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Awareness And Usage Of Nanotechnology In Detecting And Examining Blood Types: A Cross-Sectional Study In Jeddah, Saudi Arabia

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Abstract

In the present times, blood type examination and detection is considered as one of the most important and crucial dimension; utilized in different clinical and medical settings. This may include therapy for cancer, obstetric emergencies, surgical procedures, trauma resuscitation, and blood disorders. Correctly identifying the patient's and donor's blood groups using the ABO and Rhesus (Rh) systems of blood groups and looking at the need of rapid results and precision level, nano-technology is considered as the most definite avenue. This study is follows cross-sectional study and will explore the knowledge and attitudes of healthcare professionals about this innovative technology and their perceived barriers and facilitators to the adoption of this technology in practice. The findings will inform policymakers and researchers about data that will support the translation of academic innovation to clinical practice in Jeddah, Saudi Arabia.

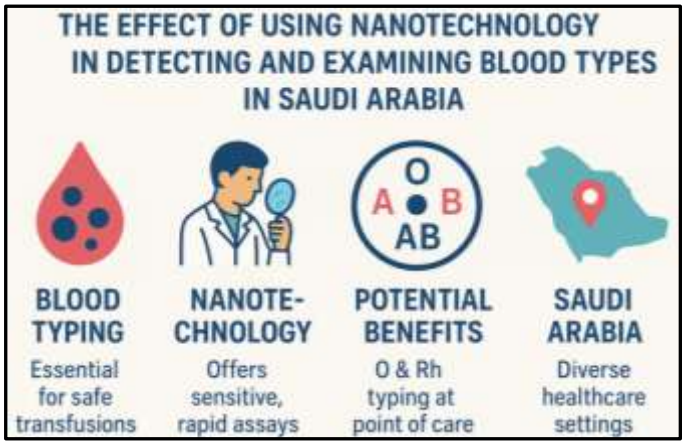
Keywords: Nanotechnology, Blood types, Detection, Examination.

Introduction

One of the most crucial components of modern medicine is blood transfusion, which is utilized in a variety of clinical settings, including cancer therapy, obstetric emergencies, surgical procedures, trauma resuscitation, and blood disorders. **[2], [3]** Correctly identifying the patient's and donor's blood groups using the ABO and Rhesus (Rh) systems of blood groups is the sole basis for the effectiveness and safety of transfusion medications. Even a little incompatibility can cause a potentially fatal acute hemolytic transfusion response. Therefore, appropriate and sufficient blood type continues to be a necessary precondition for organ transplantation, transfusion practice, and prenatal care.**[5], [7]** Manual tube agglutination, microplate assay, column agglutination techniques (gel card tests), or automatic hematology analyzers have all been used historically for blood type. **[9]** The above-mentioned procedures are already established, gained validity and are of generalized usage at the medical facilities related to transfusion. Although, there are certain limitations attached to the same, like heavy built-in infrastructure is required, a large number of samples are required to reach certain results, training and retaining professional incurs high costs and on the other hand the testing procedure takes too much of time. **[21]**

In the situations of critical emergencies and for the places where the terrain is tough, above given methods may result in the loss of human life and delayed decision making. It can also be stated that the

conventional method of testing and identifying the blood types are not advisable at rapid POCs (Point of Care) testing environments, as in such cases precise results are required. **[5], [19]**



Source: Based on data acquired from different studies

Figure 1: Benefits of Using Nanotechnology for Blood Types

Scenario of Blood examination in Jeddah

In Jeddah, the use of nanotechnology in routine blood typing is primarily limited to research and educational environments, rather than to carry out clinical service on a broad level. Major hospitals, such as the King Fahd Armed Forces Hospital, and King Abdulaziz Medical City continue to use traditional, established methods for blood group typing via serotyping and gel microtube. Established methods are indeed effective, and have been for many decades now, but can be labor-intensive and time-consuming in a high-throughput blood bank setting. However, there is considerable research in the field of nanomedicine in Jeddah. King Abdulaziz University has established centres in nanotechnology, while researchers at King Faisal Specialist Hospital & Research Centre carry out research in dedicated departments related to bioengineering and nanomedicine. Their research includes using nanotechnology approaches to undertake many diagnostic applications, including engineering rapid test kits and undertaking molecular diagnostics. Developing this area of research is an important first step in translating laboratory-based innovations to clinical testing technologies and techniques.

