

THE CREATION OF A BIOMEDICAL LABORATORY SCIENCE COURSE IN EAST TIMOR – NEEDS AND CHALLENGES

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Abstract: East Timor gained its restored independence on 20 May 2002, after a long period of colonisation. Since then, several schools of various cycles and higher education institutions have been created to free people from illiteracy, ignorance, cruelty, and relegation. One of the Higher Education Institutions established for this purpose was the Institute of Health Sciences in Dili and the creation of a Biomedical Laboratory Sciences course, which arose in response to the shortage of human resources in this area and the urgency of ensuring basic health care. This article aims to demonstrate the major problems and challenges facing the health sciences, highlighting the particularity of the Biomedical Laboratory Sciences course at the Institute of Health Sciences in Dili, which aims to train professionals in Biomedical Sciences through teaching and learning activities, practicals, internships, and scientific work with the contribution of lecturers.

Keywords: Biomedical Laboratory Sciences; Teaching and learning activities; Human resources.

A Criação de um Curso de Ciências Biomédicas Laboratoriais em Timor-Leste – Necessidades e Desafios

Resumo: Timor-Leste obteve a sua independência restaurada em 20 de maio de 2002, após um longo período de colonização. Desde então, várias foram as escolas dos vários ciclos e as Instituições de ensino superior que foram criadas para libertar as pessoas do analfabetismo, da ignorância, da crueldade e da relegação. Uma das Instituições de Ensino Superior estabelecidas para este efeito foi o Instituto de Ciências da Saúde de Díli e a criação de um curso de Ciências Biomédicas Laboratoriais, que surgiu para responder à escassez de recursos humanos nesta área e à urgência em assegurar os cuidados de saúde básicos. Através deste artigo, pretende-se demonstrar os grandes problemas e desafios para as ciências da saúde, destacando a particularidade do curso de Ciências Biomédicas Laboratoriais do Instituto de Ciências da Saúde de Díli, que tem como objetivo formar profissionais em Ciências Biomédicas através de atividades de ensino e aprendizagem, práticas, estágios e trabalhos científicos com a contribuição dos docentes.

Palavras-chave: Ciências Biomédicas Laboratoriais; Atividades de ensino e aprendizagem; Recursos humanos.

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Introduction

East Timor's independence was restored in 2002, after 450 years of Portuguese colonisation, 3 years of Japanese colonisation and 24 years of Indonesian colonisation. The worst and most execrable part of colonisation was forcing people to work and pay taxes to the colonialists and not allowing the Timorese to continue studying at a high level of education, in this case, higher education. This happened when East Timor was under the control of Portugal and Japan. However, when East Timor was under Indonesian military control, education was good and no longer a problem, but the word independence was a problem and a primary goal for the Timorese at the time^[2]. There was a huge gap between the educated and the uneducated, the literate and the non-literate, and the poor and the rich, in East Timor and neighbouring countries in the Southeast Asian and Pacific regions. This is why, in 2013 (Guterres, 2020), Timor-Leste ranked 128th on the UNDP's list of human development index.

The independence of Timor-Leste is to reduce or if possible, to eliminate the uneducated, and poor through education. In the constitution of the Republic Democratic of Timor-Leste (C.R.D.T.L.) article 59, states that all Timorese have the right to access to education (*Constituição da República Democrática de Timor-Leste* [C.R.D.T.L.], 2002).

Meanwhile, Timorese people having the constitutional right to health, medical care and health Education is the only key to changing people's lives from unemployment to employment and from poor to rich. Concretely, a group of medical laboratory graduates from *Associação dos Analistas da Saúde Timor-Leste* (AASLT) joined an idea and established a Biomedical Laboratory Science course in 2019. The course was opened under Instituto Ciências da Saúde (ICS) Díli to produce a qualified human resource in biomedical science based on graduates' competence such as having the ability in science, technology, practical, and basic research to contribute to the development of the country through the health sector. As a result, the Biomedical Laboratory Science (BLS) students carried out basic

[2] Statute of Ossomali Research and Development (ORD) by Gregorio Rangel, a senior researcher and scientist of ORD, Timor-Leste.

research and course produced 23 graduates of biomedical science in 2023. The total number of students in the BSL course is 321.

