Place and date of publication:  
Islamabad, September 2016

This publication has been developed and produced with the technical support of the German Federal Government through the Health Sector Support Programme implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in cooperation with GFA Consulting Group.
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Acronyms

AABB  American Association of Blood Banks
CAP  College of American Pathologists
CCP  Critical Control Point
ELISA  Enzyme Linked Immuno-Sorbent Assay
GMP  Good Manufacturing Practices
HBB  Hospital Blood Bank
ISO 9001  International Standard Organization - Standard No 9001
LCE  List of Critical Equipment - deserving special attention
NAT  Nucleic Acid Testing
NRLA  National Reference Laboratory - Australia
PDCA  Plan Do Check Act - cycles for improvement
QCO  Quality Committee
QMS  Quality Management System
RBC  Regional Blood Centre
RPM  Revolutions Per Minute - parameter related to centrifugation
SBTP  Safe Blood Transfusion Programme - Pakistan
SOP  Standard Operating Procedure
SOP/TP  SOP / Testing Procedure
SOP/WP  SOP / Working Procedure
TTI  Transfusion Transmitted Infection
WHO  World Health Organisation
From a manufacturing point of view, the definition of quality is ‘conformance to requirements’. As blood and its products are used for therapeutic purposes, therefore, they must, as a minimum, be produced in accordance with the pharmaceutical manufacturing standards. To ensure quality in blood transfusion, the ‘conformance to requirements’ also necessitates that the donor is selected appropriately (as per standard donor selection criteria), to ensure the blood is safe for the transfusion to the recipient (free from TTIs, traceable with appropriate identity to prevent mismatch transfusion reactions, etc.), and blood and blood products are prescribed rationally. Hence, all the steps of the vein to vein blood transfusion chain have to be of the highest quality to ensure ‘conformance to requirements’. Therefore, the ultimate purpose of quality in blood transfusion is timely delivery of safe, quality assured blood and blood products to the recipient with the right clinical indication for transfusion.

Both the International Organization for Standardization (ISO) and Good Manufacturing Practices (GMP) are examples of rules of standardization. The aim of standardization is to achieve a highest level of consistency and reliability in the products. The National Blood Policy and Strategic Framework 2014-20, however requires the quality management system to be a hybrid of ISO 9001/2000 standards and GMP principles. This ‘Quality Manual’ developed by the technical assistance from the ‘GIZ Technical Cooperation Team’ serves as a guiding tool to implement the quality system and to assist with daily blood bank and blood centre laboratory practices. The key elements of quality systems for Blood Transfusion Services have been covered in the manual under three chapters (1) Organization and Flow of Operations, (2) Process Control and (3) Dynamics for Improvement. All policies, processes and procedures included are in line with the principles of good practice. The Manual is based on revised legislation on blood safety and the operational documents issued so far by the Safe Blood Transfusion Programme, which in turn relies on WHO Quality System for Blood Transfusion, the Guide for the preparation, use and quality assurance of blood components of the Council of Europe, and other documents nowadays considered worldwide as standard reference in the blood transfusion field.

The programme appreciates technical input, expertise and guidance received from Dr. José Manuel Cárdenas Díaz de Espada, President of the Spanish Society of Blood Transfusion and Cellular Therapy, who has guided the GIZ team and developed the first brief version of the document during his visit to Pakistan.

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Safe Blood Transfusion Programme  
Government of Pakistan
INTRODUCTION

Quality Manual Model

More than a hundred million units of blood are collected and transfused every year around the World, reflecting how effective and secure blood transfusion is perceived to be both by blood donors and patients. Blood transfusion is a particular case of tissue graft with no need of an operating theatre for collection and grafting. As a matter of fact, blood is comparatively easier to collect, easier to process and easier to be administered to patients. In addition, this simplicity allows giving crucial quick assistance to the patient in emergency situations.

When blood is drawn into a bag, a live tissue is being collected intended to be "grafted" into another body. The disinfection of the donor arm for venepuncture is surgical-like, only one single phlebotomy is allowed, the container hermetic and aseptically sealed. It follows a completely different approach to an apparently similar technique such as to drawing blood in a tube for testing.

If a tissue graft is rejected, there is a second chance eliminating the grafted tissue and trying again with a new one. This is not the case with transfused blood, which is immediately distributed within the body. An incompatible blood generates highly toxic antigen – antibody complexes which damage essential organs, mainly the kidney, inducing an acute renal failure, and triggers the intravascular coagulation of the circulating blood with dramatic consequences for the patient.

Blood transfusion is an excellent therapeutic resource for patients only if stringent but simple provisions are 100% followed thoroughly in order to ensure transfusion efficacy and safety, and so to protect the donor and the patient against the possible dangers that could be involved in the case that one or several rules are missed during the procedure.

In the blood bank setting quality and safety may be considered to be synonyms. This Quality Manual is intended to make available to you what you should know in terms of quality, i.e. safety, being you a professional who at some point deals with blood collection or blood transfusion.

A quality system is a documented system. Written procedures and records, checked at planned intervals with proper auditing, provide evidence that quality requirements have been met and the blood is safe. This is why documentation is so important, it is a health care question, it is not an administrative question.

Every blood bank employee is in direct contact with one portion of real blood bank life, in some instances the only one. You stand in an excellent position for checking if tasks are properly handled. Do not take everything for granted. Check systematically that all is correct, and make suggestions to your supervisor if you see that something should be sorted out or at least improved, and how it could be done. Enjoy your professional life.