This research represents an important advancement in nanotechnology. Research is ongoing to develop biosensing devices using nanoscale material for blood typing that are faster, more sensitive and portable. For example, in the researchers' current example, they are testing whether nanoparticles can be engineered to selectively bind to blood antigens which would then develop a quick color change or fluorescent signal indicating a given blood type. This would improve point-of-care testing considerably and while blood typing has not yet been fully realized in emergency ambulance, remote clinics, or for situations that require immediate-response, this research does have the potential to be transformative and to make accurate blood typology possible in bloodstream anatomy in a short time frame. While this is not yet being used in operational environments of Jeddah hospitals, ongoing research in the City is putting local hospitals in position for future use or development of life-saving advancements.

This present study evaluates the scenario in the light of data collected from various medical facilities in Jeddah, that are engaged in examining blood types in general and for research purposes.

Objective of the Study

The main objective of the study is to find the usefulness and suitability of nanotechnology-based techniques for blood type analysis and awareness about the same in King Fahd Armed Forces Hospital of Jeddah, Saudi Arabia.

Research Process

Research Design

This present study is based on primary data hence it is liable to use cross sectional research design. This focus of the study will be on the application of Nano-technology in examining blood types in King Fahd Armed Forces Hospital of Jeddah city in Saudi Arabia. Then on the other hand the study will also focus on the various other diagnostic techniques related to determination of blood types, the emphasis will be on the implementation of Nano technology.

Study Area and Population

The main focus of this present study will be on the King Fahd Armed Forces Hospital of Jeddah, Saudi Arabia because in the present scenario this hospital is becoming the major healthcare hub with a number of multi-specialty departments and medical research avenue.

As far as the population of study is concerned, A representative sample of healthcare professionals who are directly involved in collecting, processing, and transfusing blood that includes lab technicians, hematologists, pathologists, and emergency doctors from King Fahd Armed Forces Hospital in Jeddah. A respective representative sample will be extracted from the above-mentioned population.

Sampling

Stratified Random sampling procedure was used to carry out this study.

Considering the limitation of time and resources the researcher has selected 150 respondents from the above-mentioned King Fahd Armed Forces Hospital.

Tool of Data Collection

Data was collected by using a detailed structured questionnaire, that will include the following parts:

- Demographic details

- Awareness about the advantages of using Nano-technology for examining blood types.

- Training and development status of the respondents for using Nano-technology for examining blood types.

The questionnaire included the scale-based questions, multiple choice questions, open ended questions, etc. This questionnaire was exercised in a face to face interaction with the respondents and will be sent by mail if required.

Statistical Analysis

In this present study the main focus is to identify the level of awareness and knowledge of the selected respondents for the use and application of nano-technology in examining blood type, this call for opinion and perception-based evaluation of the respondents regarding respective point in question. Hence Chi square test will be used for the same.

Diagrammatic Presentation of data

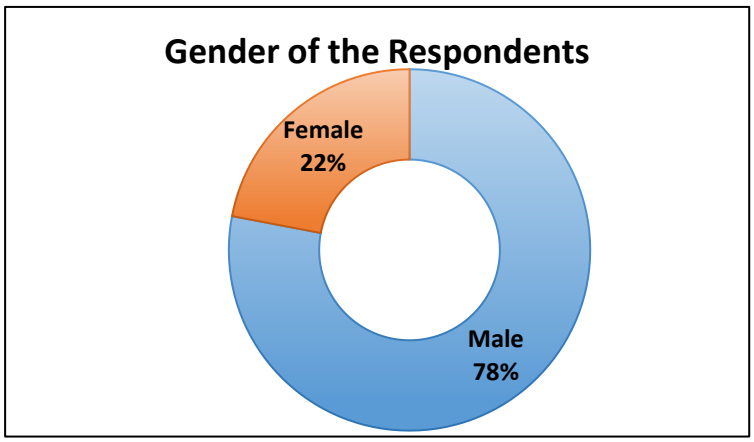


Figure 2: Gender of the Respondents

As stated in the above figure 2, most of the respondents were males (78%) and the number of female respondents was comparatively less, only 22%. As a matter of fact, the number of female healthcare professionals is gradually increasing in King Fahd Armed Forces Hospital.