East Timor's independence brought with it the major objective of reducing or, if possible, eradicating poverty, lack of education and illiteracy through education. Article 59 of the Constitution of the Democratic Republic of Timor-Leste (C-RDTL) states that all Timorese have the right to access education. Meanwhile, the Timorese people have a constitutional right to health, medical care and a healthy environment. Education is the only key to changing people's lives from unemployment to employment and from the poor to a sustainable life. Specifically, a group of medical laboratory graduates from the Association of Health Analysts Timor-Leste (AASTL) got together and developed an idea and this is how the Biomedical Laboratory Sciences course was created in 2019. The course was established at the Institute of Health Sciences (ICS) in Dili to produce qualified human resources in competent biomedical sciences, such as having capacity in the development of science, and technology, and a capacity for research to contribute to the improvement of the health sector and the development of the country. As a result, the Biomedical Laboratory Science (BLS) programme opened in 2019 and produced 23 biomedical science graduates in 2023. The total number of students on the BSL course now is 321.

To further develop teaching, and learning processes and research, lecturers need to be directly involved in research and publication to enrich their knowledge and experience. Especially in the medical laboratory, research and publication are important components for both lecturers and researchers to improve knowledge, skills and experience. Today's research and publishing is very competitive worldwide because science, technology and innovation are constantly discovering and changing, a situation which places people at different levels of knowledge and experience. Thus, the results of pedagogical and scientific activities can be used by lecturers to increase students' knowledge. It is hoped that they can help in the preparation and qualification of human resources in the medical laboratory.

Brief Information on the Founders of the CBL

The Founders of Biomedical and Laboratory Sciences (F-CBL) are a group of Timorese intellectuals in the fields of biomedical and laboratory sciences who are involved in the Association of Health Analysts of Timor-Leste (AASTL). The founders are Hendriketa da Silva, Gregório Rangel, Baltazar Lopes de Sena, and Crispin A. Venâncio de Araujo and Jaemito de Mello Soares. The initiating founder is Gregório Rangel. The group of intellectuals from the Biomedical and Medical Laboratory Analysis course wanted to contribute qualified human resources in the biomedical laboratory to strengthen laboratory diagnosis and fill the gap in human resources that are serving in all the country's health units.

The F-CBL aimed to establish a biomedical laboratory science course, called the CBL department at ICS Dili. The existence of the CBL department aims to offer an opportunity to the young Timorese generation who are interested in continuing to study biomedical laboratory sciences to avoid continuing to study in the same field abroad. The founders are working as permanent lecturers/encouragers to teach and mentor students on weekends, holidays and outside of working hours. The founders of the CBL have established a basic practical laboratory for the students, to be used during practical classes and pre-clinical examinations before the students carry out internships in health units in the country.

The Department of Biomedical and Laboratory Sciences

The Vision: To deliver health care excellence in Timor-Leste through biomedical laboratory education and practice.

Mission: (1) To conduct teaching and learning programs in the biomedical laboratory based on national competence standards in Timor-Leste; (2) To produce qualified biomedical laboratory graduates; (3) Community service in the biomedical laboratory and tropical diseases; (4) To be able to use new assay for diagnosis, monitoring and prevention of diseases.

Objectives: (1) To train students to be able to work independently in the laboratory (clinical and public health laboratories); (2) Having the capacity to carry out biomedical research, medicine and other health-related;

(3) Having the ability to create and manage private clinics, public health and other health-related laboratory.

The Initiation of the CBL Department

The department of CBL officially opened on January 12, 2019. After 5 months the existence, the department was involved in institutional accreditation through the National Agency for Academic Assessment and Accreditation (NAAAA) and the result of accreditation indicated that CBL and the other four departments (nursing, pharmacy, obstetric, nutrition and dietetics) are allowed to realize teaching and learning process under ICS Dili through the dispatch number: 141/ANAAA/MESCC/IX/2019^[3].

