出國報告（出國類別：進修）

主題：兒童氣管暨呼吸道手術

服務機關：臺北榮民總醫院外科部兒童外科
姓名職稱：葉奕廷醫師
派赴國家：英國
出國期間：**2018/10/1-2019/9/18**
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摘要

職於2018年10月起至2019年9月奉派至英國大奧蒙街兒童醫院進修兒童氣管暨呼吸道手術。兒童呼吸道手術由於手術程序較為複雜、術前診斷、初步處理以及術後照顧，與成人呼吸道疾病的思考模式略有不同。本院兒童醫學部素有「台灣兒童呼吸道重鎮」之名，許多外院無法處理的疑難雜症均會轉至本院接受治療且成效良好，尤其是氣管狹窄以及氣管軟化方面之經驗相當豐富，在兒童內外科合作之下，成果也已發表於期刊並至國際醫學會報告。

此次出國進修之目的即在藉由至國際先進兒童呼吸道治療中心進行長時間的考察，更加精進此類病患的手術及預後品質。在選定進修地點時，藉由查考相關文獻以及參加國內、國際會議之經驗，選擇英國倫敦大奧蒙街兒童醫院作為主要進修地點，後來也在大奧蒙街兒童醫院的推薦之下，短期至日本兵庫縣神戶兒童醫院進修，以獲得東西方處理此類病患上不同之觀點與做法。

關鍵字：兒童外科、兒童呼吸道手術、兒童氣管手術

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一、 目的

兒童呼吸道手術由於手術程序較為複雜、術前診斷、初步處理以及術後照顧，與成人呼吸道疾病的思考模式略有不同。本院兒童醫學部素有「台灣兒童呼吸道重鎮」之名，許多外院無法處理的疑難雜症均會轉至本院接受治療且成效良好，尤其是氣管狹窄以及氣管軟化方面之經驗相當豐富，在兒童內外科合作之下，成果也已發表於期刊並至國際醫學會報告。

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二、 過程

2018年10月1日至2019年8月18日：於英國倫敦大奧蒙街兒童醫院氣管團隊（Tracheal Team）進修，期間隨氣管團隊參加歐洲心胸外醫學會（European Association of Cardiothoracic Surgery）、胸腔外科醫學會（Society of Thoracic Surgeons）、美國胸腔外科醫學會（American Association of Thoracic Surgeons）、國際小兒外科內視鏡醫學會（International Pediatric Endoscopic Group）、美國小兒外科醫學會（American Pediatric Surgery Association）及英國小兒外科醫學會（British Association of Pediatric Surgeons）等小兒胸腔外科相關之年會進行學習、國際交流及論文發表。

2019年8月19日至2019年9月18日：於日本兵庫縣神戶兒童醫院兒童外科團隊進修，

期間隨兒童外科團隊至奈良市參加日本小兒外科醫學會近畿地區年會。

三、 心得

英國倫敦大奧蒙街醫院

大奧蒙街醫院（Great Ormond Street Hospital，GOSH ）由 Charles West 醫師成立於1852年，是英語世界中第一間專門至立於兒童疾病的兒童醫院，於2019年2月14日慶祝創院167年周年紀念。

GOSH 位於倫敦市中心博物館、大學林立的文教區 Bloomsbury District，在泰唔士河北岸，大英博物館東側，國王十字車站南側的精華地段，交通十分便利。

雖然大倫敦地區兒童醫院及大學附屬醫院林立，GOSH 仍被視為全世界最佳兒童醫院之一，院內總床數約360床，每年門診量達237,908人次，住院病患達43,218人次（2018/2019統計資料），院內有63個次專科，是全英國次專科最齊全之醫院。其兒童加護病房（PICU）、心臟胸腔外科、神經外科、癌症、腎臟科、國際醫療的業務量都是全英國最大。特別的是 GOSH 並沒有急診部門，僅接受緊急轉診，所以醫師們的職業環境相當有品質。在倫敦泰唔士河北岸的兒童急診則大多送至倫敦大學醫院（University College of London Hospital）處理。

在教學研究方面，GOSH 與倫敦大學（University College of London，UCL）合作，有專門進行兒童疾病研究的國家兒童健康研究院（Institute of Child Health，ICH），在許多領域的研究皆是世界頂尖。

