BMJ Open
Peripherally Inserted Central catheter iNnovation to reduce Infections and Clots (the PICNIC trial): a randomised controlled trial protocol

Amanda J Ullman, Deanne August, Tricia Kleidon, Rachel Walker, Nicole M Marsh, Andrew Bulmer, Benjamin Pearch, Naomi Runnegar, Jessica A Schults, Joanne Leema, Paul Lee-Archer, Cathy Biles, Katrina Southam, Victoria Gibson, Joshua Byrnes, Robert S Ware, Vineet Chopra, Alan Coulthard, Peter Mollee, Claire M Rickard, Patrick N A Harris

ABSTRACT
Introduction Peripherally inserted central catheters (PICCs) are vital for the delivery of medical therapies, but up to 30% of PICCs are associated with complications such as deep vein thrombosis or infection. The integration of antimicrobial and hydrophobic catheter materials, and pressure-activated valves, into polyurethane PICCs are innovations designed to prevent infective and/or thrombotic complications.

Methods and analysis A multicentre, parallel group, superiority randomised controlled trial with two experimental arms (1) hydrophobic PICC (with pressure-activated valve); (2) chlorhexidine gluconate-impregnated PICC (with external clamp) and one control group (3) conventional polyurethane PICC (with external clamp). Recruitment of 1098 adult and paediatric patients will take place over 2 years at three tertiary-referral hospitals in Queensland, Australia. Patients are eligible for inclusion if their PICC is to be inserted for medical treatment, with a vascular size sufficient to support a 4-Fr PICC or larger, and with informed consent. The primary outcome is PICC failure, a composite of thrombotic (venous thrombosis, breakage and occlusion) and infective complications (PICC-associated bloodstream infection and local infection). Secondary outcomes include: all-cause PICC complication; thrombotic complications; infective complications; adverse events (local or systemic reaction); PICC dwell time; patient/parent satisfaction; and healthcare costs. Differences between both intervention groups and the control group will be compared using Cox proportional hazards regression. Effect estimates will be presented as HRs with corresponding 95% CI.

Ethics and dissemination Ethical approval from Queensland Health (HREC/8001/48682) and Griffith University (Ref. No. 2019/094). Results will be published.

Trial registration number ACTRN12619000022167.

INTRODUCTION
Peripherally inserted central catheters (PICCs) are inserted via deep peripheral veins, predominantly of the upper arm, into the central vasculature. PICCs are vital for many acute and chronic diagnoses requiring prolonged and/or frequent therapy, vesicant medications, irritant pH and osmolality infusions, for patients with limited veins in both outpatient and inpatient settings. The last 40 years have seen rapid acceleration in PICC use, due to their relative safety, ease of use and cost-effectiveness compared with more invasive centrally inserted devices. However, it is now established that PICC-related complications are universally common, with up to 30% of PICCs failing prior to completion of treatment due to thrombotic (eg, deep vein thrombosis (DVT)) and infective complications (eg, catheter-associated bloodstream...
infection (CABSI) including those caused by *Staphylococcus aureus*). Innovations that prevent these complications are necessary to reduce healthcare-associated harm for vulnerable patients.

**PICC materials**

Integrating antithrombotic and anti-infective technologies into the PICC materials are potential innovations to prevent complications. Several PICC materials have been developed since their inception in the 1970s; however, the majority of PICCs currently in use are made of relatively stiff, third-generation uncoated polyurethane that softens with body temperature and withstands pressures of >300 pounds per square inch.6

Material technologies introduce antithrombotic and anti-infective properties in PICCs, with two major products entering the market over the last 5–10 years. The BioFlo PICC from AngioDynamics Inc (Queensbury, New York, USA) has hydrophobic (water repelling) properties, which has been achieved by the addition of ‘Endexo’ (a surface-modifying macromolecule based on the incorporation of fluorine atoms) during the moulding manufacturing process. The fluorinated PICC material inhibits platelet adhesion, suppresses protein procoagulant conformation and potentially reduces thrombus formation in medical devices (based on platelet counts in manufacturer completed in vitro studies only). Our pilot randomised controlled trial (RCT) in a paediatric population (n=150) demonstrated the feasibility and potential for the hydrophobic BioFlo PICC to reduce PICC thrombotic and infective complications, but the study was not powered for clinical effectiveness (PICC failure: standard polyurethane 22% (16/72)) vs BioFlo 11% (8/72): risk ratio (RR) 0.50; 95% CI 0.23 to 1.09; p=0.07).8