How to use this Model of a Quality Manual

Every agency involved in blood collection or transfusion must work under a quality management system (QMS) in order to guarantee the safety of blood donors and blood recipients. A quality manual describes in detail how the QMS is working in each particular agency. There are not two identical agencies and there are not two identical quality manuals. In these circumstances this proposal of quality manual model is intended to help
you to write down the Quality Manual that you must have in place. Before going through, a few informative ideas regarding how it is conceived and how it is structured.

The model is based on Pakistan legislation and the operational documents issued so far by the Safe Blood Transfusion Programme, which in turn relies on WHO Quality System for Blood Transfusion, the Guide for the preparation, use and quality assurance of blood components of the Council of Europe, and other documents nowadays considered worldwide as standard reference in the blood transfusion field.

The ISO 9001:2015 standard brought out in September 2015 has been the main guide followed in the quality manual model. For the correct understanding of ISO 9001:2015 certain training in quality issues is necessary. Because of this, a different approach has been followed in the model, friendlier for the blood bank staff. For example, the introductory text is related to key issues of ISO 9001 in the chapters 4. Context, 5. Leadership and 7. Support. The section Improvement dynamics is almost all based on chapters 6. Planning, 9. Evaluation and 10. Improvement, not to speak of the proposal of the PDCA cycle as methodology for improvement, formally recommended by the ISO 9001:2015. The section Process Control bears almost all the good manufacturing practice (GMP) clues with a few added details referred form ISO 9001.

It is recommended to follow this model for your own quality manual, although it is not the only one available. If you plan to get the blood bank certified under the rules of AABB standards, CAP standards, ISO 9001 or other certification bodies, probably you will prefer to follow their model.

The model is divided in three parts:

**Organization and operations flow.** Largely descriptive, this section includes an outline of the operational processes. It also deals with commitments engaged by the blood bank.

**Process control.** Section describing the support processes that ensure consistent results which comply with the quality requirements.

**Dynamics for improvement.** This is the necessary complement of a rigid process control, allowing changes for the better. The core idea is to maintain and improve the safety of donors and patients by means of a permanent observation and evaluation of results followed by the identification of spaces for improvement.

The SOP numbers described in the Model are the numbers given to the SOPs collected in the Procedures Manual of the Pakistan Safe Blood Transfusion Programme, SBTP. At the time of writing down your quality manual, you can use freely all the available documents, even - if necessary – copy paste them with necessary adaptations to your own situation. You can use the proposed texts for the quality manual coupled with the Operational Documents offered by the Pakistan SBTP. This is exactly what they were written for.
1

ORGANIZATION AND FLOW OF OPERATIONS
1. **SECTION ONE – ORGANIZATION AND FLOW OF OPERATIONS**

Name of the blood bank

Position within the institution (Pathologist/Haematologist)

Responsible Person

BTA Licence

1.1 **Reference Texts**

The Blood Service XX is engaged in the implementation of a quality system according to the requirements of

- Law YYY of the Province of ZZZ
- Blood transfusion standards issued by the Pakistan SBTP
  - Operational Document – 4 – Functional brief for HBB (OD-4 HBB)
  - Operational Document – 5 – Standard and guidelines for blood banks and transfusion services (OD-5 Standards)
  - Operational Document – 6 – SOP for blood bank processes in Pakistan (OD-6 SOP)
  - Operational Document – 8 – National Blood Donor Policy (OD-8 Donors)
  - Operational Document – 11 – Functional Brief for RBC (OD-11 RBC)
- …

(Reference texts)

1.2 **General Description**

The Blood Service XX is a unit of the Hospital HHH, and supplies blood components, mainly whole blood, red cells and frozen plasma, and occasionally platelet concentrates. There is a club of voluntary blood donors providing about one third of the blood collected; the other two thirds needed come from replacement donors. 1,500 blood units are collected and processed annually. The Blood Service is linked to the General Laboratory of the Hospital with which there is a highly interactive relationship.

(General description of the blood bank)

1.3 **Needs and Expectations of Clinical Services and Blood Donors**

The hospital clinical and surgical services rely on the Blood Transfusion Service for their patients. There is an effective communication with them and both have accorded the format of blood orders, rules for the tubes for compatibility testing, the delay times for transfusion depending of the degree of urgency, and the procedure for the administration of blood to patients. There is a quarterly meeting of the Hospital Transfusion Committee in which we discuss the incidents that occurred in the previous period, new transfusion needs foreseen for the near future, and the results of quality indicators. The other big user of the Blood Service is the donor. Besides their spontaneous comments that we document if worth to do, we check their opinions through a specific questionnaire at planned intervals.
(needs and expectations of users: clinical services and blood donors)

1.4 Products and Services Provided by the Blood Service

1. Blood components
   - Whole Blood collected in CPD
   - Red cell concentrate suspended in plasma
   - Washed red cells
   - Leucocyte-reduced red cells
   - Autologous whole blood
   - Fresh Frozen Plasma
   - Cryoprecipitate
   - Platelet concentrate, whole blood derived
     (The specifications of each component are described in OD-5 Section 7.)