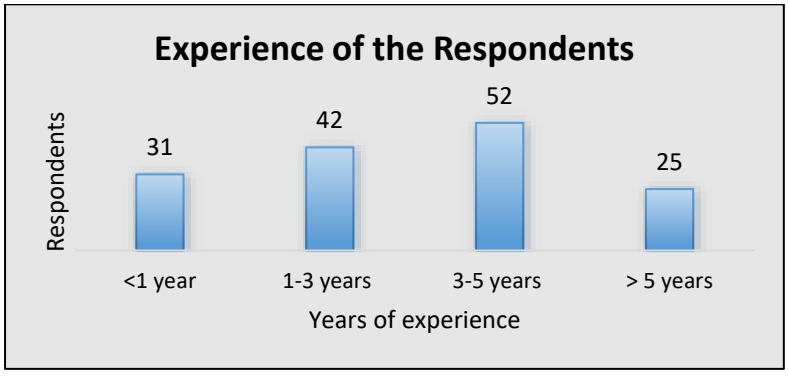


Figure 3: Experience of the Respondents

The above figure 3 shows the experience of the respondents in the selected medical facilities of Jeddah. Maximum 52 respondents were having the experience of 3-5 years, then 42 respondents were having the experience of 1 to 3 years and above 5 years, there are only 25 respondents. 31 respondents were having the experience of less than 1 year; hence they can be considered as freshers.

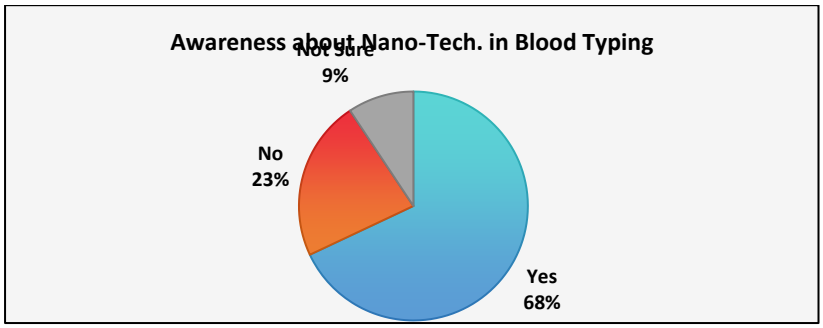


Figure 4: Awareness about Nano-Tech. in Blood Typing

Usage of nanotechnology in examining the blood types is a crucial job and the it was initially required to find the level of awareness about the same in the selected respondents. The above figure 4 shows the same. 68% of the respondents were aware about the application of nanotechnology in examining blood types, then 23% of the respondents were not aware about the same. 9% of the respondents were not sure about the point in question.

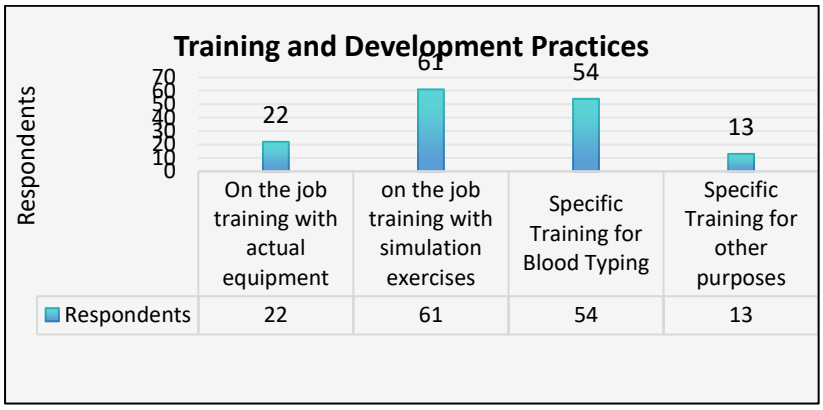


Figure 5: Awareness about Nano-Tech. in Blood Typing

As far as training for using nanotechnology in examining blood was concerned, 61 respondents stated that they were trained on the job with simulation equipment, 22 respondents received the training with actual equipment and this was also on the job. Then 54 respondents stated that they received the training

specific for blood typing and 13 respondents stated that they received the same kind of training for other specific purposes. Hence it can be stated that, in one way or the other, medical professionals were getting trained and getting acquainted to usage and application of nano-technology in their routine medical practices, rather it will take some time to achieve a respectable margin, as far as King Fahd Armed Forces Hospital of Jeddah is concerned.