Anti-infective properties impregnated into PICCs include antibiotics (eg, minocycline-rifampicin) and antiseptics (eg, chlorhexidine gluconate (CHG)). These technologies have been well studied in other central venous catheter types, with a Cochrane review concluding there was high-quality evidence that antimicrobial (non-PICC) central venous catheters significantly reduced CABSI risk (RR 0.62; 95% CI 0.52 to 0.74, n=10 405, 42 RCTs). Building on this indication, Teleflex Inc (Wayne, Pennsylvania, USA) developed the CHG-impregnated Arrowg+ard Blue Advance PICC. CHG is widely used in healthcare, due to its broad spectrum of germicidal activity against most CABSI-causing pathogens, especially *S. aureus*. Some manufacturer-funded, laboratory studies also suggest CHG coating has a role in the prevention of thrombosis development, with in vivo ovine models demonstrating a significant reduction in fibrin sheath development after 30 days in situ, in comparison with uncoated catheters (median 0.05 g (CHG) vs 0.7 g (uncoated)). However, the effectiveness of CHG-coated PICCs to prevent thrombotic and infective complications has not been formally tested in clinical trials in humans.

**PICC designs**

PICC design evolution has primarily focused on the integration of internal valves, replacing external clamps, with the aim of preventing thrombotic occlusion by reducing blood reflux. External clamps prevent gravity and pressure-related backflow of blood into and out of the PICC when not in use. Modern pressure-activated valves, such as those incorporated in the BioFlo PICC from AngioDynamics Inc (Queensbury, New York, USA), negate the need for external, clinician-initiated clamping during periods of disuse. The valves are incorporated at either the distal or proximal portion of the PICC and open with injection and aspiration pressure but remain closed during minor pressure fluctuations. Despite the integration of valves into many PICCs, data regarding their performance in preventing complications in clinical trials are minimal. Only one RCT (n=180) of the pressure activated valve versus older PICC valve technologies has been published, and this RCT was stopped early due to safety concerns with an older valve (Becton Dickinson – Bard, Murray Hill, New Jersey, USA).12

The ideal PICC would be: (A) soft and flexible to reduce procedural risks (including ease of insertion, patient discomfort and vessel irritation); (B) structurally strong to withstand pressure during rapid injection; (C) prevent microbial colonisation and adherence of blood components to reduce CABSI and DVT; and (D) cost-effective. Little research has been undertaken examining the safety and effectiveness of either hydrophobic or CHG PICCs, with or without valves, to meet these criteria, prevent thrombotic and infection complications and promote PICC function. The aim of this study is to compare two novel technologies (hydrophobic and CHG PICCs) with standard care (conventional polyurethane PICCs), to identify clinically effective and cost-effective methods to reduce the incidence of PICC failure, due to thrombotic and infectious complications.

**METHODS AND ANALYSIS**

This multicentre, parallel group, open, superiority, randomised controlled trial will compare the clinical effectiveness and cost-effectiveness in adult and paediatric patients of the:

1. Hydrophobic PICC: with pressure activated valves; BioFlo.
2. CHG-impregnated PICC: with external clamps; Arrowg+ard Blue Advance.
3. Conventional polyurethane PICCs: pressure injectable polyurethane with external clamps.

Embedded in the RCT are additional microbiological and thrombogenic subgroup studies to determine the effect of these interventions on bacterial colonisation, PICC-associated infection and CHG resistance, as well as assessing haematological, coagulation profiles and platelet activation.

**References**


Hypotheses

Primary

1. Patients with either (1) hydrophobic or (2) CHG PICCs will have significantly fewer device failures (composite outcome of thrombosis, infection, occlusion and breakage) compared with patients receiving (3) usual care (conventional polyurethane PICCs).

Secondary

1. Patients with the (1) hydrophobic and (2) CHG PICCs will have significantly longer complication-free device life compared with patients receiving (3) usual care (conventional polyurethane PICCs).

2. Patients with the (1) hydrophobic PICCs will have significantly lower rates of thrombotic complications (composite of thrombosis, occlusion and breakage), compared with patients receiving (3) usual care (conventional polyurethane PICCs).

3. Patients with (2) CHG PICCs will have significantly lower rates of PICC associated infections, than patients receiving (3) usual care (conventional polyurethane PICCs).

4. There will be significant cost savings to the Australian health system when using (1) hydrophobic or (2) CHG PICC, compared with patients receiving (3) usual care (conventional polyurethane PICCs).

