

## **History of Medical Laboratory Services in Bahrain - Part III The Salmaniya Medical Centre (1975 -1985)**

Fayek Al Hilli, PhD\*

During the independence of Bahrain in 1971, the Department of Health of the Government of Bahrain was renamed The Ministry of Health (MOH) of the State of Bahrain. Dr Ali M. Fakhro MD, the Director of Health became the first Minister of Health at that time. There were three main ministerial departments: the Diagnostic and Curative Service headed by Dr Ibrahim Y Al-Saad, a Bahraini Paediatrician was responsible for hospital affairs. The Preventive Service headed by Dr Abdul Fatah Abu Zaid, an Egyptian public health physician was responsible for Primary Health Care in the peripheral "Health Centres". The Public Health Service, headed by Dr Riffat Abdul Hameed, also an Egyptian public physician was responsible for Public Health Services. The organisation of the laboratory was recognised under the Diagnostic Services.

**Organization.** When Inglott left the Laboratory in February 1975, "The Laboratory" was called the Department of Pathology and was recognised by the Salmaniya Hospital and the MOH (ie. the Government) as a clinical department, headed by a Chairperson<sup>1,2</sup>. This was a milestone for the "The Laboratory" and recognition of the role of diagnostic services in clinical practice so as to equate it with any other clinical "Department". Dr P.R. Dasgupta replaced Inglott as Chairman of Pathology<sup>a</sup>.

The Department of Pathology at Salmaniya was subdivided into three units; the Biochemistry; Haematology and Blood Bank; Histopathology and Cytopathology. The small Parasitology detachment remained at Salmaniya Laboratory<sup>1,2</sup>. The fourth unit, Microbiology, managing Bacteriology and Serology was under the administration of Public Health Laboratory (PHL). This organisation was not the making of the new MOH but an inheritance of Inglott's era.

**Planning the Laboratory of Salmaniya Medical Centre (SMC).** The years, which followed Inglott's departure, were quiet yet dynamic. Primarily it was important to provide continuity of the routine work, particularly in Haematology and this was made easier with the use of automation procedures in the laboratory and the employment of experienced technicians. However, the main task was to prepare the laboratory for its

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\* Consultant Pathologist  
Department of Pathology  
Salmaniya Medical Complex &  
Assistant Chief Editor  
Bahrain Medical Bulletin  
Kingdom of Bahrain

next expansion at the SMC Tower Block, scheduled for opening in December 1978. This was a complex task and involved planning, analysis of workload, allocation of budget for every single function in the laboratory, revision of space requirements, replacement of decommissioned and outdated laboratory equipment with state of the art technology, tendering and commissioning of new equipment, manpower requirements and their job description and training, etc.

**Haematology and Blood Bank.** After the Departure of Inglott, the Haematology Section was left unsupervised. Luckily, Mr Ismail Ibrahim Akbari who had returned from the United Kingdom in 1974 as a trained haematology technician with a Diploma in Laboratory Technology was able to provide reasonable professional coverage in haematology and blood bank. He refined and introduced several laboratory techniques particularly in the screening of haemoglobinopathies and occasionally reported on bone marrow aspirates.

Dasgupta also provided adequate professional coverage in haematology but in the face of increased diversity of workload it was necessary to recruit a specialist to this important field. Accordingly, Dr V.V. Dashmukh, an Indian Clinical Pathologist was appointed in 1975, primarily to provide coverage for the Haematology Service vacated by Inglott and develop the long neglected Blood Bank and coagulation disorders tests.

For these reasons, Mr John Lal, an experienced Indian technician was also appointed<sup>b</sup>. Dashmukh had extensive knowledge in laboratory medicine and was an experienced haematologist, efficient histopathologist, and able parasitologist and clinical biochemist.

**Other Laboratory Specialities.** The Biochemistry, Histopathology and Cytopathology service remained in the main Salmaniya laboratory while the Bacteriology remained at the PHL awaiting the completion of SMC laboratory to shift both services to the new premises.