2. Compatibility testing: patient typing, antibody screening, crossmatch

3. Study protocol of adverse reactions to transfusion
   (Blood components and services to be provided, and their quality requirements)

1.5 Quality Policy

Quality for us is a synonym of safety for patients and donors. It is considered as the most appreciated goal in our Blood Service and applied to all services provided: collection, processing, testing, storage and distribution of blood components, and compatibility testing. Our quality management system ensures this assertion by supplying safe and efficacious blood components issued in a timely manner for the patients, and taking care of the good health of blood donors providing a pleasant experience for being a donor of blood. The service given will comply with all relevant legislation and also the provisions given by the Safe Blood Transfusion Programme. Our definition of quality is ‘conformance with requirements’. We shall specify the requirements for our suppliers and shall comply with the requirements of the clinical services and blood donors. How we comply with these specifications will be followed up. Every staff member is aware of his responsibilities and duty regarding quality maintenance at all levels. We shall improve our quality by means of plan – do – check – act cycles. This policy is communicated to all members

(Quality policy and its communication)

1.6 Operational Processes Taking Place at the Blood Service

Processes in the Blood Service take place in a sequential manner. (It is useful to draw at this point a process map in which the interrelations among processes in the Blood Service in your particular situation can be clearly exposed; see process map models in OD-4 section One and in OD-11 section Three and an example at the end of 1.6 of the Quality Manual.) The standard operating procedures involved in each process are described in the Procedural Manual (see OD-6 SOP). Support and strategic processes are described in the Quality Manual sections of Process control and Dynamics for improvement. What follows is an outline of the core operational processes that take place in the Blood Service. Critical points have been marked as (CCP); they deserve a specific attention.
a. Blood Donor Recruitment

The main aim is to recruit donors, not just to collect blood. In connection with a blood donor association set up at the University, regular blood donors receive an appointment to come to donate in a timely manner. Posters and brochures are also distributed by the association inviting new blood donors to come in and try. In addition, relatives and friends of patients in need of transfusion are invited to replace the blood received.

Documents: OD-3

b. Donor Selection

Prospective donors receive written and pictorial information regarding blood donation and transfusion with particular emphasis on reasons for self-exclusion (CCP). Donor selection is carried out by a specifically trained staff using a questionnaire. Criteria for donor selection (CCP) are at hand for consulting and in particular cases the interviewer can rely on the medical officer in charge for consultation. A donor chart with all the personal data, the way of contact, the results of the interview, and the informed consent is signed by both the donor and the interviewer (CCP). A test of Haemoglobin (CCP) and a check of Blood Pressure complete the selection process.

Documents
- SOP/WP/01
- SOP/WP/02ab
- SOP/WP/03
- SOP/WP/04
- SOP/WP/05

c. Blood Collection

Suitable donors enter the collection room. Their identity is confirmed (CCP). A unique number is assigned to the unit to be drawn. Once in position, the phlebotomist prepares the phlebotomy field following a precise technique (CCP). There is one single puncture (CCP). If it fails and the donor agrees, the blood is discarded and the puncture may be tried in the other arm with a new bag. During the collection the blood is mixed (CCP) with the preservative solution using a balance / mixer, or alternatively by hand mixing every 30 seconds. Pilot tubes for testing are filled at the beginning or at the end of the collection depending if there is a diversion bag or not (CCP). The donation chart, the primary and satellite bags, and the pilot tubes, all have to bear the same and unique number (CCP). The sealed bag is maintained in controlled temperature up to the time of storage or fractionation. After the collection the donor is given advice and is observed for 10 - 15 minutes (CCP). Refreshments are offered. Apheresis donation follows additional particular rules.

Documents
- SOP/WP/06
- SOP/WP/07
- SOP/WP/08
- SOP/WP/09
- SOP/WP/10
- SOP/WP/11
d. Blood Component Processing

After the collection all the units of blood and blood components are maintained in quarantine (CCP) apart from the released units. The fractionation of the blood follows one first step of centrifugation. The parameters of centrifuge speed, time and temperature have been validated (CCP) in advance in order to ensure the content of each blood component. Some components require two or more serial centrifugations. The second step is the transfer of the separated component to a satellite bag. All the transfers have to be carried out in a close system if the shelf life is the standard for the component (CCP). In an open system the shelf life is reduced to six hours at room temperature or to 24h if maintained at 4º (CCP). Before splitting the satellite bags from the primary bag a check of the identification number of the unit is performed (CCP). Each blood component is stored at their adequate temperature. On demand, leucocyte reduction of red cells may be carried out by means of a leucocyte removal filter. Unfractionated blood is stored at 2º to 6º as whole blood unit. At planned intervals a random sampling of at least 1% of each blood component is checked for specific parameters and its consistency verified by statistical process control (CCP).

Documents

- SOP/WP/12
- SOP/WP/13
- SOP/WP/27
- SOP/WP/28
- SOP/WP/29
- SOP/WP/30
- SOP/WP/49

e. Blood Testing

Pilot tubes drawn at the time of collection and bearing the same unit number are used for the test processing. ABO/Rh D typing is carried out at least twice (CCP), one with the tube sample direct and indirect (CCP), and one with a sample form the bag. If the blood was not given by a first time donor, then the previous donor chart should be checked to confirm the identical result. An antibody screening against red cells antigens is carried out in first time donors, to donors that have been transfused since their last donation, and women who have been pregnant. Infectious disease markers for HBV, HCV, HIV, and syphilis are carried out in each sample (CCP). In case of a reactive result the same sample is repeated twice; if any of the repeated samples test reactive the unit is definitively discarded. A Malaria test is also carried out. Serological screening effectiveness is confirmed through an external proficiency testing control (CCP) carried out at planned intervals.