The department's aim in creating the CBL is to offer the same opportunity to the young Timorese generation to continue their studies in biomedical laboratory sciences in the country. It should be remembered that there is only one biomedical laboratory course at the *Universidade Nacional Timor Lorosae* (UNTL), which is difficult to access for all secondary school graduates in the country.

The CBL's vision is to provide excellent healthcare in East Timor through biomedical laboratory teaching and practice. To achieve this vision, the lecturers are committed to practical classes, to imparting knowledge in the classroom and to demonstrating practical skills in the laboratory with the students during practical classes. This means that the lecturers are showing and acting in front of the students during the practical lessons. After that, all the students can perform for themselves during the practical classes and the pre-clinical examination process before the students go on to the internship period^[4].

The Official Documents are Drawn up by the CBL Department

As of the 2019-2020 academic year, the CBL department has drawn up several official documents, such as the department's general manual, the

^[3] The dispatch of National Agency for Academic Assessment and Accreditation, Ministry of Higher Education, Science and Culture.

^[4] The general manual of Biomedical Laboratory Science, ICS Dili.

strategic plan matrix, the internal regulations and the annual action plan. In the 2022 academic year, the department also drew up a manual to guide students during their internship period in the country's health facilities.

The general handbook for the CBL department is mainly used to describe the criteria for a student candidate applying to the CBL department, such as good health, physically and mentally, having a high school diploma in natural sciences or any other related field. Each student must pass all subjects in the first semester before they can programme other subjects in the following semester and up to the fifth semester. However, the sixth semester focuses only on the pre-clinical exam and the internship programme^[5].

The strategic plan matrix is mainly used to define the department's long-term activities. The activities include the creation of a basic laboratory for practical classes, a feasibility study, a laboratory management system, capacity building and a research programme. As a result, the creation of the basic laboratory and the feasibility study programme have been implemented. The basic laboratory for practical classes, designed to train students before they start the internship programme, and the results of the feasibility study have been developed and published in national and international journals.

The main objectives of the CBL department's internal regulations are to define the organisational chart and competencies, the schedule of subjects for each student, the teaching regulations, the distribution of grades, the internship and scientific work^[6]. On the one hand, the programme contents and modules were used to prepare teaching materials (PowerPoint presentations – PPT) for teaching students^[7]. On the other hand, the internship regulations were also implemented and used to assess the students during the internship period^[8]. As a result, 23 first-year students from the CBL department have passed all the regulations and

[5] The curriculum of CBL department.

[6] The internal regulation for CBL department by Gregorio Rangel, initiator founder of CBL.

[7] The syllabus for CBL department by Gregorio Rangel, initiator founder of CBL.

[8] The internship guideline for CBL department by Crispin B. A. de Araujo, founder of CBL.

will be graduating for the first time in the history of ICS Dili in 2023. The documents being used by the CBL department are shown in Table 1. The list of documents used is based on the needs of the department each academic year.

No.	Name of documents	English Version	Tetum Version
1.	The general manual for the CBL department		Available
2.	The Matrix of Strategic Plan	Available	
3.	The internal regulation		Available
4.	The syllabus		Available
5.	The module	Available	
6.	The internship manual		Available
7.	The guidelines for the internship report		Available
8.	The guidelines of scientific work report	Available	
9.	The feasibility study report	Available	
10.	Research and publication documents	Available	

Table 1 List of documents that are being used by department CBL to run the teaching and learning process including research activity. Source: CBL Department, ICS Dili.

The documents available were prepared by the CBL department in different languages to facilitate the evaluation and accreditation process that is related to the CBL department. The documents were in English, such as the strategic plan matrix, the modules, the scientific report guideline, the feasibility study, the research document and the article were also in English.

