The second conference was held on September 3rd, 2024, with a total of more than 130 participants.
- Fifteen presentations were presented by the researchers (NCCD- 4 presentations).

JCC meeting held on Feb. 21st. 2024

- The JCC meeting for the "Control of Tuberculosis and Glanders" SATREPS project, supported by the JICA and AMED , took place on February 21, 2024, both in-conference hall and online.
- As per the approved agenda, the meeting was chaired by D. Bayarbold, the head of the PHD of the MOH and the project director.
- 62 people attended the meeting.

Outcome 02

THE RESULTS OF RISK ASSESSMENT OF *M.BOVIS* IN MONGOLIA

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

Materials and methods:

- A total of 26 legal acts and documents in force in Mongolia were analyzed.

Result:

- In our country, the legal framework for registration, information, surveillance, diagnosis, treatment, prevention, public health measures and other issues of infectious diseases of animals, including bovine tuberculosis (Mycobacterium Bovis), has been sufficiently formed.
- In the evaluated legal acts (except Order No. 28 of the Deputy Prime Minister of Mongolia of 2023 "On Revision of Regulations"), when a suspected or confirmed case of any infectious disease that harms the health of the population (such as bovine tuberculosis) is registered, who and what in time, there are no clear provisions on how to report and how to implement response measures.

Conclusion:

- In our country, the legal environment for registration, information, surveillance, diagnosis, treatment, prevention, public health measures and other issues of infectious diseases of animals, including bovine tuberculosis (Mycobacterium Bovis), has been sufficiently formed. However, there is a lack of information transfer and collaboration between veterinary hospitals and health facilities.

Outcome 03

A risk assessment of zoonotic infections, such as glanders and bovine tuberculosis, was conducted and the actual situation was determined.

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

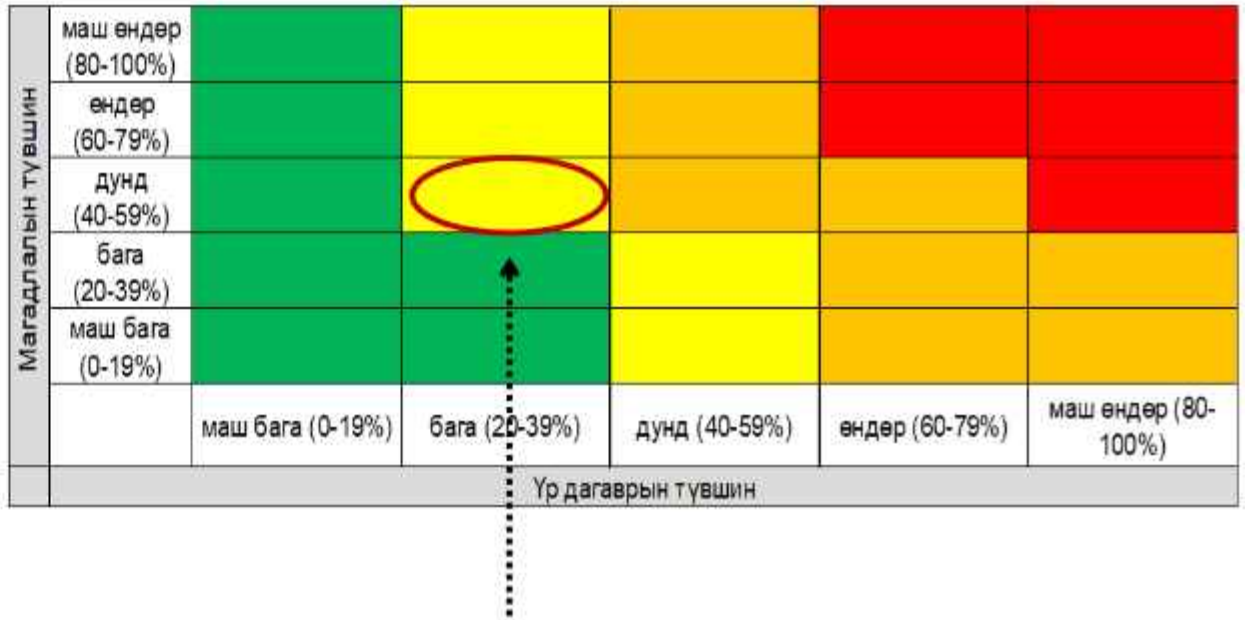
Participants: 20 medical doctors & vets

Participated organizations: NCCD, GAVS, IVM, Capital VD, private VU & slaughter house of UB

Organized time: 5th of July, 2024

Venue: EOP of NCCD

DISCUSSED & ASSESSED: A TOTAL OF 31 QUESTIONS



ASSESSED: Probability 37.5% **&** impact 40%

The risk level of the disease spreading among the population has been assessed as "MEDIUM RISK".

Recommendation of risk assessment *B.Mallei*

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The following measures are proposed for further implementation:

The steps to address the outlined measures:

- Develop and approve procedures for reporting cases of human disease caused by glanders
- Develop and approve guidelines for the diagnosis and treatment of human diseases:
- Improve diagnostic capacity and introduce new methods:
- Organize training for the Ministry of Health and the public on human diseases:
- Decide on the costs required for response measures
- Determine the rate, duration, and degree of disability in diagnosed cases
- Improve inter-sectoral coordination

By implementing these strategies, we aim to enhance disease surveillance, diagnosis, treatment, and overall public health response capabilities while promoting inter-sectoral collaboration and community engagement

Outcome 03

Surveillance of glanders of Zoonotic department, NCCD

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

Active efforts were made to conduct glander surveillance among herder households in 7 aimags.