Documents

- SOP/TP/21a-23a
- SOP/TP/21b-23b
- SOP/TP/22
- SOP/TP/24
- SOP/WP/14
- SOP/WP/15ab
f. Release
An authorized person (CCP) checks the results of each unit, both the component processing and testing. Test results include both, a twice valid ABO RhD result, and negative results for all mandatory microbiologic screening tests (CCP). Those components that do not comply fully with the quality requirements are segregated and managed as non-conforming products (CCP). Those complying 100% (CCP) are released from quarantine. They must be appropriately labelled with all the relevant information (CCP). The coded unit number on the label bag must be confirmed by double check with the unit number in the original label of the bag (CCP). The blood component is taken onto inventory for use. If the release follows a batch process, all the non-conforming blood components of the batch must be identified and segregated before starting the release process (CCP)

Documents
- SOP/WP/30


g. Storage and Transportation
The blood components must be stored in controlled conditions (CCP) suitable for each component, either a refrigerator, a freezer, a shaker, or an incubator. The transportation is also subject to control (CCP). The conditions for storage and transportation are described in OD-5 Standards, item 6.G.2 for blood components processed in a closed system and in item 6.S.5.1.1 in case they have been processed in an open system. All the equipment for storage is tightly calibrated and maintained (CCP) See Process Control.

Documents
- SOP/WP/31
- SOP/WP/32
- SOP/WP/33
- SOP/WP/34
- SOP/WP/35

h. Compatibility Testing and issuance of Blood
Entering blood orders are reviewed to check that all the items have been fulfilled and the patient samples well identified (CCP). The person who drew the samples must be identified (CCP) and all data must be concordant (CCP). If anything is lacking, it must be sorted out before going through. A check of previous records of the patient (CCP) is necessary to confirm the blood type and to check if there is any relevant information regarding the transfusion, for example the presence of irregular antibodies. An ABO/RhD typing of the patient, direct and reverse, is necessary (CCP). If red cells have been ordered, red cell concentrate or whole blood, a crossmatch between patient’s serum and red cells of the unit has to be carried out. The test includes at least immediate saline spin and coombs test after proper incubation (CCP). An antibody screening test is also advisable. If testing positive,
the antibody must be identified and only blood lacking the corresponding antigen should be selected for cross-matching. The cross-matched units are properly labelled (CCP) with the results and patient identification. In the case of plasma or platelets orders, a compatibility table should be followed but no crossmatch is necessary. If not immediately issued to the patient’s ward, the components have to be stored in controlled conditions. The porter of the blood component issued has to follow precise conditions during transportation to the patient’s ward (CCP).

Documents

- SOP/WP44
- SOP/TP/45ab
- SOP/TP/46ab
- SOP/TP47ab
EXAMPLE OF FLOWCHART OF A REGIONAL BLOOD BANK
Processes are presented in a sequential format with their interactive links

(OD-11 section 3)
1.7 Staff Responsibilities and Organization Chart - Organigram

The responsibilities and duties of each member of the Blood Service’s staff have to be clearly set. You can either describe each post in this part of the quality manual, or you can make reference to a Job Description Manual. Examples of posts to be described:

**Administration**

**Donor Management**
- Medical officer
- Nurse
- Donor recruiter
- Phlebotomist
- Driver – assistant (mobile units)

**Component processing and distribution**
- Medical officer
- Medical technologist
- Laboratory technician
- Laboratory attendant

**Laboratory**

In any case, your quality manual must provide an organogram that will summarize the interrelated positions and responsibilities (cf. the example below).

You can find tables regarding the needs of personnel in OD – 11 RBC Annex One and in OD – 4 HBB Section 5 (cf. enclosed example).
PROCESS CONTROL
2. PROCESS CONTROL

Donor recruitment and selection, blood collection, blood processing and storage, compatibility testing, blood administration, post-transfusion care, and haemovigilance, all these processes have to be carried out following stringent rules.

Blood component and transfusion services are provided by means of validated written procedures carried out by competent personnel, working in adequate premises, using verified materials and reagents with controlled equipment. Every element mentioned has to comply with the rules, and documentation has to provide evidence for this to be true. This approach is called Process Control and it is the only way to ensure the safety of the blood donor and the patient. Just to point out the list:

1. Validation
2. Written procedures
3. Competent personnel
4. Adequate premises (and environment)
5. Verified materials and reagents
6. Controlled equipment
7. Records (documentation providing evidence)

Linked with the above there are five additional supporting processes:

8. Purchasing (linked to materials and equipment)
9. Identification and traceability (linked to records)
10. Control of non-conforming products (what went wrong)
11. Control of the subcontracted services (external services have to meet requirements)
12. Control of the finished product (verify a consistent output)

2.1 Validation

Process validation is defined as “the collection and evaluation of data, from the process design stage throughout production, which establishes scientific evidence that a process is capable of consistently delivering quality products”. In other words: to validate a procedure is to ensure with assays that following the procedure the result will meet the required quality.

Every procedure in the blood bank has to be validated. Most of the times it is an easy task, but in others it may require intensive assays. This may happen with complex procedures such as ELISA testing for infectious disease screening, or with critical points such as blood donation recording. New component production, for example washed red cells, require to be validated before making them available

Prospective validation of critical processes should include:

- A short description of the process
- Critical process steps to be investigated
- Equipment to be used, maintenance and calibration needed
- Finished product specification for release
- Technique for testing
- Sampling plan
- Methods for recording and evaluating the results of the tested samples
- Functions and responsibilities
The validation output is a **validated procedure** that should be followed by setting down the remaining elements of process control: equipment, materials, reagents, records, and training the personnel involved. The validation process + the plan to put in place is usually called the *Quality Plan*

In special circumstances (for example in emergency situations) a *concurrent validation* is possible, in whose case the validation is parallel to the real production.