Prior to 1977 only 39 analytes on blood and urine were performed at the Biochemistry Section mostly using manual methods of analysis. AA2 from Technicon Company installed in 1969 in the laboratory was the only automated system available at the time.

**The College of Health Sciences (CHS).** While planning for the building of SMC Tower block and the expanding health services with the opening of several Health Centres in many areas in Bahrain were under way, it was necessary to develop and train the manpower required to operate these expansions and to replace the non-Bahraini employees with qualified and trained workers. There was a need to train several thousand young Bahraini in all paramedical fields including medical laboratory technology, nursing, radiography, pharmacy, physiotherapy, public health, midwifery, medical equipment bioengineering and many other specialities. Accordingly the CHS was established in 1976 to graduate the required manpower and Mrs Maha Al Hamar (formerly using the maiden name Miss Maha Alkhalidi) and her husband Mr Faisal Al-Hamar were transferred from the Salmaniya Laboratory to the CHS to co-ordinate the laboratory technician training programme. Since then several hundred technicians have

graduated, some of whom continued their postgraduate studies in European and North American universities and obtained Doctor of Philosophy degrees<sup>b</sup>.

### **THE TOWER BLOCK OF SMC**

In 1978 the entire laboratory was shifted to the spacious Department of Pathology situated in the ground floor of the new six stories tower block of SMC. The Centre was officially opened on 16 December of the same year by the late Amir of Bahrain, Shaikh Isa Bin Salman Al-Khalifa.

The laboratory was designed in the form of letter U and the space was equally divided between the four major specialities (Bacteriology, Biochemistry, Haematology and Histopathology). But this new expansion facility did not solve the problem of space requirements of the laboratory and it seemed that during the planning stages neither the architects of the tower nor the laboratory personnel understood the requirements of each other. There was also no consideration to the nature of work in each of section of the laboratory, the workload, patients and specimen flow, manpower, and the size of equipment in each section. Thus the Biochemistry section with its voluminous equipment, greatest workload and the requirement to provide a 24 hours emergency service was given an equal space share as the Histology section in which the equipment were small and the workload was less. In fact the new laboratory was allocated the same space as the old “Salmaniya Laboratory” but the addition of Microbiology to the SMC disrupted the equality with other specialities. There were no phlebotomy waiting area for patients, no exhaust ventilation system, no bench space for specimen registration and separation, the media preparation in Microbiology was within the main Bacteriology bench space. Furthermore, the new laboratory was also deficient in amenities available to the 120 laboratory staff and more than 2000 daily patients who shared two toilets. The corridors were also large at the expense of the main laboratories and for safety reasons the hospital rules refused the utilisation of these passages to accommodate secondary laboratory equipment such as storage cabinets, refrigerators, etc so as to relieve the much needed space elsewhere. What was most important, there was no vision for future plans especially with regards to workload. Within 3 years of opening the new tower, 5 new peripheral Health Centres were opened in various parts of Bahrain dumping their workload on unprepared and over-stretched SMC laboratory.

**Organisation.** In December 1978, Dr Fayek Al-Hilli joined as the first Bahraini Pathologist and became chairman in June 1979. In 1980, Dr K.V Nadkarni joined as a Consultant Pathologist reporting on haematology and surgical pathology specimens. Dr K.V. Rao an Indian qualified Consultant Clinical Biochemist also joined the in May 1984.

The graduates of the CHS were the main technical force in the laboratory and dealt with most of the routine workload. But there were areas, which required experienced technicians to oversee the specialised professional work as well as the training of the graduates themselves. There was also a need to undertake clinicopathological interpretations of laboratory results, standardization of techniques, introduction and

implementation of quality control, expansion and introduction of new technologies and cost effective tests etc. Accordingly, Miss Sameera Khalil of Microbiology and Miss Seema Zainal from Haematology were sent to the American University of Beirut, Lebanon to obtain BSc degree in Medical Laboratory Technology. Mr Hassan Ibrahim Sanad, a Bahraini BSc graduate who had joined the laboratory in 1979 was also sent in 1982 to France to obtain special technical training on hormone assay. Dr Idrees Bhai, a senior-experienced scientist in endocrinology was also recruited from India to address the growing importance of hormone assays<sup>b</sup>. Many CHS graduates and expatriate technicians also joined the laboratory<sup>b</sup>.