The Lecturers of the CBL department

The department has several programs classified as the main programme, such as teaching and learning programs with sub-programmes such as theoretical and practical classes, internship and final scientific report for

students, research and scientific seminars for lecturers, writing articles and publishing in national and international journals. There are two classifications of lecturers. Lecturers are classified as compatible lecturers and non-compatible lecturers. Compatible lecturers are lecturers with a degree in biomedicine and medical laboratory science, and non-compatible lecturers do not have a degree in biomedicine or medical laboratory science.

The teaching staff in the CBL department consists of permanent, incentivised and part-time lecturers. Most of the lecturers are graduates in biomedical and medical laboratory sciences, with bachelor's, master's and doctoral degrees in biomedical and medical laboratory sciences. All lecturers have completed their studies at various accredited universities around the world, such as Universidade Nova Lisboa, Portugal, Udayana University, Indonesia, Ubon Ratchathani University, Thailand, Hasanudin University, Indonesia, Mahidol University, Thailand, University of the Philippines and Punjab College of Technical Education (PCTE), India. All these universities are accredited universities in each country and the world. However, the professors who are currently teaching as compatible professors in the CBL department are those listed in Table 2.

No.	Number of Lecturers	Education level	Area expertise
1	1	Specialist in psychiatry	Medical doctor
2	2	Ph.D.	Medicine and Biomedical Science
3	2	Masters	Medicine and Biomedical Science
4	15	Bachelor	Medical Laboratory Science

Table 2 Number of lecturers who are lecturing as compatible lecturers at the CBL Department.
 Source: CBL Department, ICS Dili.

Most of the compatible lecturers in the CBL department are a doctor specialising in psychiatry who teaches cytology and histology. Two PhDs in medicine and biomedical sciences who teach immunology-serology and research methodology. Two masters' in medicine and biomedical sciences

who teach molecular biology and parasitology. Fifteen graduates in medical laboratory sciences who teach other compatible subjects. Most of the professors currently work at the National Health Laboratory, the National Hospital, international agencies and other health-related institutions. They can therefore share their knowledge and experience with students during the teaching and learning process to improve students' knowledge and skills.

On the other hand, lecturers who are not compatible are lecturers from other health-related degrees, such as public health, general chemistry, civic education, applied maths and information and technology, ethics and morals, and entrepreneurship in the medical laboratory. These lecturers have contributed greatly to the teaching and learning process. The list of incompatible lecturers is shown in Table 3.

No.	Lecturers	Education level	Area expertise
1.	11	Bachelor	Public health and other related areas
2.	3	Master	Public health and other related areas
3.	2	Specialist in neurology	Medical doctor

Table 3 List of non-compatible lecturers who are lecturing at the CBL department. Source: CBL Department, ICS Dili.

Research and Publication

Research and publication in the CBL department have been implemented. The feasibility study of human resources in laboratory medical sciences in Timor-Leste was carried out in 2020. The study was funded by ICS Dili. The feasibility study article was published in national and international journals (Rangel, 2022). On the other hand, there are three (3) articles currently available in international journals and one (1) article contributed to a national journal also funded by ICS Dili, as indicated in table 4. All articles are available on google.com, Google Scholar and ResearchGate.

No.	Title of publication	Year of publication	Name of journal	DOI & ISSN
1	Impact of Plasmodium falciparum malaria on liver and red blood cell	2022	International Journal of Gastroenterology Hepatology and Endoscopy	10.51521/IJGHE.2022.1104 2578-885X
2	Bioinformatics analysis on microRNAs that modulate significant host immune response genes as potential biomarkers in cerebral malaria infection	2022	International Journal of Gastroenterology Hepatology and Endoscopy	10.51521/IJGHE.2022.1105 2578-885X
3	Assessment of human resources in medical laboratory science in Timor-Leste	2022	Revista de ciências e Tecnologia de Timor-Leste	Print [2958-2822] Online [2958-2830]
4	Circulating Exosomal MicroRNAs as Prognostic Biomarker in Cholangiocarcinoma: A Systematic Review	2023	HIV Nursing	1474-7359 Q4

Table 4 List of publications that had been published on behalf of the Biomedical Laboratory Science department. Source: Online Journals.

