4: Safe transfusion – right blood, right patient, right time and right place

Essentials

- Avoid unnecessary and inappropriate transfusions.
- Preventable ‘wrong blood into patient’ incidents are nearly always caused by human error and may cause fatal reactions due to ABO incompatibility.
- Most mistransfusion incidents are caused by identification errors at the time of pre-transfusion blood sampling, sample handling in the laboratory, collecting the wrong component from the blood bank or transfusion to the patient.
- The identity check between patient and blood component is the crucial final opportunity to avoid potentially fatal mistransfusion.
- At every stage of the blood administration process the key elements are positive patient identification, excellent communication and good documentation. These can be enhanced by the use of electronic transfusion management systems and barcode technology.
- Hospitals should develop local transfusion policies based on national guidelines and ensure all staff involved in the clinical transfusion process are appropriately trained and competency assessed.
- Where possible, patients should give ‘valid consent’ for transfusion based on appropriate information and discussion, but signed consent is not a legal requirement.
- Non-essential ‘out of hours’ requests for transfusion and overnight administration of blood should be avoided wherever possible because of an increased risk of errors.

Data from the UK Serious Hazards of Transfusion (SHOT) initiative (http://www.shotuk.org) show that around 1 in 13 000 blood units are administered to the wrong patient with occasional fatal outcomes. ‘Wrong blood into patient’ incidents are preventable and nearly always caused by human error. The root cause of most incidents is misidentification at the time of pre-transfusion blood sampling, laboratory testing, collecting the blood component from the blood bank or administration of the transfusion at the bedside. Potentially fatal ABO-incompatible transfusions still occur although improved clinical policies, staff training and introduction of methods to improve identification, resulting from the various Better Blood Transfusion initiatives, has significantly reduced their number over the last decade. Avoiding unnecessary or inappropriate transfusions is an essential starting point for safe transfusion practice.
The British Committee for Standards in Haematology (BCSH) Guideline on the Administration of Blood Components (2009) (https://b-s-h.org.uk) describes the essentials of safe requesting, collection and administration of blood components (summarised in Table 4.1) and should form the basis of local transfusion policies.

The key principles that underpin every stage of the blood administration process are:

- Positive patient identification
- Good documentation
- Excellent communication.

Table 4.1 Safe blood administration (adapted from the BCSH Guideline on Administration of Blood Components, 2009, with permission)

| Positive patient identification | Positive patient identification at all stages of the transfusion process is essential. Minimum patient identifiers are:
|                               | - Last name, first name, date of birth, unique identification number.
|                               | - Whenever possible ask patients to state their full name and date of birth. For patients who are unable to identify themselves (paediatric, unconscious, confused or language barrier) seek verification of identity from a parent or carer at the bedside. This must exactly match the information on the identity band (or equivalent).
|                               | - All paperwork relating to the patient must include, and be identical in every detail, to the minimum patient identifiers on the identity band.
| Patient information and consent for transfusion | Where possible, patients (and for children, those with parental responsibility) should have the risks, benefits and alternatives to transfusion explained to them in a timely and understandable manner. Standardised patient information, such as national patient information leaflets, should be used wherever possible.
| Pre-transfusion documentation | Minimum dataset in patient’s clinical record:
|                               | - Reason for transfusion (clinical and laboratory data).
|                               | - Summary of information provided to patient (benefits, risks, alternatives) and patient consent.
| Prescription (authorisation) | The transfusion ‘prescription’ must contain the minimum patient identifiers and specify:
|                               | - Components to be transfused
|                               | - Date of transfusion
|                               | - Volume/number of units to be transfused and the rate or duration of transfusion
|                               | - Special requirements (e.g. irradiated, CMV negative).
| Requests for transfusion | Must include:
|                           | - Minimum patient identifiers and gender
|                           | - Diagnosis, any significant co-morbidities and reason for transfusion
| Component required, volume/number of units and special requirements |
| Time and location of transfusion |
| Name and contact number of requester. |

**Blood samples for pre-transfusion testing**
- All patients being sampled must be positively identified.
  - Collection of the blood sample from the patient into the sample tubes and sample labelling must be a continuous, uninterrupted event involving one patient and one trained and competency assessed healthcare worker.
  - Sample tubes must not be pre-labelled.
  - The request form should be signed by the person collecting the sample.

