

Literature review

The use of donor blood samples and blood components in medical research applications

Apiwan Pipatvanichkul

National Blood Centre, Thai Red Cross Society

Introduction

Blood transfusion practices have evolved over the past century, transitioning from the use of whole blood to the administration of specific blood components to targeted therapeutic needs. At present, there is an increasing demand for blood and blood components in medical treatment. Blood donation is currently the most important aspect of global healthcare, contributing over 100 million blood units annually. Blood donation is crucial source of blood for patients undergoing surgery, experiencing traumatic injuries, managing chronic conditions, and receiving cancer therapies. This essential procedure serves as sustaining and saving lives.^{1,2} It is essential that the volume of blood collected through voluntary donation is adequate for medical needs throughout the country. Ensuring a sufficient and stable supply of donated blood is a critical component of a well-functioning healthcare system, as it directly supports life-saving treatments, surgical procedures and emergency medical care. The availability of such resources must be continuously monitored and managed to avoid potential shortages that could compromise patient care.

Before donated blood can be used for transfusion, precise screening is conducted to detect infectious diseases including HIV, hepatitis B, hepatitis C and syphilis. In some countries, additional tests may be conducted beyond these, such as HTLV or West Nile virus. Small samples from each donation are tested to confirm the blood is safe for recipients. This process not only protects patients but also helps monitor public health trends.

However, donor blood samples and donated blood are also crucial for various medical and research applications. These samples help ensure blood safety, advance scientific studies and improve disease detection and treatment. In cases where donated blood is not need for therapeutic use, it may be allocated for scientific or medical research purpose.

Donor blood samples and blood components in medical research

Blood samples from donors can be used to develop and validate new diagnostic tests. These tests help detect diseases more accurately and efficiently, leading to earlier treatment and better patient outcomes. For instance, advancements in cancer detection and blood-based biomarkers have been made possible through research involving donor blood samples.

Data involved in blood donation can be used in various studies for improvement in healthcare system such as blood screening results, personal activity of blood donor and record of blood donation. The use of donor blood samples in a research study is mainly as a control group, as these samples come from a healthy population, providing a reliable comparison to the experimental group.

Blood service organizations and hospital blood banks represent valuable settings for biomedical research for several reasons. Firstly, they offer convenient access to a large pool of well-characterized healthy individuals suitable for genomic and epidemiological studies.³⁻⁵ Secondly, the availability of donor information facilitates

Correspondence should be addressed to Apiwan Pipatvanichkul, MSc., National Blood Centre, Thai Red Cross Society, Pathumwan, Bangkok 10330 E-mail: vonling.97@gmail.com

follow-up or re-contact for the collection of additional biological samples.⁶ Lastly, blood donors are more likely to support voluntary research initiatives, particularly those involving blood donation. It is commonly assumed that voluntary blood donors exhibit positive attitudes toward donating their blood for research purposes.⁷

A successful integration of blood banking and biobanking for the purpose of advancing medical research has been established in the region of Bavaria, Italy.⁸ The findings about the level of willingness to donate blood were consistent with those observed in previous research conducted in others regions, including Tunisia, Western countries, and parts of Africa. These studies have consistently shown similar trends in public willingness to participate in blood donation programs, suggesting that the factors influencing blood donation behavior may be influenced by common cultural, socio-economic and demographic variables across different geographical contexts. The alignment of these results further strengthens the validity and reliability of the current studies' conclusions, offering a broader understanding of global patterns in blood donation willingness.⁹⁻¹¹ In comparison, a study conducted in Denmark reported that blood donors expressed belief that the utilization of their donated blood for medical research would significantly extend the potential benefits of their contributions. Donors in this study perceived that such research not only contributed to the immediate medical needs of patients but also played a crucial role in scientific knowledge advancements and improving public health outcomes. This perception highlights the broader societal value that individuals place on their blood donations, viewing them as a means of supporting long-term health initiatives and scientific advancements that benefit both individuals and communities.¹²