Study setting and sample

Adult and paediatric patients are being recruited at three tertiary referral hospitals in South East Queensland, Australia (Royal Brisbane and Women’s Hospital (RBWH); Princess Alexandra Hospital (PAH); and Queensland Children’s Hospital (QCH)), aiming for recruitment over 2 years. Sites have phased recruitment commencement (QCH 8 November 2019; PAH 20 January 2020 and RBWH 1 June 2020), with delayed commencement at RBWH due to COVID-19. Patients requiring a PICC are being recruited via departments of medical imaging and vascular access services from cancer care, medical, surgical and intensive care areas. Patients who meet all inclusion and no exclusion criteria (see table 1) are eligible to participate in the study once.

Outcome measures and definitions

Primary outcome

The primary outcome is PICC failure, a composite of thrombotic (venous thrombosis, breakage and occlusion) and infective complications (PICC-associated bloodstream infection and local infection) (all defined further) severe enough to cause cessation of PICC function prior to therapy completion.13

► Venous thrombosis: ultrasound/venographic/image confirmed thrombosis occurring within the same vessel as the PICC within 1 week of PICC removal, in a symptomatic patient (pain and swelling),14 confirmed by blinded radiologist.

► Breakage: split in PICC material with leakage or radiographic evidence of extravasation/infiltration into tissue, in a PICC flushed to clear thrombosis and/or occlusion.15

► Occlusion: complete ≥1 lumens cannot be flushed or aspirated, or resolved post-thrombolytic dwell16 and partial: decreased ability of ≥1 lumens to either infuse blood or fluid and/or withdraw blood or fluid from ≥1 lumens despite the use of thrombolytic.17

► PICC-associated bloodstream infection (BSI): a laboratory confirmed BSI where an eligible BSI organism is identified with PICC in place for ≥2 consecutive calendar days on the day of the BSI (day of PICC placement being day 1) and the PICC in place on the date of the event or the day before (see CDC Device-associated Module BSI for full criteria),18 confirmed by a blinded infectious disease specialist.

► Local infection: clinical signs of local venous infection at the PICC insertion site (eg, purulent drainage), confirmed with a positive (>15 cfu) swab or catheter tip but with negative or no blood culture (see CDC VASC definition for full criteria)18 confirmed by a blinded infectious disease specialist.

Secondary outcomes

► All-cause PICC complication: a composite of the thrombotic and infective complications previously, but evident at any stage during PICC dwell, and may or may not require PICC removal.

► Thrombotic complication: a composite of venous thrombosis, occlusion and breakage at any stage during PICC dwell.

► Infective complication: a composite of PICC-associated BSI and local infection at any stage during PICC dwell.

► Individual complications: individual thrombotic (venous thrombosis, breakage and occlusion) and infective (PICC-associated BSI and local infection) complications evident at any stage during PICC dwell and may or may not require PICC removal.

► Adverse events: any local or systemic allergic reaction (eg, pruritus), pain and mortality.

Table 1 Inclusion and exclusion criteria

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>► PICC to be inserted for medical treatment.</td>
<td>► Previous enrolment in the current study.</td>
</tr>
<tr>
<td>► Informed consent.</td>
<td>► Current catheter-related bloodstream infection.</td>
</tr>
<tr>
<td>► Vascular size sufficient to support 4-Fr PICC or larger.</td>
<td>► Thrombosis in vein where PICC is to be inserted.</td>
</tr>
<tr>
<td></td>
<td>► Non-English speaking without an interpreter.</td>
</tr>
<tr>
<td></td>
<td>► Known sensitivity to study products (including CHG).</td>
</tr>
<tr>
<td></td>
<td>► Added since trial commencement: admitted for COVID-19, or to a designated COVID-19 unit/facility.</td>
</tr>
</tbody>
</table>

CHG, chlorhexidine gluconate; Fr, French; PICC, peripherally inserted central catheter.
PICC dwell time: hours from PICC insertion until removal.

Patient/parent and staff satisfaction: collected at PICC insertion (staff) and study end (staff and patient/parents), using 0–10 numeric rating scales of increasing satisfaction.

Healthcare costs: estimate of direct product costs, healthcare resource utilisation (including additional equipment and staff time) and failure-associated resource usage (described further).

Sample size and study power
Our baseline PICC failure rate associated with the conventional PICCs is 15%.20–22 We expect PICC failure of 7.5% with hydrophobic and CHG PICCs based on pilot trials8 and systematic reviews.9,23 That is, we expect hydrophobic and CHG PICCs to have a 50% relative risk reduction in PICC failure rates compared with conventional PICCs. Using a two-sided alpha significance level of 0.035 (chosen to facilitate comparison of the two intervention arms against a single control arm), 366 PICCs in each group achieves 85% power to detect a relative 50% difference in failure rates between intervention ((1) and (2)) hydrophobic and CHG PICCs) and control ((3) conventional PICCs) groups. Consequently, we are required to enrol 1098 participants.