**Mr Mohsin Al Tajer Special Investigation Laboratories at the Al Fateh Building.**

As part of SMC expansion, the Al Fateh building was being constructed across the Tower Block to accommodate the out-patient clinics of the ENT, Gynaecology, and Ophthalmology on the first two floors, and on the second a generous donation was made to establish “Mr Mohsin Al Tajer Special Investigation Laboratories”. There was nothing “special” about these “laboratories” other than adding a list of “new” tests mainly hormone assays. It also provided an additional working space. In 1985, the entire Biochemistry Section was relocated to the Al Fateh leaving its “emergency service” in the main SMC Tower Block. The vacated space at the tower was shared by haematology and microbiology services. Haematology moved the coagulation studies into a more spacious environment and had additional administrative space to keep files and records as well as bench spaces for medical residents to screen blood films and bone marrow aspirates. As for the microbiology, the vacated space was allocated to Serology thus giving the section 80% more space than the previous overcrowded bench space.

**Haematology and Blood Bank.** When the Haematology shifted in 1978 to its new place at the Salmaniya Tower, Hemalog-8 analyzer was introduced for full blood count and this was replaced in 1983 by a newer model Coulter Counter S-plus IV capable of offering 18 haematological parameters. Automatic Slide Stainer was also introduced.

With increasing workload and as dictated by time, need, and the non-availability of expertise, Deshmukh was occasionally assigned laboratory duties other than haematopathology. He was reluctant to do any new tasks despite his remarkable professional capabilities and experience. Instead, as a bureaucrat, he preferred to adhere to his job description and the terms of his service contract. He resigned in the summer of 1984 and Nadkarni replaced him as Head of Haematology and Blood Bank Section<sup>a</sup>.

In 1982 Dr J.P. Bapat joined the Haematology Laboratory and helped to establish the Haemoglobinopathy Unit using Acid Agar Gel Electrophoresis method for the screening of abnormal haemoglobins. At the time, haemoglobin molecule abnormalities were quantitated by the Helena Laboratories “Quick Scan” Scanning Device. Quantitation of glucose-6-phosphate dehydrogenase was introduced. On 3 November 1983, Dr G.P. Bhagwat joined Pathology as the first Chief Resident of the Department and helped Nadkarni in the Haematology and Blood Bank and in 1985 he was promoted to Consultant and became in charge of the Blood Bank<sup>b</sup>.

In 1983, special stains were introduced for the cytochemical classification of leukaemias. These included Leucocyte Alkaline Phosphatase (LAP), Periodic Acid Schiff (PAS), Sudan Black and Peroxidase stains.

The coagulation studies included Bleeding Time (BT), Clotting Time (CT), Prothrombin Time (PT) and APTT. In 1984, indirect methods for the detection of coagulation disorders by Thromboplastin Generation Test (TGT) was introduced and these were replaced at a later date by specific coagulation factor deficiency studies including the Quantitation of Factor II, VII, VIII, IX and X activity. Factor XIII assay (Urea Clot Lysis Test) was also introduced. Other introduced tests included Mechanical Osmotic Fragility (after incubation of rbc's at 37°C for 24 hours), Ham's Test and Sucrose Lysis Tests for screening of PNH cases, Plasma Fibrinogen Quantitation, FDP assay, Kleinhauer's Test for foetal cell detection in mother's circulation, NBT Test for neutrophils activity, Alkali Persistence Test (APT) for the detection of foetal haemoglobin in the gastric aspirate of children, screening of rbc's enzyme defects Pyruvate Kinase (PK), Glutathione Reductase (GR) and Plasma Viscosity determination by Viscometer. In 1985, the workload in the Haematology increased by 230% compared to 1980 (Table 1).