The survey in Northern California established that most of blood donors are likely to participate in genetic research while less than 10% of donors are less probable to donate blood if research was conducted in blood

banks.¹³ According to the findings from the Gaza Strip study, around 27% of participants indicated that part of the donated blood may be used for scientific research purposes. However, they emphasized that any such usage must strictly ensure the anonymity of the donor and no personally identifiable information should be provided in order to protect the privacy and confidentiality of the individuals involved.¹⁴ A significant portion of the Swedish population demonstrated a willingness to donate blood samples for medical or scientific purposes, provided that strict measures were in place to ensure the anonymity of the donors. This indicates the public's readiness in contribute to research is closely tied to the assurance that their personal identity would not, under any circumstances, be connected to the biological samples they provide.¹⁵

In Thailand, samples obtained from blood donors, as well as various blood components, have been utilized in a wide range of medical research initiatives. These research activities were carried out in collaboration with academic institutions, reflecting an ongoing partnership between the healthcare sector and the academic community. Such collaborations aim to advance scientific knowledge, improve clinical practices and support the development of innovative medical treatments, while adhering to ethical standards and protocols regarding donor consent and data confidentiality. Moreover, a significant portion of medical research extensively utilizes leftover blood samples, which are typically collected during routine clinical procedures and otherwise discarded. These residual specimens have become an invaluable resource for a wide range of scientific investigations, as they are readily available and offer a cost-effective alternative to the collection of new biological materials. The use of such samples in medical research facilitates advancements in disease prevention, diagnostic testing and the development of new therapies, while also minimizing the need for additional invasive procedures on living individuals. Conducting research using leftover

blood samples is generally considered as minimal risk to participants. This is primarily because such samples are typically de-identified, meaning no personal information is linked to the biological material, thereby protecting the privacy and confidentiality of individuals. Moreover, the use of residual specimens does not require additional procedures or interventions from the donor, further reducing potential harm or burden. However, it is essential that the use of these leftover samples is conducted in accordance with ethical guidelines and regulatory standards to ensure the privacy, confidentiality and rights are fully protected.

Informed consent constitutes a fundamental component of ethical guidelines and regulatory frameworks governing the participation of human subjects in research.¹⁶ The primary objective of informed consent is to ensure that prospective participants are provided with comprehensive and comprehensible information, enabling them to make an autonomous and informed decision regarding their participation in the study.¹⁷ Two studies conducted in the United States reported that approximately 90% of blood donors emphasized the importance of obtaining their explicit consent prior to the use of leftover donated blood samples for medical research purpose.¹⁸

In the context of medical research in Thailand, researchers may request the use of residual blood samples and blood products from donations for scientific and medical studies. Such requests must be submitted to National Blood Centre of the Thai Red Cross Society, which is the primary organization designated by the government to ensure a safe and high-quality blood supply for patients nationwide. At Thai Red Cross society, all blood donors are required to sign the informed consent in blood donation application form prior to the collection of blood, mentioning the collection, processing, utilization and disclosure of their personal data in relation to medical research and transfusion services. The use of donor blood for research must follow strict ethical and

legal standards, including mandatory informed consent and strong privacy protections, especially for genetic data. The Department of Bioethics at the Clinical Center of the U.S. National Institutes of Health (NIH) has proposed that the use of broad consent for research involving biospecimens is ethically acceptable when it incorporates three key components: (1) an initial consent that outlines the broad range of potential research uses, (2) an established process for oversight and approval of future research activities, and (3) where feasible, an ongoing mechanism for communicating with and providing updates to donors.¹⁹

Conclusion

In addition to being used for the treatment of patients who have suffered blood loss due to various medical conditions, donated blood may be utilized for research in biomedical sciences and related fields. The purpose of such research is to generate new scientific knowledge that can be applied to medical advancements, such as investigations into antimicrobial resistance or the genetic mutation of microorganisms. These studies are of significantly importance for future policy planning and the development of disease prevention strategies.

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