For validating a long standing procedure, it is possible to follow a *retrospective validation* based on historical data. Retrospective validation cannot be applied to new procedures or to procedures in which changes have been introduced.

**Documents**
- Validation results
- Quality Plan

### 2.2 Written Procedures

The control of written procedures is also named *control of documentation*. Procedures are key within the quality system in several aspects: they give provisions about how to perform a task, they are useful for training purposes, they give information to retrospective investigators regarding the method in use during a certain period of time, and they are also informative for third parties if requested. It is important to remember this because it is possible that changes are being communicated to the personnel and implemented, and they also must have the procedure amended for the record.

In the Blood Service procedures, several formats are possible: written, presented as a flow chart, presented as a picture or pictures. They can be available as printouts or in electronic format. The operator must have at hand the procedure in force. Special care should be taken to withdraw obsolete versions of the same procedure.

A procedure must have as a minimum the following items: Title, author, supervisor reviewer, date of entry into force. It is highly desirable to add a serial code number, number of version, and in case of substitution the data of the superseded procedure.

All the obsolete documents have to be withdrawn and destroyed, except one copy that will be archived for the records.

### 2.3 Competent Personnel

The required competence for each post is dependent on the job characteristics. The qualification of the post for one person relies on:

- **Academic level required**: medical degree, speciality, registered nurse, lab technician, computer specialist…
- **Skills required**: foreign language knowledge, familiar with Microsoft Office, personal communication skills
- **Training**:
  - **Common**: General knowledge of Blood Transfusion, Blood Service organization, quality system, quality policy, biosafety rules
  - **Specific**: for the post to be assigned
Supervised practice for a period of time followed by an evaluation to see if that person is suitable for the post

Competency is reviewed every year

Education activity is given for knowledge update at planned intervals along the year. Additional training should be given as necessary following the introduction of new procedures, or if gaps in education are observed

All the training must be recorded. Each employee must have an updated personal file

2.4 Adequate Premises

Premises should comply with standard conditions related to a clinical laboratory and space for public access. In ordinary circumstances, the conditions of three spaces are considered critical:

- Donor interview has to take place in a confidential setting
- The processing room for blood components must not exceed of 24°C and not below 18°C. If platelets are not going to be generated, the room temperature could be lower than 18°C
- Tubes, blood bags, other devices and some reagents that can be stored at “room temperature” in fact may have temperature limits for storage. This should be taken into account at the time of controlling the temperature of the warehouse OD – 4 HBB section

Three and OD – 11 RBC provide information related to conditions such as accessibility, ventilation, lighting, fire prevention, biosafety, room for disposal etc.

2.5 Verified Materials and Reagents

All the materials, blood bags, devices and reagents entering in the Blood Service must be put in quarantine and segregated from the other goods until an authorized person verifies their suitability and releases the received products. Some critical materials and reagents may require specific laboratory testing to check their compliance with quality requirements before they use in routine. Until then they must be hold in a quarantine section.

Documentation needed:

- Table with the materials expected to enter, and checks to be carried out in each case
- Records of the verification: date, material, quantity, batch number, verification result and supervisor

Consult as needed the document, OD-5 Standards:

- 5.S.6 control of purchased material for collection
- 7.S.3.1 control of typing reagents
- 7.S.5.2 control of reagents for serological testing

2.6 Controlled Equipment

Start making a list of the equipment which directly affects the quality requirements such as:

- Refrigerators, freezers, platelet shakers, incubators, directly affect the viability of blood components and testing reagents stored
- The balance/mixer or the weighing scale: control the amount of drawn blood during blood collection, something that has to be maintained within established limits
The refrigerated centrifuge performance affects the necessary quantity of haemoglobin or platelets per bag, another essential quality requirements

The equipment related to TTI screening tests affects to the quality of the results

Cell washers for coombs test not performing well, may give false negative results in the crossmatch and put in danger the safety of the patient who is going to receive the transfusion

Others…

This List of Critical Equipment (LCE) is extremely important and must be kept updated in case of any change or addition.

All the equipment considered critical has to be controlled in order to ensure their quality requirements and performance. The control involves three parts: 1) on installation, 2) maintenance, and 3) after repairs.

On installation

- Verify that the place, electricity, water supply and drain, all fit the supplier’s recommendations
- Validate the performance once put in place. Temperature, if critical, has to be checked with a reference thermometer (do not rely only on the supplier's documentation!). In other instances, the validation may be carried out by an end-point confirmation technique, for example in the case of centrifuges or equipment for TTI screening
- Refrigerators and freezers must work under a continuous record of temperature, with an alternative power supply, and with a back-up cold chain equipment (OD-6 6-S-5.5). If gaps in the recording are suspected, then checking the temperature every four hours and writing the result in a table, is a second-line alternative

Maintenance

- Depending on supplier’s recommendations, maintenance and calibration, internal or external, must be implemented in a planned manner

After repairs

- After repairs, relocation or adjustments that may alter the functioning, a performance check has to be carried out before release for enter in routine

Documents

1. List of critical equipment.
2. All the operations related to critical equipment as regards to installation, maintenance and repair have to be documented: date, check, result, operator. It is useful to open an individual chart for every piece of critical equipment at the entry of each new one, and keep it updated.