Data Collection and Analysis:

- The face-to-face interviews with herders using a 20-question questionnaire are valuable for assessing risk factors associated with glanders exposure.
- Analyzing blood samples from 70 herders using the indirect enzyme-linked immuno-sorbent assay is a crucial step in detecting antibodies that indicate potential glanders infection.
- Ensure that the data collected is securely stored and accurately documented for further analysis and reporting.
- Feedback the results

Province name	Soum name	Time
Khentii	Kherlen, Bayankhutag	2024.05.13-17
Ovorkhangai	Burd, Khujirt, Arbaikheer	2024.06.13-17
Selenge	Zuunburen, Yeruu	2024-06.24.27
Bayan-Ulgii	Ulgii, Tolbot, Tsengel	2024.07.24-08.05
Dornod	Dashbalbar, Choibalsan, Matad	2024.9.9-9.14
Sukhbaatar	Sukhbaatar,Baruunurt, Erdenetsagaan	2024.9.26-2024.10.02
Dundgobi	Bayantsagaan, Luus	2024.10.16-18

Procurement and supply of the project

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН
ҮНДЭСНИЙ ТӨВ

- In conclusion, the successful receipt and utilization of 98 types of diagnostic reagents, tools and equipment in 2024 signify a significant step towards strengthening the healthcare infrastructure and services. The Ministry of Health remains committed to ensuring the efficient management and utilization of healthcare resources to promote the well-being of the population




Overseas training on NGS and bioinformatic

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН
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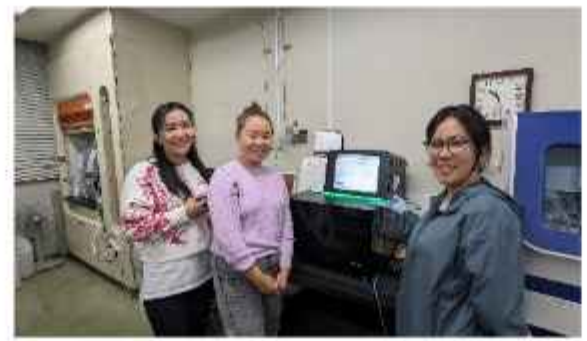
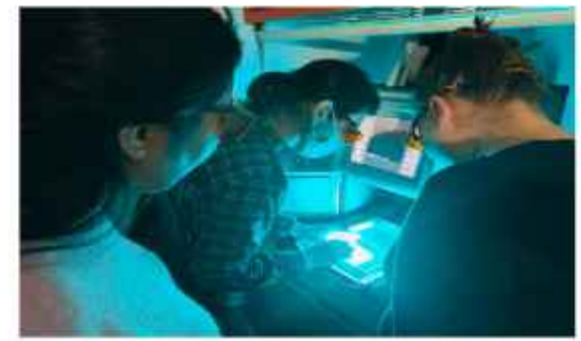
- At RIT in Japan, 2 doctors and 1 laboratory technician were attended a 1-month NGS and bioinformatics training.


Outcome 04

Based on the results of the research, activities will be carried out to ensure the operation of two zoonotic disease platforms

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН ҮНДЭСНИЙ ТӨВ

Activities to ensure the operation of two zoonotic disease platforms. These activities may include:

- Enhancing surveillance and monitoring systems for zoonotic diseases (meeting and discussion)
- Improving diagnostic capabilities for early detection and treatment (Develop the rule and submit to MOH "Passive case finding strategy in hospital based and active screening among high risk population".)
- Implementing preventive measures such PT and health education campaigns (approved TB care guideline A/38 on 29th Jan 2024)
- Collaborating with healthcare providers and stakeholders to address zoonotic disease challenges (meeting and discussion)
- Conducting research to better understand the epidemiology and transmission of zoonotic diseases (implementing research and data analysis)
- Developing and implementing strategies for effective disease control and prevention. (TB strategy , 2025-2028 is developing)

Plan of activities in future

ХАЛДВАРТ ӨВЧИН СУДЛАЛЫН
ҮНДЭСНИЙ ТӨВ

	Activities	Time
1.	Arrangements and conduct JCC 4th meeting	Jan-Feb.2025
2.	To evaluate the results of project outcomes related activities	Jan-March.2025
3.	Data analysis of the project study results and submit domestic and international journals	Jan-March.2025
4.	To organize the International conference of the project	May-June.2025
5.	Based on the research results indicating a prevalence of TB among healthy individuals, it is crucial to implement activities to ensure the operation of two zoonotic disease platforms.	Jan-Oct 2025
6.	Write a report on the results of the research conducted within the project and submit it to the Ethical Committee of the MOH	March- Apr. 2025
7.	Write a report of project activities, 2020-2025	March-Apr.2025

Acknowledgement

We extend our sincere gratitude to

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Sincerely thankful for their invaluable financial support

- The Japanese International Cooperation Agency (JICA)
- The Japanese Agency for Health Research and Development (AMED)

Special sincerely thankful for their kind cooperation

- The Hokkaido University, School of Veterinary Medicine (HU, FVM),
- The Hokkaido University Center for Zoology (HU, RCZC),
- The Tuberculosis Research Institute (RIT),
- The Institute of Veterinary Medicine (IVM),
- The National Center for Communicable Disease (NCCD) and Mongolian all partners

Thank you for listening

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