**Collection and delivery of blood component to clinical area**
- Before collection, ensure the patient (and staff) is ready to start transfusion and there is good venous access.
- Only trained and competent staff should collect blood from transfusion laboratory or satellite refrigerator.
- Authorised documentation with minimum patient identifiers must be checked against label on blood component.
- Minimum patient identifiers, date and time of collection and staff member ID must be recorded.
- Deliver to clinical area without delay.

**Administration to patient**
- The final check must be conducted next to the patient by a trained and competent healthcare professional who also administers the component.
- All patients being transfused must be positively identified.
- Minimum patient identifiers on the patient’s identity band must exactly match those on blood component label.
- All components must be given through a blood administration set (170–200 µm integral mesh filter).
- Transfusion should be completed within 4 hours of leaving controlled temperature storage.

**Monitoring the patient**
- Patients should be under regular visual observation and, for every unit transfused, minimum monitoring should include:
  - Pre-transfusion pulse (P), blood pressure (BP), temperature (T) and respiratory rate (RR).
  - P, BP and T 15 minutes after start of transfusion – if significant change, check RR as well.
  - If there are any symptoms or signs of a possible reaction – monitor and record P, BP, T and RR and take appropriate action.
  - Post-transfusion P, BP and T – not more than 60 minutes after transfusion completed.
  - Inpatients observed over next 24 hours and outpatients advised to report late symptoms (24-hour access to clinical advice).

- If further units are prescribed, repeat the administration/identity check with each unit.
Completion of transfusion episode

- If no further units are prescribed, remove the blood administration set and ensure all transfusion documentation is completed.

### 4.1: Patient identification

A patient identification band (or risk-assessed equivalent) should be worn by all patients receiving a blood transfusion. The minimum identifiers on the band are:

- Last name
- First name
- Date of birth
- Unique patient ID number (wherever possible a national number such as the NHS No. in England and Wales, CHI No. in Scotland or HSC No. in Northern Ireland).

In emergency situations or where the patient cannot be immediately identified at least one unique identifier, such as A&E or trauma number, and patient gender should be used.

Wherever possible, patients for blood sampling or transfusion should be asked to state their full name and date of birth and this must exactly match the information on the identification band. To ensure accuracy and legibility, the ID band should be printed from the hospital’s computerised patient administration system, ideally at the bedside. Otherwise, verification of identity should be obtained, if possible, from a parent or carer at the bedside and checked against the identification band. Identification discrepancies at any stage of the transfusion process must be investigated and resolved before moving to the next stage.

Identification of patients, samples and blood components throughout the transfusion process can be enhanced by the use of electronic transfusion management systems using barcodes on ID bands and blood components and hand-held scanners linked to the laboratory information systems. Most UK hospitals still use manual ID checks at the bedside although electronic ‘blood-tracking’ systems to control access to blood refrigerators are in more widespread use.

### 4.2: Documentation

The documentation required at each stage of the transfusion process should be kept to an essential minimum and, whether hard copy or electronic, be ‘user-friendly’ to encourage compliance by busy clinical teams. Combined transfusion prescription and monitoring charts or care pathways can be used to record the information and provide a clear audit trail. The development of standardised transfusion documentation in the UK has the potential to reduce errors by clinical staff moving between hospitals. All transfusion documentation should include the minimum patient identifiers. Documentation in the clinical record should include:

Pre-transfusion:

- The reason for transfusion, including relevant clinical and laboratory data.
- The risks, benefits and alternatives to transfusion that have been discussed with the patient and documentation of consent (see below).
- The components to be transfused and their dose/volume and rate.
- Any special requirements, such as irradiated components.
During transfusion:

- Details of staff members starting the transfusion.
- Date and time transfusion started and completed.
- Donation number of the blood component.
- Record of observations made before, during and after transfusion.

Post-transfusion:

- Management and outcome of any transfusion reactions or other adverse events.
- Whether the transfusion achieved the desired outcome (e.g. improvement in symptoms, Hb increment).