Recruitment, randomisation, allocation concealment and blinding
Hospital-based research nurses (ReNs) are screening patients, gaining informed consent from patients/parents, randomising, educating clinical staff, patients and families, monitoring protocol compliance and collecting weekly data on patients ’ on trial’ plus final outcome data for completed patients. Patients are randomised via a central web-based service (Griffith University) immediately prior to each PICC insertion to ensure allocation concealment until study entry. Randomisation is at in a 1:1:1 ratio between groups, with randomly varied block sizes (up to 20) and stratification by: (1) hospital and (2) hypercoagulable state (adults: high risk of thrombosis as per Michigan Risk Score24; paediatrics: previous thrombosis or active cancer).

PICC inserters have been provided training by the product manufacturers regarding the insertion of intervention PICCs, with additional resources available to support practice. The inserters are provided with the randomised PICC in prepacks, immediately prior to insertion, to ensure study fidelity. It is not possible to blind clinical staff, since they must insert, access and monitor PICCs, and they are visibly different. However, the outcome of PICC failure is objective, easily assessed and routinely assigned by clinical staff who are not investigators. Infectious disease physicians and radiologists are masked when determining infection and thrombosis outcomes, standardised definitions are used for these outcomes and the biostatistician will be masked to allocation when provided the dataset.

Insertion and care of PICC
Other than PICC type, all other PICC insertion, care and management have been standardised in accordance with Queensland Health clinical practice guidelines (at all study sites).25 This includes skin preparation with 2% CHG in 70% alcohol prior to insertion, sterile insertion, ultrasound guidance for insertion, securement with sutureless securement devices and polyurethane dressings and removal as soon as clinically appropriate. Maintenance and removal will be by usual hospital staff, with existing guidelines in place. As a pragmatic trial, variations in such care are being noted but not considered as protocol violations. A protocol violation is the insertion of a non-randomised PICC.

Data collection
Data are being directly collected into a secure online database (Research Electronic Data CAPture, Vanderbilt).26 The ReNs are following participants weekly for a maximum of 8 weeks (captures 90% of dwell data; will be censored at that point) or until PICC failure/removal if earlier. Discharged patients are having follow-up data collected by phone, a method that we have previously demonstrated reliability.27 The study manager are undertaking quality checks and monitoring 100% source data verification for: all data for the first patient per site, all consent forms, all primary endpoints and a random 5% of other data for all patients.

At enrolment, ReNs are collecting consent forms and data on patient, provider and device factors that potentiate PICC-associated complications and failure.2 These include: patient (eg, critical illness factors, coagulopathy, diagnostic group, neutropaenia, previous history of CABSI or venous thrombosis); device (PICC lumens, PICC size and vessel size); and provider (eg, inserter discipline, care during insertion and care during access) factors.

Immediately or within 24 hours of recruitment, PICC inserters are asked to rate the ease of PICC insertion (0=very difficult, 10=very easy).

Weekly, the ReNs are visiting or contacting participants to assess for primary and secondary outcomes, current use, and any clinical, PICC or treatment factors that have changed since recruitment.

Within 24 hours of PICC removal or at 8 weeks, the ReNs are collecting data on reason for removal including presence and type of failure if present, PICC dwell and infusates. Also within 24 hours, ReNs are asking the patient/parent about satisfaction with the PICCs (0=completely dissatisfied, 10=completely satisfied).

Within 1 week of PICC removal or at 8 weeks (maximum data collection), ReNs are collecting microbiological and clinical data for infectious, thrombotic and microbiological outcomes.