GOSH 氣管團隊（Tracheal Team）

GOSH 的氣管團隊成立於2000年，由心胸外科教授 Professor Martin Elliot（已退

休）所組織，包含心胸外科、耳鼻喉科、診斷性及介入性放射科、加護病房、物理治療師及護理人員等等。從2006年起被英國 NHS（國家醫療保險）認定為全國唯一能處理複雜性氣管手術的醫院，接受全英境內病患經由轉診接受治療，由於治療成果昭著，目前歐陸以及中東地區轉診量逐漸上升。

氣管團隊接受轉診治療的疾病包括：先天性氣管狹窄、氣管支氣管軟化、喉氣管食道裂、氣管腫瘤以及因先天性心臟病而引起的呼吸道壓迫，每年新轉診數量平均為130人次。其中先天性氣管狹窄施行滑動式氣管成型術（slide tracheoplasty，STP）方面，首先發表此技術是目前任職於 GOSH 心臟胸外科主任 Professor Victor Tsang[1]，並且從1995年起由 Professor Martin Elliot 主導，常規進行此項手術。隨著技術的精進以及照護團隊的技術及默契增長，目前有全世界此類手術數量最多、追蹤最久、死亡率最低的紀錄[2]並在期刊中有多篇文獻發表[3–7]。

自從2000年開始成立專門處理兒童複雜呼吸道疾病的氣管團隊之後，藉由每週固定的多專科團隊（multidisciplinary team，MDT）討論，回溯發現藉由多專科團隊討論照護的模式，可以顯著降低先天性氣管狹窄病患在加護病房以及總住院的天數及花費[4]。

氣管團隊的運作模式

GOSH 的氣管團隊在 Elliot 教授退休之後，是由小兒耳鼻喉科的 Dr. Richard Hewitt 領導，成員包括前述的兒童心胸外科、兒童外科、診斷性及介入性放射科、加護病房等多專科，團隊設有研修醫師（fellow）一名，專科護理師（clinical nursing specialist，CNS）兩名。

團隊日常的活動是上午的查房，研修醫師會跟兩位專科護理師到病房將目前團

隊中住院病患看過一輪，大部分的時候小兒心臟胸腔外科的醫師會加入查房的行列，然後開始一天的工作如手術或進行術前術後例行檢查等等。另外團隊例行的會議有禮拜四上午11點的小兒胸腔多專科會議，下午一點半的腫瘤多專科會議以及下午五點的氣管團隊多專科會議。在氣管團隊會議時，研修醫師會報告這個禮拜新的會診病人（每個禮拜大約三到五個新病例），然後討論目前住院中以及未來可能要回診病人的狀況。小兒放射科醫師則操作另一台電腦隨時打開醫療影像進行判讀，其他各職類則適時的表達意見與討論。

近年來，氣管團隊業務量上升，除了每年約15人次接受 STP，和基本的先天性肺部發育異常（congenital pulmonary airway malformation）、支氣管閉鎖（bronchial atresia）及游離肺（pulmonary sequestration）之外，其他兒童胸腔手術之種類以及複雜度也有上升。

例如英國有許多因為誤食鋰電池造成食道損傷，導致食道氣管廔管的病例，許多外院無法處理的病患均轉至 GOSH 接受治療，治療方式包括將廔管處切除並作 STP，或用自體的心包膜或肋膜修補氣管後壁[8]。

而目前 GOSH 也針對單側肺部發育不全或未發育的病人，或者在嬰幼兒時期因為後天原因（腫瘤、嚴重慢性感染）需做單側全肺切除，術後併發嚴重縱隔腔偏移者，此類病患由心胸外科以及整型外科共同手術，放置組織擴張器到患側胸腔內，讓氣管可以回到中線，並穩定縱隔腔。此一作法在 GOSH 已有20餘例的經驗，即將撰寫論文發表。

GOSH 也有許多肌肉骨骼發育異常的病患，牽涉到胸腔的外型及運動，會產生呼吸方面的症狀而需要外科的介入。常見的凹胸（pectus excavatum）近年來在 GOSH 卻非常少見，只有遇到兩三年前接受納式（Nuss）手術矯正完成後來移除金