4.3: Communication

Verbal communication between clinical staff and the laboratory risks misunderstanding or transcription error. Written or electronic communication should be used wherever possible although requests for urgent transfusion should be supplemented by telephone discussion with laboratory staff. Good communication is especially important at times of staff handover between shifts, both on the wards and in the laboratory, and can be enhanced by a standardised and documented process.

4.4: Patient consent

The Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) recommends that ‘valid consent’ for blood transfusion should be obtained and documented in the clinical record (signed consent for transfusion is not mandatory, but may be a local requirement). This is underpinned by the following recommendations:

- Use of standardised sources of information for all patients in the UK – appropriate information leaflets are available from the UK Transfusion Services and should be used in all hospitals.
- Use of a standardised information resource for clinicians, indicating the key areas to be discussed when obtaining consent – an example is available from http://www.transfusionguidelines.org.uk/index.asp?Publication=BBT&Section=22&pageid=7691.
- As with any emergency treatment, the need for consent must not prevent or delay essential urgent transfusion, but the presence of a valid Advance Decision Document declining transfusion should always be respected (see Chapter 12). Patients transfused when it is not possible to obtain prior consent should be provided with information retrospectively. This is important, as transfused patients are no longer eligible to act as blood donors. For the same reason, patients who have given consent for possible transfusion during surgery should be informed if they actually received blood while under anaesthesia.
- Patients needing long-term transfusion support should have a modified form of consent (e.g. annual review and re-consent) and this should be specified in local policies.

4.5: Authorising (or ‘prescribing’) the transfusion

Blood components are not licensed medicines and their ‘prescription’ is not legally restricted to registered medical practitioners. There are clear advantages in terms of safety and efficiency in allowing non-medical practitioners, especially those working in specialist areas such as clinical haematology or oncology, to
authorise transfusion in defined situations. A framework has been developed in the UK to allow ‘appropriately trained, competent practitioners’ such as registered nurses and midwives to make the clinical decision and provide the written instruction for blood component transfusion.

All transfusion ‘prescriptions’ (written authorisation to transfuse) must contain the patient’s minimum identifiers and specify the component, dose/volume, rate of transfusion and any special requirements. It should remain a permanent part of the clinical record.

4.6: Requests for transfusion

Hospital policies should define which clinical staff are authorised to request blood and what training they need. Telephoned requests for blood components should be kept to an essential minimum because of the risk of transcription errors. Non-urgent ‘out of hours’ requests should be avoided wherever possible as SHOT data clearly show an increased risk of errors. Computerised physician order entry (CPOE) systems can reduce errors and provide useful guidance to the requesting clinician. Transfusion requests (whether written or electronic) should contain the following information:

- Minimum patient identifiers plus gender (which may be essential for component selection) – BCSH guidelines recommend that organisations have a ‘zero tolerance’ policy for amending or adding to the ‘core identifiers’ once a request is submitted.
- Diagnosis and any other clinically relevant information plus the reason for transfusion (not just ‘pre-op’ or ‘anaemia’) as this helps laboratory staff select appropriate components and facilitates audit. This may also be helped by the use of standardised indication codes for transfusion, such as those developed by the English National Blood Transfusion Committee
- Time, location and urgency of transfusion.
- Relevant information on previous reactions, blood group antibodies or pregnancies.
- Type and dose or volume of blood component required.
- Any special requirements (e.g. irradiated, CMV negative).

4.7: Pre-transfusion blood sampling

Misidentification at blood sampling may lead to fatal ABO-incompatible blood transfusion, especially if the patient has not previously had their blood group documented. Inadequately or mislabelled samples carry a significantly increased risk of containing blood from the wrong patient. Risk of misidentification may be reduced by electronic systems, but all sampling should be carried out in line with the following principles by trained and competent staff:

- Patients must be positively identified and their details must match those on the request form.
- All inpatients must wear an identity band (or risk-assessed equivalent).
- Collection of the sample and labelling of the sample tubes must be performed as one uninterrupted process involving one member of staff and one patient.
- Sample tubes must never be pre-labelled.
- The sample tube label must contain the minimum patient identifiers (exactly matching those on the request form and identity band), date and time of sampling and identity of person taking the sample.
- Labels printed away from the patient (e.g. addressograph labels) must not be used on the transfusion sample but labels printed ‘on demand’ and applied to the tube next to the patient, as used in some electronic ID systems, are acceptable.
- All handwritten labels must be legible.
- BCSH guidelines recommend that laboratories have a ‘zero tolerance’ policy for rejecting samples that do not meet the above minimum requirements.
4.8: Collection of blood components and delivery to clinical areas