Suggested table for equipment control

- Blood bag refrigerator, cold room, freezer
  - Continuous temperature recording plus independent audible and visual alarm for appropriate high and low temperature parameters: daily
• Laboratory refrigerator, laboratory freezer, incubators, water baths
  o Thermometer daily
  o Precision thermometer every year

• Blood bag centrifuge
  o Precision RPM meter plus stop watch to control speed, acceleration and retardation, at least once a year
  o Temperature daily

• Table centrifuge
  o RPM meter plus stop watch to control speed
  o acceleration and retardation, occasionally

• Anti-globulin test automatic washer
  o Anti-Rh D sensitised cells every run

• Haemoglobin photometer
  o Calibration: standard Hb quality control sample daily

• Cell counters
  o Calibration: reference sample daily
  o Drift: working standard

• Automatic pipettes Dye-or isotope-labelled protein at least once a year

• Balance
  o Analytical-control Weights 5 mg – 100 g every 6 months or after each location change
  o Preparative control weights 100 mg – 100 g

• pH meter Control solutions pH 4-7, 7-10 each time of use

• Platelet agitator
  o Thermometer daily
  o Frequency of agitation monthly

• Laminar flow hood and sterile area filters
  o Air pressure meter daily
  o Particle counter tri-monthly
  o Bacteriological plates monthly

• Blood mixer (swing) Control weighing and mixing bi-monthly

• Spring balance for bags Control weighing monthly

• Sterile connecting device
  o Test and visual examination Standardised tensile strength or pressure test every 6 months

• Blood transport container
In the absence of a validated transport system, minimum/maximum thermometer or a
temperature recording device: every time of use (on receipt)

Source: Guide to the preparation, use and quality assurance of blood components 16th ed.
Council of Europe

2.7 Records

Records provide evidence of the facts and results related to compliance with standards. Records must have its integrity preserved, protected against modification, destruction, or unauthorized access. They must be written on paper or in an electronic database. Records have to be maintained for different periods of time depending on their nature:

- Records related to blood donor identity and donations, to patient identity and transfusions received allowing full traceability of every blood component from donor to patient must be maintained for at least 30 years
- Records related to donor health history and selection, blood components produced, units not used, and screening results must be maintained for at least fifteen years
- Other records such as training, control of temperature, equipment maintenance, etc. must be kept for at least three years

2.8 Procurement

Suppliers have to document their performance in quality terms, solvent and reliable. Their historical relationships with the Blood Service should be acceptable. A list of accepted suppliers must be kept updated. Critical reagents, materials and equipment can only be purchased to accepted suppliers.

Documents:

List of accepted suppliers

Particular provisions for purchasing materials for collection can be found in OD-6 section 5-S-1.1.3 and for test reagents in OD-6 Section 7-S-2.2.1

2.9 Identification and Traceability

Blood donors, patients, donations, samples, and components are uniquely identified when entering into the Blood Service

Donors receive an individual donor number and each donation they give receives a unique code number. This system allows tracking and linkage of all the information regarding donor’s history, donations, tests results, blood components, storage, and further issue to patients for transfusion. Patients are also identified with a unique personal code number.

It is essential to have in place systems ensuring traceability. Extensive records are made of the identity of consumables used. The lot of the collection bag must be recorded in the donation chart. The code system applied to donors and patients facilitates the traceability vein-to-vein

2.10 Control of Non-Conforming Products

Blood and blood components which do not comply with all the quality requirements must be 1) identified as non-conforming, 2) segregated, and 3) recorded in a list of non-conforming
products until they situation is cleared. A non-conforming product may follow one of these possibilities:

1. It may be processed again and comply this time with the required result (for example a screening reactive result which thereafter is non-reactive in duplicated repeated tests)
2. It may be requalified (for example a plasma not frozen on time cannot be qualified as Fresh Frozen Plasma but may be requalified as Normal Plasma)
3. It may be used under concession (for example a pack of red cells with low volume, can be accepted by the physician in the ward if it is the only unit compatible with the patient)
4. Or it may be discarded (for example a unit testing HBs Ag repeatedly reactive)

2.11 Control of Subcontracted Services

Certain services such as irradiation of components, leucorreduction, NAT testing, may be contracted to external services or institutions. The subcontraction of services has to be documented with the necessary provisions in order to ensure the quality of the service provided.

2.12 Quality Control of the Finished Product

Blood components follow a 100% quality control in critical parameters, ABO typing, Rh D typing, screening of TTIs. The quality control of these critical parameters are included in the processing chain and do not necessarily need further checks. Other quality parameters are checked by random sampling followed by statistical process control. A subset of these involves destructive testing and is usually carried out at the end of the shelf life, for example the pH check of platelets or the haemolysis percentage in the case of red cells. Another final subset is carried out within the technique itself and do not need to be addressed specifically; for example the negative result of a coombs test is confirmed with the addition of sensitized red cells. The recommended quality control of blood components is as follows:

**PACKED RED CELLS SUSPENDED IN PLASMA**
- Volume 280 ± 50 ml. Check 1 per cent of all units
- Haematocrit 0.65-0.75. Check 4 units per month
- Haemoglobin minimum 45 g per unit- Check 4 units per month
- Haemolysis at the end of storage < 0.8 per cent of red cell mass. Check 4 units per month

**WASCHED RED CELLS SUSPENDED IN NORMAL SALINE**
- Volume: To be defined for the system used. Check all units
- Haematocrit: 0.65-0.75. Check all units
- Haemoglobin: Minimum 40 g per unit. Check all units
- Haemolysis at end of the process: < 0.8 per cent of red cell mass. Check all units
- Protein content of final supernatant < 0.5 g per unit. Check all units