**Table 1. The number of laboratory tests carried out at Salmaniya laboratory between 1979-1985. The 1979 workload for Biochemistry, Bacteriology, Serology, Parasitology, Histology, and Cytology are not available.**

YEAR	Biochemistry	Haematology	Blood Bank	Bacteriology	Serology	Parasitology	Histology	Cytology
1979		287564	57279					
1980	175064	313448	66568	37844	32458	147565	3458	2444
1981	210911	335067	72389	446684	30263	152290	3678	3266
1982	303840	455977	117457	588975	35582	177652	4103	4921
1983	363440	560648	139302	526694	36889	227472	5369	4970
1984	451085	670458	154173	598802	43710	240198	4916	5558
1985	488495	662262	142799	586470	46718	213576	6045	5910

When the laboratory moved in 1978 to its new place at the SMC tower, the vacant laboratory at the "North block" was renovated to house the Blood Bank. It was in the 80s that the Arab Council of Ministers of Health endorsed the organization of blood donation in the Arab countries. Accordingly, the Blood Bank was renamed "The Central Blood Bank" taking into consideration that it was the main Centre in the country. Mr S.V.Ingle worked in the Blood Bank. In 1985 the workload in the Blood Bank increased by 250% compared to 1980 (Table 1).

**Clinical Chemistry.** In December 1978, the Biochemistry Section was equipped with two Technicon SMA-6/60 (SMAK), one for the analysis of electrolytes and the other for liver function tests. These sequential multiple assay autoanalyzers employing the "single-multiple coil technology" were very big and occupied considerable floor area allocated to this Section. They were, however, trouble free and "heavy duty performing equipment"

and like their AA2 prototype (acquired in 1969) delivered reproducible results. But these were soon embargoed because of the inclusion in 1984 of Technicon products on the list of Arab Israeli Boycott Bureau. Moreover, the emergence of other smaller and cheaper equipment with better and more dependable technology particularly those from the Japanese industry prompted the laboratory to seek other alternatives.

Centrifugal analyzers, a novel technique incorporated into Centrifichem - 400 by Norman Anderson at Union Carbide Company was acquired in 1979 and was ideal as a batch analyser. Its improved version with a capacity of 28 parameters and marketed as Centrifichem - 600 was also acquired in 1983 and used for the automated and quick assay of cholesterol, triglycerides, calcium, phosphorous, uric acid and creatinine. Beckman analysers for the fast determination of glucose and urea were acquired in 1978. In 1979, a new Atomic Absorption Spectrophotometer (Perkin-Elmer Company) for the estimation of lithium, copper, zinc, lead, and mercury was obtained thus replacing the old version from Zeiss Company, which was kept as a stand by apparatus. Many new tests like HBA1C, thyroid antibodies (antithyroglobulin and microsomal antibodies), Cerebrospinal Fluid-lactate, lipoprotein electrophoresis, and gamma glutamyl transferase (GGT) were introduced in 1985.

Automated Clinical Analyser (ACA III) made by Du Pont Company, USA was installed in 1978 to provide efficient service to Accident and Emergency (AE) patients and to undertake "STAT" requests from other clinical areas. It had the capacity to perform 30 chemical parameters. This analyser proved vital in the running of the 24 hours "Emergency Laboratory". As the workload increased in the subsequent years another similar unit was obtained.

In 1981, there were 58 analytes of blood and urine performed at the Biochemistry Section. The total number of tests performed in 1981 was 210911 as compared to 451085 in 1985; an increase workload of more than 200%.

**Endocrinology.** There was a growing demand on the laboratory to establish hormone assay especially the investigation of thyroid and infertility disorders. Until late 70s specimens for such assays were sent to private laboratories in the United Kingdom at a great cost and considerable delay. However, the emergence of Radio Immuno Assay – RIA- (invented by Rosalyn Yalow), was simple, accurate and cost effective method has changed the entire outlook of endocrinology investigation. It enabled the laboratory to estimate hormones present in ultramicro quantities. To follow these developments the RIA laboratory was established in 1980 in the Biochemistry Section with a Gamma Counter (LKB Company). Accordingly, the assay of Thyroid stimulating Hormone (TSH), T3, T4, Follicular Stimulating Hormone (FSH), Leutinising Hormone (LH), Prolactin, Progesterone, Oestradiol and Testosterone became available in Bahrain. This represented an important landmark in the improvement of laboratory services. The laboratory gradually expanded the test pattern to include Cortisol, Growth Hormone, Oestriol (E3), Human Placental Lactogen (HPL) and vitamins such as B12 and Folate. The RIA laboratory was also equipped with a Processor, Refrigerated Centrifuge, Cold Room and other accessories.