Errors in collection are a frequent root cause of wrong blood into patient events. All staff responsible for collecting blood from the transfusion laboratory or satellite refrigerators must be trained and competency assessed according to local policies. Manual documentation of collection, such as a ‘transfusion register’, has been traditionally used but the process can be strengthened by the use of electronic ‘blood-tracking’ systems.

- Staff collecting blood must carry documentation, such as a blood collection slip or the transfusion prescription, which contains the minimum patient identifiers. This must be checked against the details on the laboratory-generated label attached to the blood component pack.
- Computerised blood-tracking systems using barcodes can check (and record) the identity and accreditation of the person collecting or returning the blood (e.g. by scanning a barcode on their ID badge), ensure that the details on the collection documents match those on the selected blood pack and that the blood is within its expiry time and date. Computer-controlled satellite blood refrigerators are also now available that will only allow access to blood components compatible with the appropriate patient. These are ideal for ‘remote issue’ of blood components at locations without an on-site transfusion laboratory.
- The Blood Safety and Quality Regulations (BSQR) require that the time a component is out of a controlled temperature environment is recorded and ‘cold chain’ data must be kept for 15 years. Red cells that have been out of controlled refrigeration for more than 30 minutes must not be reissued for transfusion. (The rationale for the ‘30-minute rule’ is often questioned as it is based on studies carried out many years ago on very different blood components. Recent research shows that red cells show no impairment of function up to 60 minutes out of controlled refrigeration but evidence of bacterial safety is needed before a change in policy can be recommended.)
- Emergency group O stock in the blood refrigerator must be clearly identified and separated from units labelled for specific patients. The laboratory must be informed immediately when emergency stock is removed so that it can be replenished and an audit trail maintained.

4.9: Receiving blood in the clinical area

Before collecting blood components from the blood bank, the clinical staff should ensure the patient is wearing an identity band and has given consent for transfusion, the transfusion ‘prescription’ has been completed correctly, there is patent venous access and staff are available to start the transfusion promptly and monitor it properly. Only one unit should be collected at a time unless rapid transfusion of large quantities is required (e.g. major haemorrhage). The arrival of components in the clinical area should be documented and the transfusion started as soon as possible.

4.10: Administration to the patient

The identity check between patient and blood component (Figure 4.1) is the final opportunity to avoid potentially fatal mistransfusion (‘the last chance saloon’). The check must be performed for every unit transfused. The key principles of safe bedside administration are:

- Blood components must be administered by registered practitioners who are trained and competent according to local policies.
- The final check must take place next to the patient, not at the nursing station or another remote area.
- There is no evidence that either one or two staff performing the bedside check is safer and local policy should be followed. If two people perform the check, each should perform it independently.
- If the checking process is interrupted, it must start again.
Transfusion must only go ahead if the details on the patient identity band (positively confirmed by the patient if possible), the laboratory-generated label attached to the component pack and the transfusion prescription are an exact match. Any discrepancy must immediately be reported to the transfusion laboratory.

- Check the expiry date of the component and ensure the donation number and blood group on the pack matches that on the laboratory-generated label attached to the pack.
- Any special requirements on the transfusion prescription, such as irradiated component, must be checked against the label on the pack.
- Inspect the component pack for signs of leakage, discoloration or clumps.
- A 'compatibility report form' issued by the laboratory and the patient’s clinical records must not form part of the bedside identity check (‘checking paper against paper’). Compatibility report forms are generated by the same laboratory computer used to produce the laboratory-generated label on the blood pack and the two will always match (even if the blood is being presented to the wrong patient).
- It is strongly recommended (BCSH and National Patient Safety Agency (www.npsa.nhs.uk)) that laboratories do not issue compatibility report forms to avoid their inappropriate use in the final administration check.