屬支架的病人，原因是 NHS 限縮可以執行 Nuss 手術的醫院，所以無法在 GOSH 進行此項手術。

不同團隊分工方面，氣管團隊所著重的疾病範圍在氣管、支氣管相關疾病之診對治療，對於喉科（嗆咳、聲門下狹窄）方面，則是由耳鼻喉科團隊全權負責，並不會進到氣管團隊討論；而食道吞嚥方面，則是由小兒外科及腸胃科負責；肺部及胸廓則是有胸腔的多專科團隊來處理。這點與美國目前風行的呼吸消化團隊（aerodigestive team）略有不同，美國呼吸消化團隊以辛辛那提兒童醫院為例，是由兒童耳鼻喉科、兒童胸腔科、兒童腸胃科及兒童外科組成，處理的病患以嗆咳及聲門下狹窄為大宗，氣管狹窄以及氣管軟化只是其中的一小部分。

英國健保制度下的醫療行為

英國由於採行 NHS 公醫制，又極為落實家庭醫師及轉診制度，所以可長可短的等待是日常醫療行為的一部分，在來英國之前就有聽聞例如關節置換須等上數月的情形。由於呼吸道疾病嚴重時可能攸關生死，所以病患的處理都相當的積極。不過 GOSH 氣管團隊對於不需緊急處理或者只是之前手術後回診追蹤的病患，建議下次回 GOSH 返診的時間間隔通常在6到8週之間，相較於台灣醫學中心同時要兼顧專科治療以及初級照護（primary care）的情況有相當大的差異。

在外科手術相關方面，英國人做事很注重程序及禮儀，一般而言都會有把事情做好再交給別人的習慣。 開刀日當天的行程，在上午八點十五分時，會在開刀房旁的麻醉準備室內進行當天手術病例的交班，首先房間內的所有人必須要簡短的講述自己的名字以及任務，然後負責當天手術的主治醫師或者資深研究醫師（Fellow）會報告今天要手術病患的背景資料、疾病以及預計進行的術式，可能需要體循師、

麻醉以及護理人員配合的特殊事項等等，同時各職類同仁也會表達他們對於手術細節的疑問，而由於加護病房的占床率很高，床位調控通常是當天早上才能確認，在當時也會確認術後加護病房的動態。最後會由護理師依據 checklist 進行確認，直到大家都滿意沒有問題才會去病房接病人。

病人從病房到麻醉準備室之後，麻醉科醫師會做術前必要的準備例如插管、打中心靜脈導管、動脈導管等等。由於呼吸道胸腔手術的風險較高，所以準備時間較長，通常第一台刀到十點左右才會真正開始。外科醫師雖然有時間的壓力，但也幾乎不會干涉麻醉準備的過程，因為那是麻醉的專業範圍，他們有權利把工作做好。

英國小兒外科醫師的訓練

由於英國與歐陸嚴格限制住院醫師工時（每週40小時），所以在專科醫師的訓練上有相因應的措施。英國兒童外科醫師的訓練，在醫學院畢業之後，需接受兩年的 foundation training（FY1-2）、core surgical training（CT1-2），之後先取得外科專科醫師（MRCS），再進到總共六年的小兒外科專科訓練 specialty training（ST3-8）。而小兒外科訓練是以 consortium 為單位，許多醫院聯合訓練，學員則在醫院之間輪替，薪水則統一由 NHS 供應。此訓練制度之優點在於，由於每間醫院病例數以及專長不同（而且 NHS 常有限制某些手術僅能在某些醫院進行，例如肝臟手術在英國東南部只能在 Kings College University Hospital、中部只能在 Leeds University Hospital 進行），學員可以藉由多間醫院聯合訓練，達到截長補短的效果，而且可以學到不同醫院、不同醫師對於同一疾病的不同處理方式。