In November 1985, a major project of screening all pregnant women for gestational diabetes was launched. The screening test with 50 g oral glucose and a subsequent GTT if necessary became established norm thereafter. A large number of women attending the Antenatal Clinics benefited from this program.

**Microbiology.** In anticipation of SMC expansion Dr William, a non-clinical research-oriented immunologist, was appointed in 1977 as a Consultant Microbiologist. But very soon it became apparent that to ensure the development of the microbiology service as a clinical specialty it was necessary to appoint medically qualified specialist who can understand the disease process. Accordingly, Dr Sujata Kumar, a highly qualified and experienced microbiologist joined the laboratory service in 1981 thus becoming the second female Consultant to join the laboratory service after Tahira Kazi in 1969<sup>2</sup>.

Kumar came to work in a laboratory environment, which was not her design. Her appointment was opposed by some senior technical staff who thought that the position did not require the appointment of a Consultant when they could technically provide the same service. This misconception was based on their assumptions of seniority and influential relationship with other senior members of the MOH rather than clinical knowledge or skill. This opposition continued until the day when she resigned and left Bahrain in 1985. At this level, the planners of the MOH did not oversee and ignored the clinical needs of hospital practice. In 1984 Dr Abdul Aziz Abdulla Yousif returned to Bahrain after completing his PhD in Microbiology. He was appointed as Specialist Microbiologist in 1986.

The working environment in Microbiology was overcrowded, but Kumar organized the workflow into stations and thus allocated each bench space to a particular microbial culture specimen (i.e. pus, throat, blood, urine, and stools). As for the serology service a separate bench space was allocated for the limited number of serological tests made available (e.g. VRDL, ASO Titre, CRP, C3, C4, Widal). In 1985, the workload in Microbiology and Serology increased by 1550% and 144% respectively compared to 1980 (Table 1).

There were several outbreaks of cholera and typhoid epidemics during the tenure of Kumar and she dealt with each situation in the most professional way reflecting her experience and methodological approach to health problems. Her documentations on antimicrobial sensitivity pattern, bacteraemia, urinary tract infection in Bahrain were the first microbiological studies in Bahrain and remained baseline for comparison until 2000s<sup>3-5</sup>. She was particularly interested to train young technicians; many of whom are now senior technologists<sup>b</sup>.

**Parasitology.** This section was physically detached from the main microbiology laboratory and there was no logical explanation for this separation other than to avoid possible contamination of microbial culture plates. However, the position of Parasitology in a small room near the main reception and patient waiting area of the laboratory was wrong taking into consideration the local social habit of not showing excreta publicly. Furthermore, there were no amenities for patients to collect excreta and those required to

collect semen samples were left with great embarrassment and inconvenience. Furthermore, there were no clinical areas for sample collection, and male patients referred to the laboratory with urethral discharge had to go into the same toilet with a male laboratory technician for swab collection, also to the embarrassment of both males. In 1985, the workload in Parasitology increased by 145% compared to in 1980 (Table 1).

**Human Immunodeficiency and Hepatitis Related Viruses.** During the early 80s infections related to these viruses alerted public attention with strong demands for the screening of blood donors and high risk population groups. Again, there were problems of “domain and territory”, as to which health service within the MOH should be responsible for this task. For example, the Microbiology service claimed it is part of their responsibility to deal with micro-organism, infections and “immno” while the Blood Bank assumed similar function as the logical place to receive and “filter” any possible infected material. At the end, rather than decentralising the responsibility and providing the screening at multiple outlets, the Undersecretary of the MOH decided that the screening should only be done at PHL not because it was the section concerned with epidemiology and disease control but because there was an application for research study on the appropriateness of technical commercial methodologies.