- The prescription and other associated paperwork should be signed by the person administering the component and the component donation number, date, time of starting and stopping the transfusion, dose/volume of component transfused and name of the administering practitioner should be recorded in the clinical record.
- To reduce the risk of bacterial transmission, blood component transfusions should be completed within 4 hours of removal from a controlled temperature environment.
- Non-essential overnight transfusion of blood should be avoided, except in adequately staffed specialist clinical areas, because of the increased risk of errors.

**Figure 4.1 Identity check between patient and blood component**

4.11: Monitoring the transfusion episode

Transfusion observations should be recorded on a dedicated transfusion record or electronic device that can generate a report for filing in the clinical record. Minimum monitoring of each unit transfused should include:
• Regular visual observation of the patient during the transfusion and encouragement to report new symptoms.
• Baseline pulse rate, blood pressure (BP), temperature and respiratory rate (RR) must be recorded no more than 60 minutes pre-transfusion.
• Pulse, BP and temperature should be checked around 15 minutes after the start of transfusion (many serious reactions, such as ABO incompatibility or bacterial transmission present early in the transfusion episode). If any of these observations have changed, check RR as well.
• If the patient reports new symptoms, repeat the baseline observations and take appropriate action (see Chapter 5).
• Check pulse, BP and temperature not more than 60 minutes after the end of the transfusion (and as a baseline before any further units are transfused).
• Inpatients should be observed for late reactions over the next 24 hours and day-care patients advised to report symptoms developing after discharge (preferably with issue of a ‘Contact Card’ giving access to immediate clinical advice).

4.12: Technical aspects of transfusion

4.12.1: Intravenous access

Blood components can be transfused through most peripheral or central venous catheters, although the flow rate is reduced by narrow lumen catheters and long peripherally inserted central catheters (PICC lines).

They should be transfused through an administration set with a 170–200 μm integral mesh filter. Paediatric administration sets with a smaller prime volume are available for small-volume transfusions. Although special platelet administration sets are available, it is safe to use a standard blood administration set, but platelets should not be transfused through a set previously used for red cells as some platelet loss will occur. It is not necessary to prime or flush blood administration sets with physiological (0.9%) saline but a new administration set should be used if blood components are followed by another infusion fluid. Although there is little evidence, current guidelines recommend changing blood administration sets at least every 12 hours to reduce the risk of bacterial infection.

Blood and other solutions can be infused through the separate lumens of multi-lumen central venous catheters as rapid dilution occurs in the bloodstream. Where possible, one lumen should be reserved for the administration of blood components.

4.12.2: Infusion devices

There are two main types: gravity delivered or infusion pumps. Devices must be CE marked and used according to the manufacturer’s instructions (including the use of compatible administration sets). Infusion devices must be maintained in accordance with the manufacturer’s guidelines and the pre-administration check should include a check of the device and its settings. The device should be monitored regularly during transfusion to ensure the correct volume is being delivered at the correct rate.

4.12.3: Rapid infusion devices

These are used in situations such as major haemorrhage. Infusion rates range from 6 to 30 L/hour and most incorporate a blood-warming device. They should be used with a large-gauge venous access catheter.

4.12.4: Blood warmers
Rapid infusion of red cells recently removed from the refrigerator may cause hypothermia. Concerns include impaired coagulation in surgical or trauma patients and cardiac arrhythmias if cold blood is transfused rapidly into a central catheter or in neonates and small infants having large-volume transfusions. The National Institute for Health and Care Excellence (NICE) in England recommends that, in all patients undergoing elective or emergency surgery, ‘intravenous fluids (500 mL or more) and blood products should be warmed to 37°C’.

Blood warmers may also be used in patients with clinically significant cold antibodies (discuss with a transfusion medicine specialist).

Only CE-marked blood warmers should be used. Some operate up to 43°C but are safe if used in accordance with the manufacturer’s instructions. Improvised blood-warming, such as immersion of the pack in hot water, in a microwave or on a radiator must never be used.