在訓練期間，英國小兒外科醫學會一年會舉辦兩次全國性的訓練課程，一次是獨立的兩天的課程，一次則是和年會同時舉辦的課程，課程內容由當年輪值的大學

醫院安排，讓所有訓練學員對於所有臨床課題都有一致性的瞭解，也是學員之間互相交流的重要場合。相較之下，國內醫學會如消化外科醫學會、耳鼻喉科醫學會、神經外科醫學會等皆有由學會舉辦之訓練課程，唯小兒外科醫學會，雖然每年接受專科訓練人數少，理論上舉辦教學活動應不會花費太多，但尚未有此類全國性之訓練課程以及各院輪訓制度。追究其原因，概可歸因於以下幾點因素：

（一）小兒外科醫學會每年訓練人數少，但分散在南北各醫學中心，雇用歸屬每個醫院而非如英國是屬於 NHS 管轄，在人員輪調上缺乏彈性，無法在不同醫院體系之間進行交換學習。

（二）小兒外科專科醫師設置與醫學中心評鑑掛勾，造成病例稀釋，而且醫學中心之間各立門戶，若將病例轉出會受內部檢討，導致罕見病例無法集中，醫療品質無法提升。

參加2018年歐洲心臟胸腔外科醫學會

由於 GOSH 氣管團隊主責氣管狹窄的醫師是兒童心臟胸腔外科醫師，而且歐美進行氣管手術的大多也是由兒童心臟胸腔外科醫師執行，所以自然發表研究成果的場域大多是在心臟胸腔外科的會議（在純小兒外科的會議中鮮少有此類主題的文章發表概為此原因）。歐洲心臟胸腔外科醫學會（European Association of Cardiothoracic Surgeons）是歐洲最大的心臟胸腔外科醫學會，2018年的年會辦在義大利的米蘭，據官方統計在2018年有4587人次註冊參加年會，參與國家的前五名是義大利、德國、美國、英國及俄羅斯，總共接受投稿1449篇，其中467篇被選為口頭報告。本次 GOSH 氣管團隊總共發表兩篇研究，也是小兒胸腔方面發表最多的醫院。第一篇是探討利用心包膜補片（pericardial patch）進行大面積氣管缺損修補之結果，研究指

出在2015到2017年間有9位兒童在 GOSH 接受心包膜補片修補氣管缺損，缺損原因中以鈕扣電池吞食腐蝕性傷害造成氣管食道廔管為大宗，其餘包括復發性先天性氣管食道廔管、氣管狹窄手術後癒合不良等等，病童接受補片修補之後追蹤，死亡率為11%（一名），有22%（兩名）補片失敗需再次手術，長期追蹤發現有56%（五位）的病患因為補片處強度較弱造成有症狀的氣管軟化需接受支架放置的治療。

第二篇研究則是探討在先天性單側肺臟無發育或者後天接受單側全肺切除的病童當中放置胸腔內填充物（prosthesis）的經驗以及結果報告，研究指出，單側肺臟無發育的病童在出生後可能因為對側肺部代償性過度擴張、加上可能合併先天性氣管狹窄的因素，而會發生縱隔腔偏移、氣管扭曲造成呼吸道阻塞的狀況，而幼童因腫瘤或嚴重感染等等原因接受單側全肺切除之後，也可能因縱隔腔偏移而造成血液動力學不穩定以及無法脫離呼吸器的狀況。此時可以考慮在患側胸腔植入填充物，隨著年齡增長慢慢將填充物的容積增加，在2010年到2018年之間有17位兒童因上述原因在 GOSH 接受單側胸腔植入物，有九位是因為先天性單側肺部無發育（其中六位合併氣管狹窄）出生之後反覆發生呼吸中止且無法脫離呼吸器，另外八位則是因為後天原因接受全肺切除。若是先天性的原因大多會採取分階段手術的方式，先植入填充物，穩定縱隔腔，之後視情況進行氣管狹窄以及先天性心臟病的修補；後天性原因則僅需植入填充物並定期追蹤，增加填充的體積。

參加2018年歐洲兒童大腸直腸外科醫學會

歐洲地區每年會固定舉辦兒童大腸直腸外科醫學會，2018年的年會辦在荷蘭的奈梅亨（Nijmegan）。參加此次課程主要是因為在大會當中，除了一般的論文發表以及專題演講外，特別為較資淺的醫師設有教學課程，有專家針對手術的步驟詳細說明，

