

# Outstanding achievements of medicine and pharmacy in Vietnam during the period of 2011-2015

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## Abstract:

Based on the success of research that applies advanced international medical and pharmaceutical technology to projects of Vietnam's Ministry of Science and Technology, the author presents some outstanding achievements in science and technology in medicine and pharmacy during 2011-2015. These results contribute significantly to the healthcare of the community; raises Vietnam's medical science to keep up with developed countries, provides a great socio-economic significance, and also indicates the important position of science and technology as well as the benefits of scientific investment into medical and pharmaceutical fields.

**Keywords:** advanced medical and pharmaceutical technology, science and technology, Vietnam.

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In the past five years, thanks to science and technology programs from the Ministry of Science and Technology, the level of Vietnam's science and technology advancement in the medical and pharmaceutical sectors has significantly progressed. It might be said so far, that most of the new technologies, innovative applications for diagnosis, treatments, and preventions of diseases that other countries are using, have already been deployed in Vietnam, including many techniques that have achieved a comparable level with those in developed countries. This paper presents some of the outstanding achievements of medical and pharmaceutical science and technology reached in the last five years.

## **Biological technology**

Across the world, modern biotechnology was accepted into medical and pharmaceutical fields very early on and has achieved incredible success. In the middle of the 1970s, during the last century, due to the

success of monoclonal antibodies, scientists revolutionized biotechnology by forming medicines, and now, the revolution has fully exploded. Many achievements in medicine have been reached. Many nascent techniques have been used to help diagnose life threatening diseases early and accurately, and several new treatments have been created to cure those diseases. Biotechnology has established some new specialties including molecular medicine, molecular pathology, and methods that have unraveled the many mysteries of the microscopic world of disease. Vietnam's biotechnology's lag by about 30 years behind the rest of the world, but until recently, that lag time has shortened. We can say the essential biotechnologies used for diagnosis, treatment and prevention of diseases used in the rest of the world has been implemented in the country.

**Successful application of genetic engineering techniques for the diagnosis, treatment and prevention of diseases, for example:**

+ Applied multi-primer PCR to identify EML4-ALK & EGFR genes targeting therapy for non-small cell lung cancer (Crizotinib) [1]. Applied FISH techniques to determine HER2 in breast cancer to help specify the exact target in selecting drugs [2]. This was a new horizon in cancer treatment, and is highly effective.

+ Applied ASB realtime PCR technique for the detection of T1799A BRAF gene mutations to diagnose papillary thyroid cancer [3].

+ Created multi-primer PCR protocol (Multiplex PCR) for the detection of common sepsis pathogens [4].

+ Used a gene sequencing technique to identify a number of genes involved in the antibiotic resistance of 13 common strains of pathogenic bacteria found in Vietnam [5].

+ Used chromatography and FISH to establish a protocol to engineer three neonatal disease screenings: Hypothyroidism congenital adrenal hyperplasia and lack of GDP-6 [6].

+ Protocolled diagnosis and screening of common Vietnamese genetic diseases before embryo transfer (Pre-implantation Genetic Diagnosis) in vitro fertilization [7].

## **Application of stem cells in treatment**

We have mastered the technique of isolating stem cells from different sources to treat some blood disorders, cardiovascular diseases, osteoarthritis, respiratory issues, and cancers; and those preliminary and initial results are similar to countries in other parts of the

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world [8].

### Techniques of Ionizing radiation

Ionizing radiation is used mainly for three specialties: nuclear medicine, X-ray and oncology. In recent years, a number of modern techniques of ionizing radiation have been launched. These techniques have helped early diagnosis, accurate and early detection of metastases, cancer recurrence, and accurate diagnosis of stage of diseases. Therefore, the treatments are correct, appropriate, effective and safe. These techniques have changed over 30% of initial treatment plans into proper therapies, causing a breakthrough in cancer treatment. Here are some outstanding results:

- The application of Intense Modulated Radiation Therapy (IMRT) using PET/CT image scanning to simulate radiation therapy planning to the treatment of throat cancer, lower throat larynx cancer, and esophagus and lung cancer [9]. IMRT is a technique that uses adjusting doses of radiation beams based on tumor morphology, and changes the intensity of the radiation beams according to the density of the cancer cells, thereby optimizing the high doses at the tumor while minimizing the doses on surrounding healthy organs. Therefore, treatment efficiency is higher and safer. This is the top technique for radiation currently used around the world; only a few developed countries implement this technique, such as the United States, Germany, Italy, Australia.

- The application of radiosurgery techniques using the rotating gamma knife technique for the treatment of brain tumors and some other brain diseases [10]. The rotating gamma knife procedure has the accuracy of classical gamma knife system, but uses Co-60 radiation sources and cubism radiation techniques based on the accelerator, forming a cubism radio-surgery approach based on the principle of using the powerful radiation sources of Co-60, and is focused and correctly localized to the tumor or pathological brain region. The radiation beam is rotated and focused at different trajectories, so tumors and

lesions receive the highest doses of radiation, but surrounding healthy tissue received very low radiation doses. So the radiosurgery system with gamma knife is an ideal piece of equipment used in the current rotating set of radiosurgery techniques.