The first article focused on malaria infection affecting the liver and red blood cells in malaria patients. The study aimed to show the process and mechanism of malaria infection that caused severe malaria in the liver phase and anatomical changes in red blood cells. The second article relates to the bioinformatic analysis of microRNAs and host immune response genes as potential biomarkers in cerebral malaria infection. The aim of the study centred on the bioinformatic analysis of host-targeted miRNA response genes associated with malaria pathogenesis as a potential biomarker for the development of severe malaria and cerebral malaria. The third

study was related to the feasibility study of human resources in medical laboratories in East Timor, to identify the number of medical laboratory workers serving in health units compared to the workload in the country. The fourth study was on circulating exosomal microRNAs as prognostic biomarkers in cholangiocarcinoma (CCA). The study aimed to carry out a systematic review of exosomal miRNAs as candidate clinical biomarkers in CCA. The study and publication fee were funded by the Dili Institute of Health Sciences, and the articles were received and published in several national and international journals. The articles are also available on Google Scholar and ResearchGate.

The Students of the CBL Department

The number of students in the CBL department in the 2019-2022 academic year is 321. The majority had completed secondary school in each year of admission to ICS Dili. In the 2019 academic year, the CBL department had 28 students as its first cohort. In the 2020 academic year, the number of students increased to 62 as the second group. In the 2021 academic year, the total number of students who enrolled in the CBL department was 77 students as the third group. In the 2022 academic year, the total number of students in the CBL department was 154, as the fourth batch. The total number of students in the CBL departments by year is shown in Table 5 and Figures 1 and 2, whose data includes the number of male and female students by year.

No.	Student admission per year	Sex		Total	Observation
		Male	Female		
1.	2019	16	12	28	23 alumni and 5 students were stay
2.	2020	19	43	62	Still in process
3.	2021	40	37	77	Still in process
4.	2022	58	96	154	Still in process
Total				321	

Table 5 Number of students admitted per year at the department of CBL

The 28 students in the first group in 2019, 23 students completed their studies in 2023 and 5 students stayed on. The number of students therefore remains at 289. The CBL department also has a student association that organises extracurricular activities in the department each year.