並且有機會用動物的組織來練習兒童大腸直腸外科手術的操作。

由於國內類似病例相對稀少，在訓練過程中實際主刀的機會貧乏，此時模擬訓練更顯出其價值。在兩天的會期當中，資淺醫師可以藉由兩個半天的教學課程，對於巨結腸症以及無肛症兩個主要的疾病從病人診斷評估、初步處理、最終手術治療以及術後追蹤和可能發生的併發症，在專家的引導之下除了概念之外對於一些臨床的細節也有一定的認識。針對手術術式方面，在課程中也有詳細的教學影帶，在歐美專家的解說之下讓學員對於手術步驟以及一些應注意的事項有更深刻的瞭解。在會期之後的隔天則是整天的動物實驗課程，前往大學醫院的動物實驗室進行動物實驗，在實驗之前會重複播放手術步驟的影帶，再次熟悉手術的過程，然後分小組（每組三位由一位導師負責）進行。三天的課程下來收穫滿滿，也實際有動刀的機會，補足訓練過程中不足的部分。

在兩天的會期下午則是 College Tour（名稱來源是荷蘭著名的訪談性電視節目，專門訪問名人），訪談歐洲巨結腸症以及無肛症兩個領域的專家各一位，講述他們的學思歷程或者最新研究的結果。之後則是互動辯論的議程，挑出專家們對於巨結腸症以及無肛症兩個領域最有爭議的五個議題，以一對一專家辯論的方式，在輕鬆的氣氛之下各自表達觀點與實證，最後由一位美國的專家（Dr. Marc Levitt）進行總結。

參加 GOSH 內部新生兒呼吸道課程

此課程的對象是任何對新生兒呼吸道處理有興趣的醫療人員，由新生兒科、麻醉科以及兒童緊急轉送服務（Children's Acute Transport Service）專科醫師負責教授，內容涵蓋新生兒呼吸道解剖、生理、藥理等等，在臨床技術中心進行教學，課後進行實際演練（類似急救課程當中的 Mega Code），雖然稍有臨床經驗，但要用英文進行

情境處理還是第一次，但在老師以及同學的引導之下順利的完成課程。

辛辛那提兒童醫院短期參訪

在 GOSH 指導老師的推薦之下，我在進修的時間當中抽空拜訪辛辛那提兒童醫院進行短期的參訪學習。辛辛那提是美國中西部俄亥俄州的大城，位於俄亥俄州的南部，以俄亥俄河和肯德基洲相臨。辛辛那提兒童醫院成立於1883年，目前是辛辛那提大學（University of Cincinnati）的附屬醫院，每年住院達32,326人次，急診量達173,203人次，專科門診量達951,434人次，外科方面每年手術量達6,414台算是相當大規模的兒童醫學中心。在 U.S. News 醫院評比中，2018-2019年排名全美第二，2019-2020年排名全美第三，全院十個專科的排名也在全美前十以內。

辛辛那提兒童醫院的兒童耳鼻喉科在全美富有盛名，兒童聲門下狹窄著名的 Cotton-Myer 分級系統命名的兩位兒童耳鼻喉科醫師 Dr. Cotton 以及 Dr. Myer 即在此醫院任職。此次參訪學習主要是針對呼吸消化團隊（Aerodigestive Team）進行觀察，對兒童外科的部分也藉機進行見習。

辛辛那提呼吸消化團隊是由小兒耳鼻喉科醫師 Dr. Michael Rutter 所領導，由小兒耳鼻喉科、小兒胸腔科、小兒腸胃科、小兒外科、復健科、語言治療師等多專科組成的團隊。團隊運作的主力是眾多的專科護理師（Nurse Practitioner，NP），一共有十位，每個病人從接到會診開始就由該位專科護理師全程負責，NP 會負責安排一切門診檢查和治療、與團隊主治醫師共同商討治療策略並預畫治療的時間線，在每個禮拜三早上八點的呼吸消化團隊會議中，每個 NP 會輪流報告自己手上病患哪些本週要接受手術或檢查、哪些是新會診的病患已經安排什麼樣的檢查、以及過去的一週手上有哪些病患有新的手術或檢查結果。由於會診的量相當的大，每週約有五