Microbiological substudy
To determine the effect of (1) hydrophobic and (2) CHG PICCs on bacterial colonisation, PICC-associated infection
and CHG resistance, compared with (3) conventional PICCs, catheter tips are being sent for further microbiological analysis in a selection of participants following PICC removal. This includes all PICC tips removed due to suspected infection, plus a control group of PICC tips from participants with no symptoms of infection (matched according to randomisation arm at a ratio of 2:1 cases to controls). All PICC tips are being cultured using the roll-plating method on blood agar, with quantification of cfus, species identification using Vitek-MS (BioMerieux) and susceptibility testing for a standard panel of antibiotics by Vitek 2 automated broth microdilution. In addition, CHG tolerance is being tested by determining minimum inhibitory concentrations against organisms isolated from PICC tips using broth microdilution (with an MIC ≥1mg/L defining reduced susceptibility to CHG). Genes known to be associated with CHG tolerance (eg, qacA/B and smr) are being confirmed by PCR. In patients with suspected CASBI and the same species grown in PICC tip cultures, organisms isolated from both blood and tip cultures are having DNA extracted and whole genome sequencing performed on the Illumina MiniSeq platform. Raw reads are being trimmed, checked for quality metrics, assembled and analysed using a custom pipeline to confirm species identification, define in silico multilocus sequence type and detect the presence of any antibiotic resistance genes. Other genes known to be associated with CHG tolerance and biofilm formation are being sought by BLAST against the assembled genomes. To confirm whether PICC tip and blood culture isolates are clonal, core genome differences between blood and PICC tip isolates are being determined by comparing single nucleotide polymorphisms.

**Thrombogenic substudy**

A subgroup of participants (n=120) are having blood collected on PICC insertion and, if possible, at the time of removal to assess haematological, coagulation profile and platelet activation. Blood samples are being collected via the PICC (from discard and whole blood aspirate) by ReN in sodium citrate and EDTA vacutainers (platelet/ full blood count), and the samples will be analysed for full blood examination (including white blood cell differentiation), clotting times (prothrombin time and activated partial thromboplastin time), platelet activation studies (flow cytometry) and D-dimer. These analyses will link the theoretical proposed mechanism of action to the clinically reported outcomes, strengthening study outcomes. Scanning electron microscopy will semiquantitatively assess blood component adherence to internal and external surfaces of removed PICCs.

**Data analysis**

Analysis will be ‘intention to treat’ with patient the unit of analysis. Baseline characteristics for each of the PICC groups will be descriptively presented using frequencies and percentages for categorical variables and means and SDs (or median and IQR if appropriate) for continuous variables. Primary analyses will compare between-group device failure rates using Cox proportional hazards regression, with treatment group included as the main effect. Effect estimates will be presented for hydrophobic PICCs versus conventional polyurethane PICCs and for CHG-impregnated PICCs versus conventional polyurethane PICCS as HRs with corresponding 95% CIs. Time-to-event data will be displayed graphically using Kaplan-Meier curves, and the differences between each of the hydrophobic and CHG PICC treatment groups and the conventional polyurethane PICC group will be compared using the log-rank test. The cause of any missing data will be assessed, and sensitivity analyses to investigate the potential impact of missingness will be undertaken using multiple imputation techniques if appropriate. A per-protocol analysis will assess the effect of protocol violations (ie, insertion of an unallocated PICC). P values ≤0.05 will be considered statistically significant, except for the primary outcome (<0.031), which has been chosen due to the two intervention arms being tested against a single control and to account for the two interim analyses of each intervention arm against control.

**Estimating cost parameters**

We hypothesise significantly reduced costs over control from a direct hospital perspective for the episode of care (2020 standardised $). We will quantify additional costs, cost offsets and net monetary benefit, considering PICC failure, reinsertions and treatment costs of complications per group. A micro-costing or bottom-up approach will be used with detailed resource use for PICC insertion/removal recorded for 75 procedures selected at random (25/group). Staff wage costs for application, troubleshooting, replacement, consultation and equipment used will be recorded. Regression analysis of the total cost per patient as the dependent variable will be further tested for appropriate model specification. To explore potential differences in health-related quality of life and patient experience, participants are being asked to complete both the EuroQol Five Dimension (EQ-5D) and the Australian Hospital Patient Experience Question Set, developed by the Australian Commission on Safety and Quality in Health Care, at removal.

**Patient and public involvement**

Feedback regarding the acceptability of the intervention products was sought from patients and their families during the pilot studies, which informed the development of this study. The overall results of the study will be communicated to the study participants by sending a plain language summary, and the associated peer-reviewed articles, to the provided email address.

**ETHICS AND DISSEMINATION**

This trial is registered with the Australian New Zealand Clinical Trials Registry. The trial has approval from the Clinical Trials Registry. The trial has approval from the...
Children’s Health Queensland Hospital and Health Service Human Research Ethics Committee (HREC) (HREC/QCHQ/48682) and Griffith University HREC (Ref. No. 2019/094) and is being managed in accordance with the Australian Government National Health and Medical Research Council (NHMRC) National Statement on Ethical Conduct in Human Research and the Note for Guidance on Good Clinical Practice (CPMP/ICH-I-135/95).