**Histopathology.** The relocation of Histopathology to the new Tower block did not solve the problems of this section. There was no acquisition of new equipment and in fact all the machines and other utilities used in the old laboratory since 1968 were simply shifted to the new premises<sup>1</sup>. There was no storage area and very soon the paraffin blocks, microscopic slides and museum specimens were stacked below the working benches. The only advantage was the provision of a separate bench space for cytology staining and screening. In 1985, the workload in Histopathology and Cytopathology increased by 175% and 242% respectively compared to 1980 (Table 1).

**Mortuary.** This was hardly used since very few hospital and police post-mortem examinations were done. But the number of latter cases gradually increased and the hospital pathologists were reluctant to do forensic work. Therefore, the police authorities appointed Dr Kamel in 1985, an Egyptian retired forensic specialist.

**The Emergency Laboratory.** The advantages in the old Salmaniya Hospital North Block of keeping the laboratory near the AE Unit changed after the shift to the Tower block<sup>2</sup>. The new AE unit was 300 meters away from the laboratory with no facility to collect specimens from patients of this unit and to transport them to the laboratory. In many instances, the emergency patients had to walk or brought to the laboratory leaving trails of blood on the hospital floor from the emergency rooms to the laboratory. Furthermore, the emergency service within the laboratory was separated into three principal sections (viz. haematology, biochemistry and microbiology) thus referred patients had to be directed to the appropriate section. Furthermore, the location of the Blood Bank in the North Block created inconvenience. There were occasional “cosmetic” changes to ease the flow of laboratory samples such as the use of couriers, fax machines, and the opening of sample collection centre near the emergency rooms.



The workload from the AE unit increased tremendously not only from the emergency rooms but also from the hospital wards, the newly opened Intensive Care Unit and the Cardiac Care Unit

**Quality Control (QC).** With the shifting of the laboratory into the tower block and the employment of many new technical procedures, it was necessary to document these techniques for future reference and training of new CHS graduates. For the first time in laboratory history, the technical manuals for Histopathology, Cytopathology, Haematology, and Blood Bank were written. Furthermore, internal quality control was started with peripheral health centres. External QC programmes were also initiated with a number of organizations:

- 1979 External Quality Assurance Programme in Clinical Chemistry of Wellcome Laboratories, United Kingdom.
- 1980 Middle East External Quality Assessment Scheme for Chemistry, Saudi Arabia.
- 1985 United Kingdom National External Quality Assessment Programme for Haematology (UKNEQA). This programme covered full blood count, reticulocytes count, peripheral blood film for cell morphology, blood film for screening of parasites, G6PD activity, and haemoglobin electrophoresis.

**The Laboratory of the Bahrain Defense Force (BDF) Hospital.** In 1980, the laboratory of BDF Hospital was opened with a modest small hall given to Pathology, supervised by Major Thompson, a British military laboratory technologist. Many experienced Bahraini laboratory staff from the Salmaniya laboratory joined the new establishment including Abdulla Al Qubaisi, Abdulla Aman, Ibrahim Al Suwaidi, and Adnan Hassani. Only routine biochemistry, haematology, bacteriology and parasitology tests were performed at this laboratory referring all other investigations (e.g. hormones, serology, histopathology, cytology) to SMC.

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**ENDNOTES**

<sup>a</sup>. P.R. Dasgupta left Bahrain in July 1979

<sup>b</sup>. Honour List. The following are laboratory workers of various ranks who had worked in the laboratory together with the dates of (joining and leaving the government) service. Mr. John Lal (24.10.1976 still in service), Mr. S.V. Ingle (13.03.80, left to Awali Hospital of Bahrain on 01.10.91), Dr G.P. Bhagwat (resigned in December 1991), Mr. Idrees Bhai (29.09.1981, 29.11.1991), Dr KV Nadkarni (left in 1993), Sameera Khalil and Seema Zainal returned to Bahrain from Beirut due to Lebanese civil war, and were subsequently continued their BSc studies in Medical Laboratory Technology in the USA.