到十個新會診所以議程名單總是一大本。與 GOSH 的氣管團隊相比，辛辛那提的呼吸消化團隊關注的範圍比較著重在誤嚥以及嗆咳（aspiration）這方面的問題，也較多是需要耳鼻喉科方面的處置，雖然整體病人量較 GOSH 多，但當中真正導因於氣管狹窄軟化與 GOSH 相較少一些。

兒童外科部分，在科內有兩位「兒童外科」的 Fellow（一屆一位，稱為 senior 和 junior fellow），負責帶領下面的輪調住院醫師（從辛辛那提大學醫院輪調過來的）以及三位「專科」Fellow：胎兒醫學、大腸直腸、創傷，另外還有一位「國際」Fellow。由於在美國要接受兒童外科的訓練是相當競爭的一件事，大家除了在住院醫師的時期會參與臨床或者基礎研究之外，在住院醫師當完取得外科專科資格之後，為了讓自己的資歷更完整，常常會先申請這種「專科」Fellow 蹲一兩年，一方面熟悉兒童外科的常規及各項疾病，第二方面可以藉由做研究、在學會報告論文的方式讓認識全國提供專科訓練醫院的負責人，留下好印象之後申請比較容易。

每天早上由當天值班的 fellow 舉行教班晨會，住院醫師以及專科護理師報告每個病人的狀況以及每天預計要做的事情，fellow 的知識和能力都有一定水準所以自主性相當高。

開刀部分則是由值班 fellow 分配每個住院醫師和專科 fellow 當天負責的手術，若手術檯上有 fellow 則手術慣例是由 fellow 主刀，因為主治醫師的責任是「要把 fellow 教會開刀」，輪調住院醫師則是按造資歷以及能力，可以在手術當中負責完成一部份的步驟。這樣重視教學的態度是讓我很驚訝的，但先決條件是科內要有足夠的病例，而且所有主治醫師必須都要認同「教會 fellow 開刀」是件重要的事情。由於在美國兒童醫院中，兒童外科也要負責外傷以及 ECMO 會診，所以值班往往是相當忙碌的，而且因為兩者皆必須搶時間執行，所以值班主治醫師要紮紮實實的留

在院內。

胸腔外科醫學會（Society of Thoracic Surgeons，STS）和美國胸腔外科醫學會（American Association of Thoracic Surgeons，AATS）

STS 和 AATS 是北美兩個最大的胸腔心臟外科醫學會，由於在美國及歐洲治療氣管狹窄及軟化的大部分是小兒心臟胸腔外科，所以除了歐洲的 EACTS 之外，STS 以及 AATS 也是氣管手術方面論文報告的重要會議。

GOSH 氣管團隊在 STS 當中有一篇論文報告，探討長段氣管狹窄合併先天性心臟病時，處理的流程，是同時手術還是分次手術，是否對於死亡率等預後產生影響，研究發現在113位合併氣管狹窄以及先天性心臟病的兒童當中，同時手術與分次手術並不會影響死亡率，但在心臟疾病嚴重度較高的病患中，可以考慮分次手術的策略來避免單次心肺機使用時間過長而導致的併發症。

在 STS 中，美國芝加哥兒童醫院在同一個場次中也報告了該院25年以來氣管手術的經驗，從1993年到2018年期間共有44位病童接受氣管方面的手術（其中27位病童接受滑動式氣管成形術、15位病童接受局部切除及端對端吻合），多變數分析顯示住院天數是死亡、再度插管以及後來接受氣切手術的危險因子，而死亡的唯一危險因子是接受同時的心臟手術。由此可見 GOSH 在氣管方面的手術量與許多美國大型兒童醫院相比仍是多上許多。

其他與兒童氣管手術相關的報告包括休士頓德州兒童醫院團隊報告兒童血管環的治療，血管環可能會造成氣管或者食道的壓迫，必須接受手術治療，在22年的期間總共有148位病人接受血管環矯正手術，其中最常見的異常解剖是雙側主動脈弓（73例），及右側主動脈弓合併異常的左鎖骨下動脈（70例），雖然有一定比例的病

人（125例）僅接受單側主動脈弓切除或者動脈韌帶的切除，但在長期追蹤之下發現有些病患在數年之後會因為持續氣管壓迫而必須接受 Kommerell 動脈憩室切除合併鎖骨下動脈重植手術。而最常見的併發症是乳糜胸。