A Data Safety Monitoring Committee will review unblinded data and serious adverse events at n=400 and n=800 to advise on any recruitment and safety issues they identify and to investigate whether one or more of the intervention arms should be stopped early for efficacy. The intervention arm will stop recruiting if the arm is significantly different to the control arm at p<0.002.

Serious adverse events are being monitored and reported to the HRECs, as are protocol modifications. If important protocol amendments are made (eg, changes to eligibility criteria), AJU will update all investigators, HRECs, patient information and consent forms and the trial registry. Clinical trial insurance is held by the university. Written informed consent is being obtained from participants or representatives prior to participation (see online supplemental file 1 for example of the patient consent form). Consent can be withdrawn. Identifying details are being kept confidential via study IDs.

The trial and substudies were written by the investigators and will be published in peer-reviewed journals using appropriate reporting formats (ie, EQUATOR) with authorship consistent with the International Committee of Medical Journal Editors Guidelines. Data will be held at Griffith University.

Trial status
The trial began on the 8 September 2019. At the time of manuscript submission, 174 patients had been recruited, with a 2-year recruitment period per study site planned.

Data statement
The data generated and/or analysed during the trial are not yet publicly available as the trial is ongoing. When the trial is complete, data sets will be available from the chief investigator (AJU) on reasonable request and after agreement by ethics.

DISCUSSION
PICCs are a common medical device and an important component of modern healthcare, but the current failure rate of up to 30% is unacceptable and leads patients to experience multiple adverse events. As demonstrated in other vascular access types, innovations in PICC materials and design are an opportunity to reduce this preventable harm to patients and improve efficiencies in healthcare. These technologies are novel and potentially life-saving; however, this independent, sufficiently powered RCT is necessary to ascertain efficacy. Adoption of new technologies without evidence, including economic, may increase expenditure without increased value or cause unintended adverse events.

Author affiliations
1School of Nursing, Midwifery and Social Work, The University of Queensland, St Lucia, Queensland, Australia
2Menzies Health Institute Queensland, Griffith University, Nathan, Queensland, Australia
3Queensland Children’s Hospital, Children’s Health Queensland Hospital and Health Service, Brisbane, Queensland, Australia
4Royal Brisbane and Woman’s Hospital, Metro North Health Service District, Herston, Queensland, Australia
5Princess Alexandra Hospital, Metro South Health Service District, Woolloongabba, Queensland, Australia
6Princess Elizabeth Hospital and University of Sydney, Sydney, Australia
7Department of Medicine, University of Michigan, Ann Arbor, Michigan, USA

Twitter Amanda J Ullman @a_ullman, Jessica A Schults @jess_schults and Claire M Rickard @claire_avatar

Acknowledgements We would like to acknowledge the contributions made to the original proposal design by Professors Marianne Wallis and Adrian Esterman. We would also like to acknowledge and thank the clinicians and researchers at each of the study sites.

Contributors AJU, TK, NMM, AB and PNAH conceived the study; AJU and JB designed the economic evaluation; AJU, DA, TK, RW, NMM, RSW, VC, CMR and PNAH designed the protocol; AJU, TK, RW, NMM, AB, BP, NR, PL-A, AC, JB, RW, VC, AC, PM, CMR and PNAH secured funding; all authors prepared and approved the final version of the manuscript.

Funding This work is supported by the National Health and Medical Research Council APP1157178.

Disclaimer No commercial entity had any role in the conception, design or funding of this study, or is the preparation of this manuscript.

Competing interests Griffith University (AJU’s former employer) has received unrestricted research and educational grants to support her research (unrelated from the current project) from 3M, Becton Dickinson and Cardinal Health. Griffith University (DA’s employer) has received consultancy payments for educational lectures based on her research and clinical expertise from 3M and Johnsons and Johnsons. Griffith University (TK’s employer) has received unrestricted research and educational grants from 3M, Becton Dickinson and Medical Specialties Australasia. Griffith University (RWM’s employer) has received unrestricted research and educational grants to support her research (unrelated to current project) from Becton Dickinson. Griffith University (NMM’s former employer) has received unrestricted research and educational grants to support her research (unrelated to current project) from 3M, Becton Dickinson and Cardinal Health. Griffith University (AB’s employer) has received consultancy payments from Becton Dickinson (unrelated to the current project). Griffith University (JB’s employer) has received unrestricted research and educational grants to support her research (unrelated to current project) from Becton Dickinson, and Navi Technologies. PM is a member of Myeloma Advisory Boards for Celgene, Janssen, Amgen, Takeda and Amyloidosis Advisory Boards for Pfizer and Caelum. No personal fees have been received for these services. PM has received a research grant from Janssen for a clinical trial. PM has accommodation and registration provided by Amgen for attendance at the International Myeloma Workshop in 2019. Griffith University (CMR’s former employer) has received unrestricted research and educational grants to support her research (unrelated to the current project) from 3M, Becton Dickinson and Cardinal Health. Other authors have no conflicts of interests to disclose.