4.12.5: Compatible intravenous fluids

It is good practice to avoid the co-administration of any intravenous fluid through the same line used for blood components, unless a multi-lumen central venous catheter is used. Solutions containing calcium (e.g. Ringer’s lactate) or calcium-containing colloids (e.g. Haemaccel™ or Gelofusine™) antagonise citrate anticoagulant and may allow clots to form if mixed in the same infusion line. Hypotonic solutions, such as 5% dextrose in water, can cause haemolysis of red cells in laboratory experiments but the clinical significance of this is uncertain and no clinical adverse events have been reported.

4.12.6: Co-administration of intravenous drugs and blood

Drugs should never be added to a blood component bag.

Wherever possible, intravenous drugs should be administered between transfusions or administered through a second venous access device (or the separate lumen of a multi-lumen central venous catheter). If this is not possible, the transfusion should be temporarily stopped and the line flushed with 0.9% saline before and after administration of the drug.

Some patients using patient-controlled analgesia (PCA) devices delivering opioid pain killers, such as those on palliative care or with sickle cell pain crises, have very poor peripheral venous access and it is convenient (and kind) to use the administration line used for transfusion. Standard concentrations of morphine, hydromorphone or meperidine have no harmful effect on co-administered red cells.

4.13: Transfusion of blood components

Table 4.2 summarises key points about the transfusion of commonly used components in adult patients (see Chapter 10 for administration of components in paediatric/neonatal practice). Clinical use of blood components is discussed in Chapters 7–10.

<table>
<thead>
<tr>
<th>Blood component</th>
<th>Notes on administration</th>
</tr>
</thead>
</table>

Table 4.2 Blood component administration to adults (doses and transfusion rates are for guidance only and depend on clinical indication) (based on BCSH Guideline on the Administration of Blood Components, 2009, with permission)
<table>
<thead>
<tr>
<th>Blood Component</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red cells in additive</td>
<td>Transfusions must be completed within 4 hours of removal from controlled temperature storage.</td>
</tr>
<tr>
<td>solution</td>
<td>Many patients can be safely transfused over 90–120 minutes per unit.</td>
</tr>
<tr>
<td></td>
<td>A dose of 4 mL/kg raises Hb concentration by approximately 10 g/L. Note: The common belief that one red cell pack = 10 g/L increment only applies to patients around 70 kg weight – the risk of transfusion-associated circulatory overload (TACO) is reduced by careful pre-transfusion clinical assessment and use of single-unit transfusions, or prescription in millilitres, for elderly or small, frail adults where appropriate.</td>
</tr>
<tr>
<td></td>
<td>During major haemorrhage, very rapid transfusion (each unit over 5–10 minutes) may be required.</td>
</tr>
<tr>
<td>Platelets</td>
<td>One adult therapeutic dose (ATD) (pool of four units derived from whole blood donations or single-donor apheresis unit) typically raises the platelet count by 20–40×10⁹/L.</td>
</tr>
<tr>
<td></td>
<td>Usually transfused over 30–60 minutes per ATD.</td>
</tr>
<tr>
<td></td>
<td>Platelets should not be transfused through a giving-set already used for other blood components.</td>
</tr>
<tr>
<td></td>
<td>Start transfusion as soon as possible after component arrives in the clinical area.</td>
</tr>
<tr>
<td>Fresh frozen plasma (FFP)</td>
<td>Dose typically 12–15 mL/kg, determined by clinical indication, pre-transfusion and post-transfusion coagulation tests and clinical response.</td>
</tr>
<tr>
<td></td>
<td>Infusion rate typically 10–20 mL/kg/hour, although more rapid transfusion may be appropriate when treating coagulopathy in major haemorrhage.</td>
</tr>
<tr>
<td></td>
<td>Because of the high volumes required to produce a haemostatic benefit, patients receiving FFP must have careful haemodynamic monitoring to prevent TACO.</td>
</tr>
<tr>
<td></td>
<td>FFP should not be used to reverse warfarin (prothrombin complex is a specific and effective antidote).</td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td>Typical adult dose is two five-donor pools (ten single-donor units).</td>
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<td></td>
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<td>-------------------------------------------------------------------------------------------</td>
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<tr>
<td>Will raise fibrinogen concentration by approximately 1 g/L in average adult.</td>
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<td></td>
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</tr>
<tr>
<td>Typically administered at 10–20 mL/kg/hour (30–60 min per five-unit pool).</td>
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</tbody>
</table>