在 STS 中，其他有趣的報告包括使用心房缺損關閉器治療氣管食道廔管（大多數人覺得不適合，反而會讓廔管變大），以及以劍凸下的路徑進行縱膈腔腫瘤的切除（在成人手術方面已經有許多經由劍凸下路徑進行肺部以及縱膈腔病灶切除的經驗，在兒童方面還沒有類似的報告，或許是未來臨床嘗試的方向）。

在 AATS 當中有專門探討兒童氣管手術的時段，當然也是這次會參加 AATS 主要的原因，密西根大學的 Dr. Ohye 報告該院使用3D 列印氣管外支架治療支氣管軟化的經驗，由於放置在體內之後希望外支架能被身體所吸收不需要手術移除，所以 3D 列印的材質選用 PCL，在體內可以自然水解。而針對外支架這種治療方式，波士頓兒童醫院的 Dr. Jennings 則表示說他曾使用 Synthesis 的可吸收骨板，藉由它遇熱之後軟化能塑形，以及用剪刀就可以方便裁切的特色，也是當作外支架很好的材料選擇，而且不像3D 列印的外支架有預先訂制的時間限制。我很欣賞這樣的思考方式，最好的解決方式不見得是最新的，而且要達到客製化的方式很多，3D 列印植入物目前牽涉太多製程、法規問題，而且列印成品需經過滅菌包裝等等，如果能有現成的材料而且又具有可塑型的特性，反而比3D 列印更加的實用。

另外西北大學芝加哥兒童醫院的 Backer 教授則發表該院處理血管環造成氣管食道壓迫的經驗分享，血管環分類複雜，常造成氣管食道壓迫，通常需進行血管重植手術，而被壓迫的氣管若將壓迫處完全解除通常不需進行重建手術會逐漸改善。

波士頓兒童醫院的 Dr. Jennings 以一位小兒外科醫師的身份，在大多為心臟外科的場合報告他的團隊進行氣管固定術治療氣管支氣管軟化的成果，內容大致與該團

隊最近發表的諸多論文相近，而該院也是氣管固定術做得最積極的醫院，雖然成效相當良好，但不免讓其他醫院認為是否有些病人其實不需要接受這麼侵入性的手術（目前波士頓兒童醫院氣管固定術皆需傳統開胸手術，其他醫院有嘗試用內視鏡手術進行但仍沒有很多經驗）。

德州兒童醫院的 Binsalamah 醫師報告了他們二十年間處理肺血管環合併完全氣管還的病例，在18位接受肺血管環重植手術的病患當中，12位被診斷有完全氣管環，其中6位接受氣管重建手術，他們的結論是有些有完全氣管環的病例可以不必接受氣管重建手術。但 GOSH 的處理哲學其實比較傾向一旦有廢血管環的病患在手術前檢查發現有完全氣管環，就一定會接受氣管重建手術，原因是這些有肺動脈環的病人雖然完全氣管環也會隨著兒童長大而變大，但大多數的病人後來會產生症狀而需要手術，所以傾向在處理肺血管環時一併處理，避免未來需要再次手術。

波士頓兒童醫院的 Kamran 醫師在這個議程的最後報告了在環形主動脈弓造成氣管壓迫的病人進行主動脈移位（uncrossing）合併氣管固定術的結果。整體而言 AATS 在氣管手術方面的主題是參加了三個心胸外醫學會當中最豐富者，其他成人疾病的議程也有選取較有興趣的題目去聆聽學習。

IPEG

International Pediatric Endoscopic Group（IPEG）是一個世界性推廣小兒外科內視鏡手術的組織，可以視為美國 Society of American Gastrointestinal and Endoscopic Surgeons（SAGES）在小兒方面的對應組織。大會當中會討論小兒外科及小兒泌尿科內視鏡的最新進展，同時也有場次是以辯論的形式對於爭議性的議題進行討論，最重要的是為小兒外科醫師提供國際交流的平台。

