BIPM Capacity Building & Knowledge Transfer Programme

2021 BIPM - TÜBİTAK UME Project Placement

REPORT

Project Name	Introduction to research methods and capacity building in medical metrology
Description	This project focused on the capacity building in scientific medical metrology for both calibration and scientific research and design purposes. Scientific medical metrology being a new field which is being explored has a wide scope to be covered through research.
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Date	05 September 2021 to 15 October 2021

Motivation & Introduction

Kenya is economically classified as a developing country and one of its vision by the year 2030 is universal health care which aligns to the UN sustainable development goal for good health and well-being. So as to achieve this goal the country needed an outlined structure for medical metrology traceability which is a mandate of the National Metrology Institute (NMI)- Kenya Bureau of Standards (KEBS) Metrology Directorate, which ensures accurate measurements are made in the medical fields because the ripple effect of wrong medical measurements can be fatal.

KEBS is the national metrology institute whose mandate is the realization, maintenance and dissemination of SI units. KEBS is planning to establish a Medical Metrology Laboratory to meet the metrological needs of the country in the medical field. As a young metrologist in the NMI, I am very eager to contribute to my organizations' objective of realization of accurate and effective scientific medical metrology measurements, which will be disseminated to the larger medical field for more accurate and traceable measurements.

My objectives for the training were:

1. Performing calibrations on the available range of assorted medical devices and analyzing the data for preparation of report or certificate.
2. Bench marking on traceability of medical metrology, and the validated testing protocols.
3. Developing calibration procedures for laboratory use.
4. Introduction to research capabilities in the field of medical metrology.
5. Social cultural exchange with the different BIPM project participants and the Turkish community.

Research

"Medical Metrology" is a relatively new metrological field which still has a lot of research ongoing in its wide scope. This is mainly due to the different measurement parameters associated in the medical field, this shows that a medical equipment can be traceable to different primary standards. The Medical Metrology Laboratory in TUBITAK UME has different standards traceable to the primary calibration laboratories in the institution, they are:

Pressure standard – Dead weight tester
Voltage standard – Josephson junction system
Resistance standard – Quantum Hall Effect
Microphone standard – Reciprocity method
Temperature standard – ITS-90 Scale
Ultrasonic Power Standard- Radiation Force Balance, this is primary standard realized by the Medical Metrology laboratory

The methods used were a blend of practical approach to all measurements after a theory introduction on the same subject. The practical approach gives a better hands-on-training and skill to perform different tasks which upon data collection and analysis, we conducted an intra-comparison with my trainers' data to confirm on my competency level and performing the tasks for reproducibility of the results which we used for preparation of calibration reports or certificates. I prepared a specific laboratory procedure for impedance characteristics measurements of piezo ceramics and ultrasonic probes which are key components in the larger medical field and carried out research on how to produce phantoms (human tissue mimicking materials) and measure their properties.

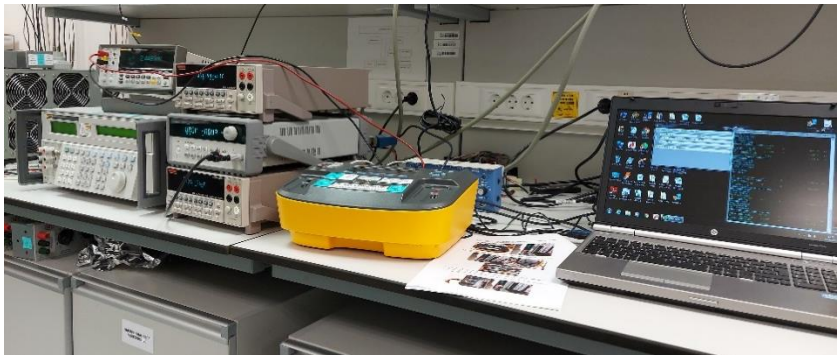
The different equipment that I calibrated and learnt on their operations, as well as specific subject covered during the program are:

1. Defibrillator/Transcutaneous pacer analyzer
2. Electro surgery analyzer
3. Gas flow analyzer
4. Infusion pump analyzer
5. Patient simulators
6. Impedance characteristics measurements of piezo ceramics and measuring probes
7. Headphones and hearing aid analyzer
8. Infrared Ear thermometer (IRET)
9. Speed of sound and attenuation coefficient properties of body tissue mimicking materials
10. Precision Multimeters
11. Heise ST-2H pressure meter
12. Photo acoustics measurements of body tissue mimicking phantoms