The application of stereotactic body radiotherapy using cyber knife has enhanced the effectiveness of treatments and is comparable to surgery.

- The implantation of radioactive I-125 seeds (Permanent radioactive seed implant) in the treatment of prostate cancer has begun: This is a new technique, that is modern, and overcomes the disadvantages of previous radiation therapies. This new technique has been implemented in a few countries around the world, and was first implemented in Vietnam at Bach Mai Hospital in April, 2015.

- The application of  $^{18}\text{F}$ -FDG PET/CT used for diagnosing and monitoring treatment outcomes of cardiovascular disease and cancer, so that the right treatment is indicated brings high treatment outcomes [11].

### Pharmaceutical sector

#### *Applications of high-tech in manufacturing and apothecary*

- The successful apothecary of injecting liposomes with two cancer drugs, including doxorubicine and amphotericin B [12]. Liposome, progressed technology in pharmaceutical applications, is a new technology used worldwide which was originally applied in Vietnam. This technology increases a drug's efficacy and reduces toxicity, through the mechanism of targeted therapy.

- The successful apothecary of long-acting pills used to treat cardiovascular diseases and diabetes, which is designed for extended-release for the purpose of reducing the number of medications that patients must take, and improve the treatment efficacy and reduce side effects of drugs [13].

- The successful apothecary of injecting lyophilized carboplatin for the

treatments of cancer on an industrial scale [14]. This form of medicine easily helps the preservation and use of drugs.

#### *Production of vaccines*

We have mastered the technology for producing the vaccine Rotavin-M1, used to prevent diarrhea in children caused by Vero cells [15]. The drug has since been confirmed for safety and efficacy by the CDC. This result has named Vietnam as the fourth country in the world to produce the Rota vaccine, after the United States, Belgium and China. Thanks to domestic drug production with low costs, the vaccines have been put into expanding immunization programs.

#### *Production of medical biological agents of high value used for diagnosis*

- The primers PCR kit has three target genes that act for rapid diagnosis of TB and drug-resistant TB [16]. Thanks to the three target genes, this kit has a higher sensitivity and specificity than imported kits.

- The rapid, accurate diagnosis kit for simultaneous multiple organ fungi has helped clinicians accurately diagnose patients with fungal organs that previously often would be overlooked [17].

#### *Application of biomass technology for producing Ngoc Linh ginseng root cells* [18]

Ngoc Linh panax is a rare medicinal herb that has been exhaustively exploited. Advantages in cell biomass has shown a very short incubation period of only about 10-20 days, reduced affect by weather, epidemics, select potential cell with high biologically active substances and stable material quality so consistent with drug production according to GMP standards. Although natural Ngoc Linh panax does not fully meet the demand, thanks to this technology the market still has many products from biomass Panax that are preferred by clinicians.

#### **Organ transplantation [19-21]**

Transplantation in Vietnam was applied 50 years later than across the rest of the world, and 20 years later than other countries in the region. The first

successful kidney transplant in Vietnam was performed in 1992; then, after 18 years of effort, in 2010, transplantation in Vietnam achieved advanced techniques of organ transplants equal to the rest of the world. That means that we have gained control of the common techniques of organ transplant, including kidney, liver and heart transplant from living donors and brain dead donors. However, by 2010, we still had some outdated technologies that the rest of the world hadn't used for nearly 20-50 years. Technologies to perform lung and pancreas transplants, and techniques for donations after cardiac death (DCD) and multi-organ transplants. To solve this problem, KC10 2011-2015 program designed scientific projects to be used for transplantation. Since then, transplantation in Vietnam has really kept up with the rest of the world and created a breakthrough for the development of organ transplant in the future.

- Resolved issues with organ transplant from DCD (non-heart-beating donors). This has contributed to solving the problem of organ shortage, which is a big challenges for organ transplant. Therefore, the source of organ donation, now, is not only from living donors (brain dead), but also from non-heart-beating donors. Organ donation from a non-heart-beating donor is easier than the brain dead donors while their hearts are still beating.

- Performed successful implementation of simultaneous pancreas, kidney transplants used for the treatment of last stage renal failure for patients who have diabetes. This result terminated Vietnam's 48-year lag behind the rest of the world's pancreas transplant technology (the first pancreas transplant in the world was performed in 1966).

- Performed successful multi-organ transplants (simultaneously transplanted two organs in a patient) including a simultaneous kidney, pancreas transplant at now available at 103 hospitals, simultaneous heart-lung transplant at Hue Central Hospital, and demonstrated competence in techniques and transplant management.