Result of Chi Square Test

	Table 1: Summary of Chi Square test					
	Awareness regarding Nanotechnology in Examining Blood Types					
	On the Basis of Gender			**On the Basis of Experience**		
	Nanotech. is better than standard practices	The Level of accuracy is higher	Time and effort is minimized by the use of Nanotech.	Nanotech. is better than standard practices	The Level of accuracy is higher	Time and effort is minimized by the use of Nanotech.
Calculated Value	**.159**	**.243**	**.159**	**.445**	**.435**	**.053**
Table Value	**3.67**	**2.827**	**3.67**	**1.621**	**1.664**	**5.878**
	Training and Development Practices					
	On the Basis of Gender			**On the Basis of Experience**		
	Training with actual equipment	Training with simulation	Specific training for blood typing	Training with actual equipment	Training with simulation	Specific training for blood typing
Calculated Value	**.835**	**1.375**	**.040**	**.943**	**.631**	**.703**
Table Value	**.705**	**.962**	**.436**	**.860**	**.145**	**5.504**
	Barriers of Adoption					
	On the Basis of Gender			**On the Basis of Experience**		
	High cost of equipment	Regulatory barriers	Reliability concerns	High cost of equipment	Regulatory barriers	Reliability concerns
Calculated Value	**.939**	**.560**	**.687**	**.897**	**.635**	**.070**
Table Value	**.917**	**.781**	**1.641**	**1.528**	**2.113**	**4.488**

Interpretation

The purpose of applying Chi square test was to identify the variation in the responses of sample units i.e. healthcare professionals engaged in examining blood types in King Fahd Armed Forces Hospital of Jeddah. Two major demographic components were considered for testing the variables:

1. Gender of the selected healthcare professionals (Male or Female)

2. Experience of the healthcare professionals (from less than 1 year to more than 5 years)

Then on the other hand prominent variables were taken into account were:

1. Awareness regarding Nanotechnology in Examining Blood Types

2. Training and Development Practices

3. Barriers of Adoption

The above variables were expanded further to three more cues, so that true responses of the nurses should be taken.

Decision rule of Chi Square test states that if all the table values are more than the calculated values then it can be stated as one of the ideal or favorable condition.

As far as awareness of the respondents about usage of nanotechnology in examining blood types is concerned, most of respondents were found aware about the use of point in question. For most of the cases the table values are higher than the calculated values, this shows that the level of awareness of respondents about nanotechnology was satisfactory.

Then at the second level, responses of the selected healthcare professionals regarding training and development for using nanotechnology in examining blood types were collected. It was found in the process that on the basis of gender and experience both, the respondents were not positive about the training with actual equipment and simulation equipment. Then on the other hand the respondents were positive about the training of blood typing for specific purpose, like detection of cancer and other critical ailments.

Then there were three components related to cost of equipment and installation, regulatory barriers and also the reliability concerns. It was found in the process that most of the respondents were agreed to the point in question and stated that the infrastructure development of medical facilities in Saudi Arabia, including King Fahd Armed Forces Hospital of Jeddah is in development stage and it will take appropriate time to reach a sustainable stage where nanotechnology can be used as routine practise for examination of blood types.

Conclusion

The cross-sectional study proposed concerning the role of nanotechnology for blood typing in King Fahd Armed Forces Hospital, Jeddah is likely to indicate that, even though research has demonstrated the potential of this technology, it has not been incorporated into most health care contexts in Jeddah. The study will likely show there is a considerable knowledge gap among many health care providers about the utilization of this technology for blood typing. Overall, the study will show that the health care providers investigated in Jeddah had an overall positive attitude toward any new technology purporting to offer better speed and accuracy but that even when attitudes are positive, barriers to implementation are steep. These barriers can be divided into the introduction costs of new equipment, no formal standards that govern the use of nanodiagnostic types of tools to perform the tests, and the need for specific training for laboratory medical technologists and technicians. Overall, the data collected in the study would help link the academic research community and clinical practice in King Fahd Armed Forces Hospital of Jeddah. The importance of providing educational sessions and developing a policy for a course of action to bridge the gap would be emphasized. The research highlights the challenges raised by practicing health care providers in King Fahd Armed Forces Hospital of Jeddah, and produces a roadmap to guide a strategic plan to implement these new diagnostic methods using a staged approach to blood typing to provide quicker and more accurate results for hospital and clinical practice in the region.

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