**PLATELET, SINGLE UNIT WHOLE BLOOD DERIVED**
- Volume > 40 ml. Check all units
- Swirling test. Check all units
- Platelet content per final unit: > 60 × 109. Check 10 units per month
- pH measured (+ 22 °C) at the end of the recommended shelf-life: > 6.4. Check a minimum of 4 units per month
PLATELET, APHERESIS
• Volume should be > 40 ml per 60 ×10^9 of platelets
• Platelet content:
  • Standard unit: minimum 2 × 10^11 per unit. Check a minimum of 10 units per month
  • For use in neonates or infants: minimum 0.5 × 10^11 per unit
  • pH measured (+ 22 °C) at the end of the recommended shelf life: 6,4

FRESH FROZEN PLASMA
• Volume: Stated volume ± 10 per cent. Check all units
• Factor VIII Average: not less than 50 IU Factor VIII per 100ml. Check every 3 months
  10 units in the first month of storage
• Fibrinogen: Average (after freezing and thawing): ≥ 60 per cent of the potency of the
  freshly-collected plasma unit. Check every 3 months 10 units in the first month of storage
• Residual cells (Check 4 units per month)
• Red cells: < 6.0 × 10^9/Litre
• Leucocytes: < 0. × 10^9/Litre
• Platelets: < 50 × 10^9/Litre
• Leakage: No leakage in any part of container. Requires visual inspection after pressure in
  a plasma extractor, before freezing and after thawing. Check all units
• Visual changes No abnormal colour or visible clots. Check all units

CRYOPRECIPITATE
• (obtained from FFP derived from one unit of whole blood)
• Volume: 30-40 mL All units
• Factor VIII ≥ 70 IU per unit
• Check every 2 months:
  • pool of 6 units of mixed blood groups during their first month of storage
  • pool of 6 units of mixed blood groups during their last month of storage
  • Fibrinogen ≥ 140 mg per unit. Check 4 units every 2 months
DYNAMICS FOR IMPROVEMENT
3. DYNAMICS FOR IMPROVEMENT

3.1 Management Review - Quality Committee

It is essential that those responsible for the blood bank quality do review the quality performance at planned intervals and decide the implementation of improving actions as necessary. The review, named “management review”, must be recorded. In small hospital blood banks with only one or two people in charge, the management review will be simple, perhaps a one sheet quarterly report containing relevant statistical data, control results, errors detected, the evaluation of the collected evidence, and the improving action decided. In medium to large hospitals or regional blood centres, where several responsible people are concerned, it is best to follow a team-approach for the management review usually called Quality Committee (QCO).

Whereas every member of the staff must be involved in the quality of the Blood Transfusion Service, the Quality Committee is the body responsible to ensure the continuing suitability, adequacy and effectiveness of the quality management system. As explained above, the QCO function is also known as Management Review. The QCO is integrated by the Director and a defined list of the staff members being responsible or representing the main areas of the Blood Transfusion Service activity. An additional expert can be invited to participate if needed when a particular issue is going to be discussed. QCO meetings may be ordinary, at planned intervals along the year, or extraordinary, meeting for purpose to discuss one single issue. Ordinary meetings must follow a strict agenda:

- Status of actions from previous meetings of the QCO
- Changes in internal or external issues relevant to the Blood Transfusion Service
- Information of quality performance and indicators, including:
- Statistical data related to activity and to nonconforming products
- Follow up of quality indicators
- Results of internal audits
- Input from customers and from interested parties
- Effectiveness of actions taken to address risks and opportunities
- New potential opportunities for continual improvement

The outputs of the QCO’s meeting are:

- Improvement opportunities
- Need of changes to the Quality Management System, including resources needed.

Being the QCO a technical body, the final decisions related to resources and investments frequently rely on the Hospital Board or Executive Committee, which should be adequately informed through the appropriate reporting.

Retain documented information as evidence of results of the meeting. Every one of the above-mentioned points must be quoted in the minutes, each one at least with one sentence.

Besides the formal issues (important), some explanation regarding their sense is necessary. The QCO’s objective is to be vigilant ensuring that all the quality requirements are being met and in consequence, the safety of donors and patients is preserved. If something goes wrong the QCO must act to sort out the situation. Action cannot be limited to maintain the quality level. There is always room for improvement, and it is also a QCO duty to improve the service given to donors and patients.
In summary, the QCO has: 1) to plan the Blood Service’s activities, 2) to command to do what was planned, 3) to check the results, 4) to act if correction is needed. The following step again goes 1) to plan the implementation of new improving measures, 2) to command…. The cycles for improvement Plan – Do – Check – Act, known also as PDCA cycles or Deming cycles are the recommended working method for QCOs

### 3.2 Planning

Planning the activities in the blood bank may be ordinary typically for one year, or extraordinary in front of an unexpected event. Whenever it is possible it is better to rely on well managed ordinary planning, including the prevention of the unexpected. Review the following lines:

#### Foreseen Risks and Opportunities

Which circumstances can endanger the quality of the Blood Bank service? A new emerging disease approaching the Country that may affect the blood safety, the increasing need of certain plasma derivatives, the intermittent supply of a reagent, are risks that should be addressed and planned what to do when there is still time. On the other hand, an awareness campaign of the media related to a shocking event related to the need of transfusion, maybe an opportunity to recruit voluntary blood donors. An increased demand of platelets may trigger the start of an apheresis programme