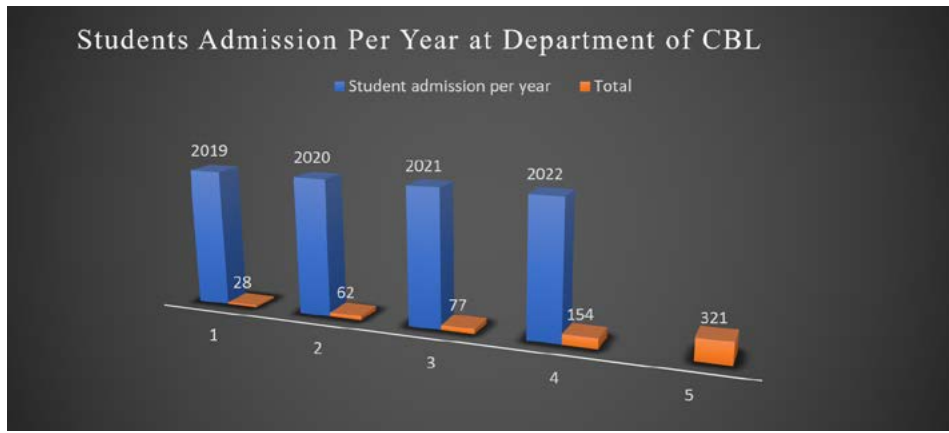


Figure 1 Student admission per year at the department of CBL

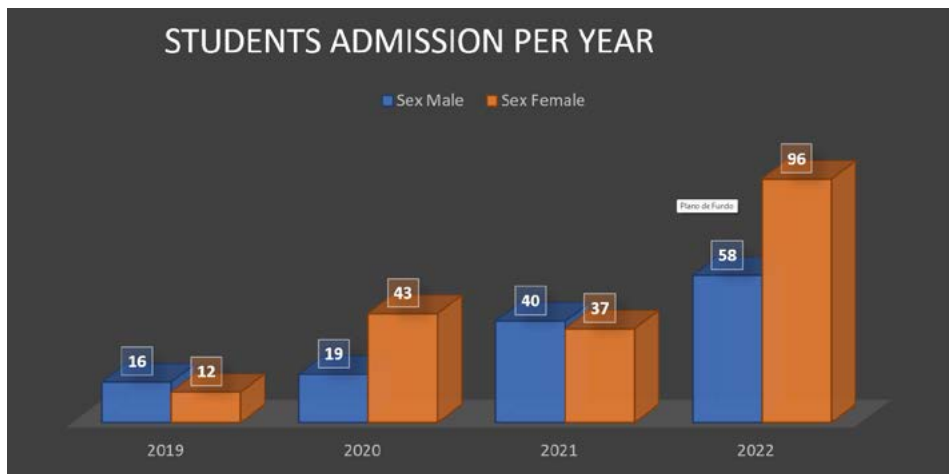


Figure 2 Students admission per year female and male from 2019 – 2022.

This figure shows that in 2019 there were 16 male and 12 female students admitted. In 2020, there were 19 males and 43 females. In 2021, there were 40 males and 37 females. In 2022, there were 58 males and 96 females. The total number of students in the CBL department is 321.

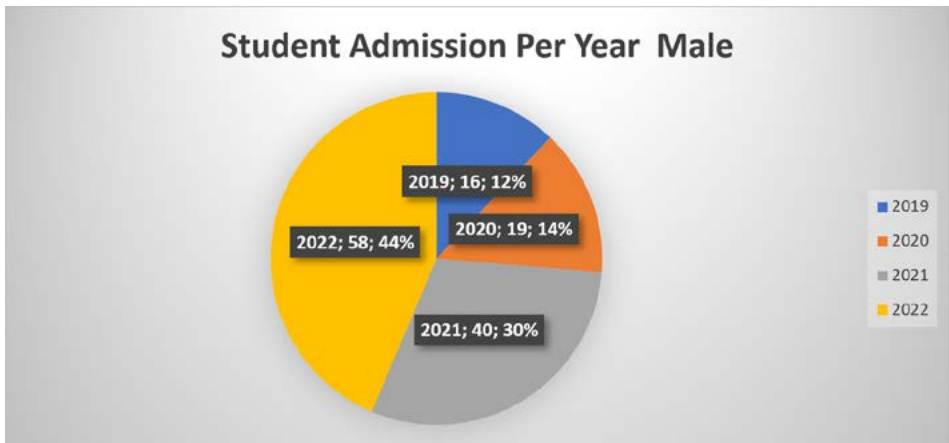


Figure 3 *Student admission per year male.*

This figure illustrated that the intake of male students per year was 12 per cent male in 2019, 14 per cent male in 2020, 30 per cent male in 2021 and 44 per cent male in 2022. The percentage indicates that every year there is a significant increase in students interested in attending the CBL department at ICS Dili.