These equipment represent a wide range from the medical field which are very crucial in our daily live, when they are able to achieve precise and accurate reading which are traceable to the SI units, and it supports the correct diagnosis of patients thus improving the quality of life. Due to the current pandemic of Covid-19 there is an increased demand of temperature scanning and monitoring, this is done by use of thermal scanners and non-contact thermometers (Infrared ear thermometers), and these infra-red ear thermometers (IRETs) are calibrated in the medical metrology by use of both Portable and Laboratory type Infrared ear thermometer (IRET) calibrators. Both the portable and laboratory type IRET calibrators designed and produced in TÜBİTAK UME are traceable to the SI

units. Medical Metrology Laboratory abides to the CIPM MRA by dissemination of the SI units through calibration and the provision of reference materials for the medical field.

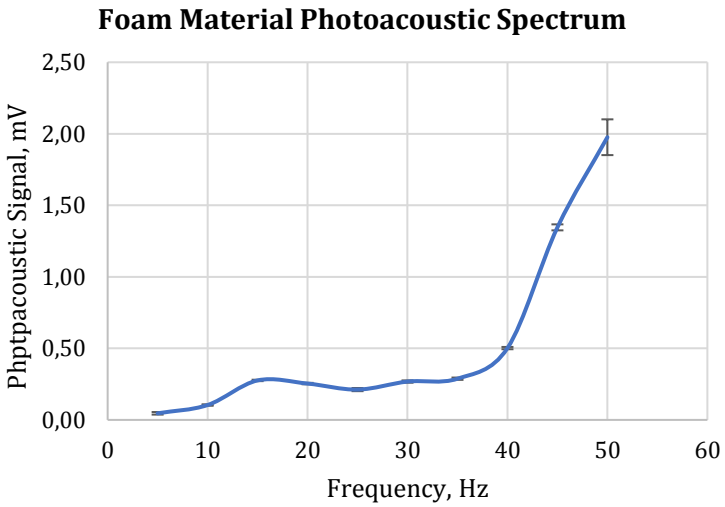
Few examples of practical work performed in TÜBİTAK UME are presented in Figure 1.



(A)

(B)

Frequency [Hz]	Photoacoustic Signal [mV]	Standart Deviation [mV]
5	0,046	0,009
10	0,104	0,005
15	0,276	0,005
20	0,254	0,005
25	0,212	0,011
30	0,268	0,008
35	0,288	0,008
40	0,502	0,008
45	1,346	0,021
50	1,976	0,125



(C)

Figure 1. View from practical work during the training

(A) Defibrillator calibration setup, (B) Portable IRET calibrator, (C) Data analysis for photoacoustics spectroscopy

Conclusions and Future Work

I have worked with a wide range of equipment in the Medical Metrology Laboratory and this will serve as a strong foundation for my future work in Kenya while we start our own Medical Metrology Calibration Laboratory. I got to understand the diversity of the medical metrology field since it has traceability from different primary laboratories, measurement standards from the Primary laboratories are traceable to the SI system of units and some are physical quantities which are well defined. In addition, medical metrology has unique standards in that they can be either electrical signals or set data from healthy human beings that is used as a reference. I understood the

importance of BIPM as the regulatory body of scientific metrology in the different correlation and correspondence activities in interlaboratory comparisons at the level of National Metrology Institutes and enhancing growth and development of staff at different NMIs.

This training aligned fully with my set objectives in that; I performed calibration of medical devices after training by the medical metrology laboratory staff and testing of my capabilities by performing intra-comparisons with my trainer's results and finally producing a sample calibration certificate. I also got to understand the traceability of medical metrology in its uniqueness, the development of calibration procedures, designing processes of different testing protocols and validating them in accordance to the manufacturer's specification and safe operations.

Acknowledgements

I sincerely thank the TÜBİTAK UME and BIPM managements and relevant personnel (Dr. Enver Sadıkoğlu, Ms. Müge Atam and Mr. Chingis Kuanbayev) from organizing this Project placement, pin pointing and selecting my project through to facilitating my amazing stay at TÜBİTAK UME. I cordially thank the Medical Metrology Laboratory team, Associate Professor, Dr. Baki Karaböce, Mr. Huseyin Okan Durmuş, Dr. Cengiz Birlikseven and Mr. Mithat Özdingiş for both their daily technical mentorship in the laboratory work and the social cultural exchange activities that led to the actualization of my study objectives. I will be looking forward for future collaborations between our organizations in the field of medical metrology as well as other metrology fields.