- For the first time, successfully

implemented an artificial heart transplant (heartware) used to extend a patient's life while waiting for a heart transplant.

Thanks to these advances, transplants in the last five years have become a frequent technique, increasing the number of transplants. There are about 1,500 transplants that have been made in Vietnam, more than five times the amounts of transplants during the previous 17 years. In December 2015 alone, there were 96 cases of kidney transplants. In Viet-Duc hospital, four cases of transplants were performed within one day (one heart, one liver and two kidney transplants). The number of hospitals which can perform the organ transplants has increased from 12 to 17 nationwide.

Transplantation was not only achieved in technical progress, but also in management skill; this is especially clear with transplant coordination. In two years, there have been three times that organ donors from Ho Chi Minh City provided organs for transplants for patients located thousands of kilometers away in Hue and Hanoi.

### **Interventional radiology**

Interventional radiology was developed from angiography diagnosis. It was firstly applied on January 16<sup>th</sup>, 1964, when Charles Dotter (US), for the first time, used percutaneous intravascular catheters for angioplasty to treat a patient with severe femoral arterial stenosis, which resulted in toe necrosis. The patient was saved from leg amputation. Today, interventional radiology has replaced many surgical treatments used for cardiovascular, gastrointestinal, kidney, urinary, respiratory, obstetrics and gynecology, and others diseases. This is a minimally invasive technique, anesthesia is not necessary; therefore, patients might recuperate quickly. Thanks to this advantage that many severe patients who were unable to perform operation, interventional radiology has rescued them.

Interventional radiology was started late in Vietnam, at the end of the 1990s

of the previous century (which is later than the rest of the world by about 30 years), but after ten years, many vascular intervention techniques, which were implemented across the world, were performed in the country. Especially in the last five years, interventional radiology has been widely applied to all specialties: cardiology, digestive, respiratory, urinary, neurosurgery and obstetric intervention. Many complicated techniques, which were not widely implemented across the rest of the world have also been implemented such as vascular intervention treatment of congenital heart disease, thoracic and abdominal aortic aneurysm, cerebrovascular diseases, trans-jugular intrahepatic porto-systemic shunts (TIPS), trans-catheter arterial chemoembolization (TACE) and trans venous embolization (TVE) [22-24]. Most specifically, interventional radiology for cardiovascular disease has had great progress, on par with other countries in the region and the world. Through this experience, Bach Mai Cardiovascular Institute has trained more than 30 doctors from the United States, France, Japan, China, Korea, India, Singapore, Malaysia, and Myanmar on a variety of techniques that have been developed, including enlargement of mitral valve stenosis, congenital heart interventions.

### **Laparoscopic surgery**

The first laparoscopic surgery in the world began with a case of cholecystectomy by Erich Muhe (Germany) in 1985. Seven years later than the rest of the world, Vietnam has adopted techniques for laparoscopic surgery. Today, Vietnam's approach to laparoscopic surgery is an equal level with the rest of the world. After 18 years, especially in the last year, laparoscopic surgery has made great development in Vietnam. Complicated abdominal laparoscopic surgery, such as gastrotomy, hepatectomy, and the Whipple procedure, has become routine in many hospitals. Laparoscopic surgery outside abdominal procedures has also been performed, such as thoracic

surgery, neurosurgery, thyroid, bone & joint surgery. Vietnam has performed regular techniques, such as single hole laparoscopic surgery (single port), natural hole surgery (Natural orifice transluminal endoscopic surgery: NOTES) [25]. Vietnam is one of the first countries in the world to perform cancer colectomy through an anus, and the first country in the world to perform colectomy through a vagina. These techniques have been reported at an international laparoscopic surgery conference held in Moscow in 2014, and was a point of interest with colleagues. Especially in the last five years, we have implemented a number of robotic surgery methods, a modern surgical approach, and ensured high accuracy. This surgery is not common in the rest of the world. Many laparoscopic surgeries have been advanced by Vietnam, including thyroid surgery, some choledochal cysts surgery in pediatric, congenital megacolon, diaphragmatic hernia surgery and new endoscopic surgeries such as single port laparoscopic surgery, laparoscopic surgery through a natural hole. Therefore, in recent years many foreign colleagues have come to Vietnam for learning, exchange of experiences and invited Vietnamese experts to foreign countries for teaching and performing surgery.

## Conclusion

Thanks to science and technology, in the last five years, many techniques and advanced technologies in the medical and pharmaceutical sector have been implemented in Vietnam. It can be said until now, that most valuable high-tech in the diagnosis, treatment and prevention of diseases around the world have been performed in Vietnam. This is an important contribution to improving the quality of protection and health care for communities, and bringing a great economic efficiency, a great social significance, raised the level of domestic medicine to keep up the level of international medicine. These results show the significance and importance of science and technology and also

demonstrate the effectiveness of science and technology investment in medicine.

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