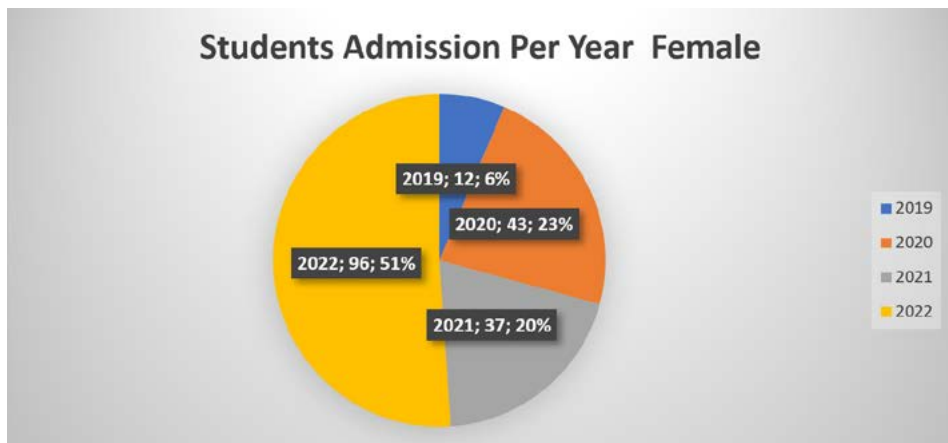


Figure 4 Student's admission per year female.

This figure showed that the intake of female students per year was 6% female in 2019, 23% female in 2020, 37% female in 2021 and 51% female in 2022. The percentage indicates that every year there is a significant increase in students interested in attending the CBL department at ICS Dili.

CBL Founder's Contribution to ICS Development

The CBL department organised an international conference on cancer and dengue in 2019. The founder also prepared a memorandum of understanding (MoU) between ICS Dili and the Ilmu Kesehatan Institute (IIK) Persada, Bali, Indonesia, for five years. The terms of reference of the memorandum are related to the exchange of lecturers, administrative staff, student exchange, internship, research and other academic exchanges agreed upon by both parties. On the other hand, the F-CBL has also taken the initiative to set up a research centre and medical science journal with an international consultant from Portugal. The name of the research centre is the *Centro de Investigação do Instituto Ciências da Saúde (CIICS)*. The research centre aims to promote an atmosphere of scientific research linked to teaching and learning processes for all ICS lecturers in Dili, who are thus invited to participate in research and development. The research

centre has been set up and is up and running. Thus, all young researchers can develop through research and development in East Timor, especially in the medical field, through the ICS in Dili. The name of the journal is Timor-Leste Journal of Medical Sciences. The journal aims to promote the results of health sciences research at national and international levels. The journal's website has been approved and is already available on the internet. The first issue of the journal was in a Call for Papers process, which ran from January to March 2023, and was extended from March to June 2023.

Opportunities and Challenges Encountered

Current Opportunities

Several hypotheses could be contemplated to improve the CBL department in the future. The majority of the CBL teaching staff hope to develop and upgrade the level of the department concerning the academic degrees it offers, namely from bachelor to licentiate; likewise, it is intended to establish a development laboratory for practical classes for CBL students, as well as allocate a budget to develop and participate as a researcher in the research centre of the Dili institute of health sciences (CIICS) and cover some publications on behalf of the CBL department. The scientific results will be published in the “Timor-Leste Journal of Medical Science”, which is managed by CIICS. In addition, ICS Dili and the Menzies School of Health Research Timor-Leste intend to collaborate on a study into the elimination of malaria cases in Timor-Leste with a project entitled: The Use of Highly Sensitive Diagnostics and Typing/Sequencing Technology in the Pursuit of Malaria Elimination in Timor-Leste.

Challenges Encountered

The CBL department is a new department within the Institute of Health Sciences in Dili and is facing some internal and external challenges, namely: firstly, ICS Dili received \$4,000 (four thousand) US dollars to carry out a feasibility study on human resources in medical laboratories in East Timor in 2020. The study was published in national and international journals.

However, there is no additional support for carrying out a pure study in the relevant department. Secondly, the CBL department of the ICS in Dili is a private higher education establishment in the health sector in Timor-Leste, which continues to have limitations in terms of human resources and infrastructure. Thirdly, there is a lack of laboratory clinics and research laboratories to fulfil the treatment and research needs of ICS Dili students and the community. Fourthly, the professors who teach at ICS Dili prefer teaching to developing research activities. Fifthly, the unavailability of external financial support (especially for research and development).

Conclusion

In summary, the study presents several points, such as (1) the realisation that colonisation, which prevailed for a long time in East Timor, resulted in slavery, illiteracy and a lack of human resources in the country; (2) education should be considered the ultimate solution to free people from slavery, illiteracy and superstition; education is the key to preparing human resources to contribute to the country's development, especially in the health sector.