Patient and public involvement statement Feedback regarding the acceptability of the intervention products was sought from patients and their families during the pilot studies, which informed the development of this study. The overall results of the study will be communicated to the study participants by sending a plain language summary, and the associated peer-reviewed articles, to the provided email address.

Patient consent for publication Not required.

Disclaimer: No commercial entity had any role in the conception, design or funding of this study, or is the preparation of this manuscript.
REFERENCES


Ethics approval Queensland Health (HREC/ OCHO/ 46682 and Griffith University (Ref. No. 2019/094).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement The data generated and/or analysed during the trial are not yet publicly available as the trial is ongoing. When the trial is complete, data sets will be available from the chief investigator (AJU) on reasonable request, and after agreement by ethics.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs
Amanda J Ullman http://orcid.org/0000-0001-8860-5319
Jessica A Schults http://orcid.org/0000-0002-5406-9519
Robert S Ware http://orcid.org/0000-0002-6129-6736
1

**PATIENT INFORMATION STATEMENT**

**Project Title**  Peripherally inserted central catheter Innovation to reduce Infections & Clots

**HREC Number**  

**Investigator**  

**Protocol Version Number:** V3.0  **Version Date:** 12/08/2020

Thank you for taking the time to read this *Information Statement and Consent Form*. We would like to ask you to participate in a research project that is explained below.

**It is ok to say no**

**What is an Information Statement?**

These pages tell you about the research project. It explains to you clearly and openly all the steps and procedures of the project. The information is to help you decide whether or not you would like the patient for whom you are the substitute decision maker to take part in the research. Please read this Information Statement carefully.

Before you decide if you want the patient to take part or not, you can ask us any questions you have about the project. You may want to talk about the project with your family, friends or health care worker.

**Important things to know**

- It is your choice whether or not to take part in the research. You do not have to agree if you do not want to.

- If you decide you do not want to take part, it will not affect the treatment and care you receive through (Insert Hospital Here)

If you would like to take part in the research project, please sign the consent form provided by the Researcher. By signing the consent form you are telling us that you:

- understand what you have read
- had a chance to ask questions and received satisfactory answers
- consent to taking part in the project

We will give you a copy of this information and consent form to keep.
1. **What is the research project about?**

Peripheral Inserted Central Catheters (PICCs) are plastic tubes which are inserted through veins in the arm or leg, into the heart, so people can receive medical treatment (e.g., medicines, fluid). Sometimes PICCs stop working due to because of blood clots and infections.

New types of PICCs have been developed, that may help prevent blood clots and infections. Within this trial we are comparing:

- A plain plastic PICC;
- A slippery PICC, that may stop blood clots attaching; and
- An anti-septic PICC, that is coated with a cleaning solution that may prevent infections.

It is important that we test these devices, to establish if these newer PICCs reduce complications, such as blood clots and infection.

The plain plastic and slippery PICCs are currently used in Australian hospitals, including this hospital. The anti-septic PICC is not currently available in Australia, but has been used in the United States for the past 2 years.

2. **Who is funding the research project?**

This trial has received funding from the Australian Government’s National Health and Medical Research Council.

3. **Compensation**

This document in no way limits your rights at law from any damage that might arise from negligence on the part of investigators.

**Why is the patient being asked to take part?**

- You have been asked to take part because you require a PICC, so you can receive treatment.

**What does the patient need to do in this research project?**

- Information about your medical condition, device and blood test results will be recorded from the hospital chart by a research nurse or assistant.

- Research nurses will visit you weekly during their hospital stay and/or during outpatient clinic visits to collect information on the device. Outpatient contact will be made weekly by either phone or SMS (depending on your preference). For participant convenience some device outcome responses may be provided by prepaid mail correspondence.

- Follow up will continue for 8 weeks or until the PICC is removed (whichever occurs first).

- To test how your blood is responding to having the PICC in place a blood test may be collected via the PICC on insertion and once during PICC dwell or PICC removal (no additional needle-sticks).

- On removal, the PICC may be collected and will be tested in the laboratory for signs of infection and blood clots developing Similarly, blood/specimens which are already collected by your doctors and nurses (for QLD Pathology) may be checked.