#### Planned Changes, Change Control

Perhaps you plan to introduce an improved method for ELISA testing, or to irradiate blood components. Planning must encompass several activities, financing, a quality plan, to train personnel, control of equipment, and review if the organogram or the process map should be modified. During the process of change the integrity of Quality Management System must be preserved

#### Quality Objectives

Every year the activity and results expected to be achieved should be planned. Objectives must be measurable, not too easy to comply with but neither too difficult to achieve. Each blood bank area should have their own quality objectives, donor recruitment, collection, testing, fractionation, transfusion. Quality objectives must be accepted and recorded

#### Input from Clinical Services and from Blood Donors

(Customer satisfaction). It is useful to ask the users how they perceive the service received. Ideas and suggestions may be a good source for improving ideas. Ask the clinical services, directly or through meetings of the transfusion committee, what they expect from the blood bank for the following year. The same is true with blood donors. The responses must be recorded, discussed, and taken into account for planning purposes

#### Input from other institutions interacting with the Blood Transfusion Service

(Interested parties). Traditionally, Quality Systems rely on the user’s opinion as a source for improvement. Recently it has been established (ISO 9001:2015) that interested parties are also a good source of information. Before planning, make consultation of suppliers, hospital’s top management, health authorities, blood donor associations, patients’ associations such as haemophilia’s or thalassemia’s, or other institutions linked in some way with the Blood
Transfusion Service. Record the contacts made and discuss them during the QCO meeting. Interested parties are also referred to as stakeholders

3.3 Checking

It is essential to plan and to follow up events based on evidence. Data have to be reliable. Special care must be taken to collect precise and significant data

Statistical Data

The ordinary workflow in the blood bank is followed-up with statistical data: units collected, number of rejected donors, non-conforming units, invalid ELISA runs. The blood bank usually handles a lot of statistical data which are typically reviewed monthly or quarterly

Quality Indicators

There are processes in need to be observed in detail for some reason. For example, it has been observed that recently an unusual number of donors have been rejected. Then a quality indicator is put in place and checked weekly in order to know the cause. A good quality indicator is the absolute number of blood donated by voluntary blood donors which allows to follow-up the degree of progression in the field and the effectiveness of the actions taken. Another quality indicator may be the waiting time of donors to donate blood; the waiting time should be maintained between limits, and when exceeded action should be taken to correct the score. Quality indicators resemble statistical data but the difference is that they are followed closely and are expected to trigger some kind of response if control is lost. There should be no more than ten quality indicators at a given time

Complaints

Complaints must be recorded, evaluated and taken into account for planning. A response must be given within a time frame. For example, 48h. for a preliminary answer, ten working days for a final response. Look-back procedures may take longer time to be resolved and this fact should be communicated at the time of the preliminary answer

Error Recording

Even in the best managed blood bank errors can take place. An error gives an opportunity to check the health of the quality system and why something went wrong. This is why it is so important to record the necessary information, the most severe, the most deeply studied. It is better to start quickly because the people involved frequently lose or misinterpret many details after 48 hours have elapsed, in particular if the error was severe. Forget to blame one person. At most you must ask why the system let the wrong person to be there. The right approach is to make a root cause analysis, necessary in any severe or repetitive error, deserving to implement a corrective action

Internal Audits

A key element of the quality system is the internal auditing. All the areas of the blood bank must be audited at least yearly by an independent person without responsibilities in the area to be audited. For example, the officer of the collection department can audit the lab, the laboratory officer the blood component processing department, and so on. The condition to be an auditor is to have been trained to do the task. Audit must be based on evidences (observations, records, interviews) and not on the personal opinions of the auditor. Non
compliances must be recorded and sorted out within a period of time, typically: 1) immediately if the non-conformity is severe, 2) in one month in moderate cases, 3) left to the next audit in mild cases. The corrected non-conformity must be checked with a re-auditing of the affected area. There are also non-ordinary audits to be carried out if a serious incident has been detected or if a new process has been implemented

**Effectiveness of corrective and improving action implemented**

All the actions for improvement have to be checked for efficacy and effectiveness. Normally this is carried out by the quality manager or by the person in charge of the quality in the blood bank. This check must be recorded.

3.4 Acting

**Evaluation of data based on evidences**

The collection of data must be followed by an analysis of its significance, better in a group discussion and to have the conclusions recorded. A good evaluation is the essential condition for improvement, and the fact of recording enforces to do so.

**Identification of Spaces for Improvement**

Remember at this point the PDCA cycle because improvement is the key. Imagination and innovation, if based in evidences and good analysis, may increase significantly the quality of the blood bank.

**Selection of Improving Action, Priorities, Available Resources**

One problem that frequently goes beyond the blood bank possibilities is how to choose the right action for improvement. In this setting it is important to make clear which are the priorities.

**Implementation of improving Action**

Once decided the improving action must be implemented. Sometimes is limited to amend a process already running, in other instances a quality plan in full is necessary.

**Implementation of Corrective Action if Needed**

A corrective action is implemented when one critical non-compliance has been produced, or if a repetitive non-critical non-compliance has been observed. In both cases it is clear that the procedure involved must be changed because there is a defect. Sometimes a human error is claimed as being the cause, but the reality is that the procedure allowed a human error to take place, and so it has to be mended. The corrective action should be directed to sort out the root cause of the detected error. It is important to distinguish between a corrective action, requiring a change in the procedure, and correction of a non-conforming product in which it is the product and not the procedure to be corrected.
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