The CBL department was created with the dual objective of, on the one hand, producing qualified human resources in the medical laboratory to serve the Timorese people and, on the other hand, to avoid dependence on the development of human resources from foreign graduates in the medical laboratory as part of Timor-Leste's preparation to compete with other Southeast Asian countries in the coming years; (3) in relation to the teaching and learning component, in order to produce qualified medical laboratory graduates, the CBL department also provides dynamic knowledge through theory in the classroom, and then practice in the development of the medical laboratory; (3) several CBL graduates are currently working as volunteers in referral hospitals, community health centres and other relevant health institutions in Timor-Leste, which reveals the good scientific preparation of the graduates; (4) this paper also discusses some obstacles faced by the ICS faculty in Dili, who continue to prioritise teaching and learning over research and publication, a situation that needs to change gradually and

continuously. On the one hand, some government institutions, non-governmental organisations and international agencies have supported public universities instead of private academic institutions like ICS Dili, a situation that also needs to be taken into account, especially in ICS Dili's relationship and partnership development. On the other hand, former ICS Dili students (nurses, midwives, pharmacists and nutritionists) have been working in various government institutions, especially in the health sectors, a situation that once again reveals the quality of the work being done at ICS Dili.

References

CENTRO DE INVESTIGAÇÃO DO INSTITUTO DE CIÊNCIAS DA SAÚDE (2023). *The Statute of Centro de Investigação do Instituto Ciências da Saúde*. CICCS: Timor-Leste.

GUTERRES, José (2022). “Creation of the Centre of Excellency for Research, Development and Innovation” (CERDI). *Managing Change at Universities—A selection of case studies from Africa and Southeast Asia—Volume II*, 171-182.

INSTITUTO DE CIÊNCIAS DA SAÚDE DE DÍLI (2021). *The Curriculum of the CBL Department*. ICS: Timor-Leste.

_____ (2021). *The Manual for the Department of CBL*. ICS: Timor-Leste.

_____ (2020). *The Internship Guideline for the CBL Department*. ICS: Timor-Leste.

_____ (2021). *The Internal Regulation for The CBL Department*. ICS: Timor-Leste.

_____ (2021). *The Syllabus for the CBL Department*. ICS: Timor-Leste.

INSTITUTO NACIONAL DE CIÊNCIAS E TECNOLOGIA (2022). *Memorandum of Understanding between ICS Dili and IIK Persada Bali*. INCT: Díli.

JMEDICALSCIENCE.TL (2022). *The Creation and Fundamentals of Timor-Leste Journal of Medical Science*. Available in <https://jmedicalscience.tl>.

KLEINE-BINGHAM, M. B., Rangel, G., Sarakbi, D., Kelleher, T., Abrampah, N. A. M., Neilson, M., ... & Syed, S. B. (2023). “Country Learning on Maintaining Quality Essential Health Services During COVID-19”. *Timor-Leste: a Qualitative Analysis BMJ open*, 13(4), e071879.

NATIONAL AGENCY FOR ACADEMIC ASSESSMENT AND ACCREDITATION (2021). The Dispatch of the National Agency for Academic Assessment and Accreditation, Ministry of Higher Education, Science and Culture. ANAAA: Díli.

OSSOMALI RESEARCH AND DEVELOPMENT (2022). *The Statutes of Ossomali Research and Development*. Timor-Leste.

RANGEL, Gregório (2022). “Assessment of Human Resources in Medical Laboratory Sciences in Timor-Leste”. *Revista de Ciências e Tecnologia de Timor-Leste* N.º 1. Available in: <https://inct.gov.tl>. Page 67-80.

THE CONSTITUTION OF THE REPUBLIC DEMOCRATIC OF TIMOR-LESTE. Available in: http://timorleste.gov.tl/wpcontent/uploads/2010/03/Constitution_RDTL_ENG.pdf. Accessed 07 April 2023.