- Photographs/video-footage may be taken of the device during participation in this study. These photographs/video-tapes are for research purposes and may be used in conference/ seminar presentations to demonstrate how these PICCs work. We will not include images of your face/identifying features, and we will not give people your name.
• We would like to keep the anonymous information we collect for other research into vascular access, blood clots and infection, and that may occur in the future.

Can the patient withdraw from the project?
Yes, you are free to withdraw your consent and to discontinue participation, by telling the research nurse and/or completing the revocation of consent form. A decision not to participate or to withdraw participation will not affect the treatment you receive.

4. What if I wish to withdraw from the research project?
Your decision whether or not to participate will not prejudice your future relations with (Insert Hospital Here). If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time. The decision to withdraw from the study will not affect your routine medical treatment or your relationship with the people treating you.

5. What are the possible benefits for the patient and other people in the future?
It is not expected that the research will result in any personal benefit to the individual. We do expect that it will benefit patients in the future to support clinicians in make good decisions.

6. Alternative Treatment
The treating doctors and nurses will choose the PICC type to be inserted.

7. What are the possible risks, side-effects, discomforts and/or inconveniences?
All PICCs are associated with some risks. Above and beyond this, in rare cases patients may experience reactions to the PICC products the anti-septic solution. This is a commonly used in healthcare – it is found in skin cleanser, hand wash and mouth wash. If you experience any itchiness, redness, swelling, blistering or other reaction, please notify your treating nurse immediately. Regular checks will be conducted as per normal practice to ensure any reactions are identified quickly, and appropriately managed.

8. What will be done to make sure my information is confidential?
• Data collected during this study will be treated confidentially. The research nurse and assistants will store data using a unique research number.
• The information will be safely stored at the hospital and/or within Griffith University.
• Combined patient results of this study will be presented in scientific journals and conferences. However, the patient for who you are substitute decision maker will not be referred to by name and personal identification information will not be revealed in any publication or presentation.
• Research records will be destroyed 15 years after the study.

9. Who should I contact for more information?
If you would like more information about the project or if you need to speak to a member of the research team in an emergency please contact: **TBA**

Name: <insert name>
Contact telephone: \(<\text{insert contact phone number}>\)

Email: \(<\text{insert email}>\)

**HREC Information:**

The Children’s Health Queensland Hospital and Health Service Human Research Ethics Committee (HREC) has approved this study. If you have any concerns and/or complaints about the project, the way it is being conducted or your child’s rights as a research participant, and would like to speak to someone independent of the project, please contact the HREC Coordinator on: 3069 7002 or email CHQETHICS@health.qld.gov.au

**Local Governance Contact Information:**

Name: \(<\text{insert name}>\)

Contact telephone: \(<\text{insert contact phone number}>\)

Email: \(<\text{insert email}>\)
CHILDREN’S HEALTH QUEENSLAND
PARTICIPANT CONSENT FORM

Title
Peripherally inserted central catheter
Innovation to reduce Infections & Clots

Protocol Number
V3.0

Coordinating Principal Investigator/Principal Investigator
Dr Amanda Ullman
(Principal Investigator)

Declaration by Patient:

I have read the Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the research project without affecting your future health care.

I understand that I will be given a signed copy of this document to keep.

I agree that a blood sample may be taken from the PICC upon insertion and removal and that this will not require any additional needle pricks. These tests will be used to look for early signs of blood clots. The PICC itself may also be collected to assess for blood clots and early signs of infection.

I agree that the device may be photographed by one of the members of the research team. These images may be taken if time permits and suitable equipment is available. This may be used in future conference/seminar presentations for research purposes. I understand that although the image will be shown, names will not be used.

I also agree for the information collected and blood tests/ catheter (collected by the research nurse or the treating clinician) to be kept in an anonymous format for future research studies by the investigators on vascular access, blood clots and infection topics.

I would like a copy of the research results to be sent to me at the end of this study.

If the PICC remains in place for outpatient care, I (circle) consent / do not consent to weekly phone call or SMS follow-up.

Email or postal address for report to be sent: ________________________________

(MASTER) PICNIC Trial: Participant Information and Consent Sheet. V4.0 12.08.2020
<table>
<thead>
<tr>
<th>Name of Participant (please print)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature of Participant</td>
<td></td>
</tr>
</tbody>
</table>

**Declaration by Study Doctor/Senior Researcher**

I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

<table>
<thead>
<tr>
<th>Name of Study Doctor/Senior Researcher† (please print)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature</td>
</tr>
</tbody>
</table>

† Please print