此次大會在會期前也有一整天的實作課程，讓比較資淺或者甚至資深但欠缺內

視鏡經驗的醫師能夠透過學習課程習得進階腹腔鏡的技巧。IPEG 實作課程特殊之處在於主辦單位採用的是「精熟學習」（Mastery Learning）的課程規劃方式，此種教學法在1968年由美國的教育學者 Benjamin Bloom 所提出，是一種團體學習的方式，但教學策略非常個人化、依據每個學生學習的狀況來調整教學的步調。此種教學法背後的理論是「只要給予學生足夠的時間，每個學生都能對於某領域的知識達到高度的理解程度」。Bloom 博士反對一般教育理論認為由於一群學生當中的資質和偏好應該是常態分配所以學習成就也應該是常態分配的理論，他認為若教育成功，學習成就應該能使90%以上的學生達到成功且感到成就感。實作課程的設計是依循 Learning For Mastery 的架構，首先會給予學員紙筆問卷讓學生自評他們對於內視鏡手術的熟悉度以及經驗，在自評之後教師根據學員自評的程度將學生分組，目的是不希望同組內的學員能力相差太大，導致教師在教學過程中無法兼顧的狀況。如此一來，能力相近的學員被放在同一組，教師可以根據學員的需求而進行教學。在正式實作之前，主辦單位也安排了一些講座讓學員對於內視鏡的技巧、內視鏡手術的優勢以及如何與麻醉科溝通配合有完整的概念。實作部分則是以3D 列印的兒童胸廓模型，配合胎牛的食道、氣管、肺來進行離體的動物實驗，主要是練習食道閉鎖氣管食道廔管和新生兒肺葉切除這兩項手術。在課後也會有紙筆問卷讓學生自評他們學習的成果，同時教師也會給予回饋。整體而言算是非常認真安排的動物手術模型實作課程。

在短短兩天的會期當中，涵蓋了大腸直腸、消化道、胸腔、泌尿道、肝膽、胎兒手術以及外科創新等等議題。個人比較感興趣的題目如下：

美國 Missouri 大學兒童醫院團隊 Angotti 醫師報告以胸腔鏡輔助的方式，協助骨科醫師以 spine tethering 的方式進行脊椎側彎的矯正。本院也處理許多脊椎側彎的病患，

回國之後若有適合病患計畫與骨科共同合作進行手術。

阿根廷 Garrahan 兒童醫院團隊 Bailez 醫師報告該院研發的多孔洞模擬器，可供兒童、新生兒內視鏡手術甚至是胎兒手術練習使用。

美國 Stanford 大學團隊 Taylor 醫師報告，設計虛擬實境的遊戲來減輕兒童對於接受醫療處置（侵入性處置或者床邊簡單手術）的焦慮以及恐懼，遊戲是由頭的轉動所控制，而且內容特別設計過不會讓兒童需要移動肢體或讓頭部有太大的動作而干擾手術的進行。

美國 Colorado 州洛磯山兒童醫院 Rothenberg 醫師報告靛青綠（indocyanine green）用於在數中辨認肝母細胞瘤在腹腔的轉移。本院有一案例使用同一技術辨認肝母細胞瘤在肺部的轉移，有類似的經驗。

菲律賓 San Juan de Dios 的 Olivos 醫師報告 Youtube 作為兒童外科醫師內視鏡手術教育學習的平台。發現在 Youtube 上可搜尋到的錄影大部分都是醫師私人的影帶，而且許多並沒有包含手術除了腹腔鏡之外其他重要的部分，且可能帶有影片中醫師個人的偏見而沒有揭露，雖然是很方便學習的平台，但醫師（尤其是正在學習內視鏡手術的醫師）在看影帶教學時要小心並且在實際手術時應謹慎求證。作者也呼籲 IPEG 作為一個教育性的組織應該拍攝「教學帶」讓後進醫師能夠有正確的影片資源能自主學習。

美國 Rocky Mountain Children's Hospital 的 Bonnard 醫師以及德國 Johannes Gutenberg University Mainz 的 Holler 醫師分別報告兩院利用自動縫合器進行十二指腸閉鎖的吻合手術，由於美國有廠商針對小兒病患設計生產直徑為5mm 的自動縫合器，以及直徑為3mm 的雙極電燒刀，此兩項器械已普遍在歐美地區的醫院使用，所以在內視鏡運用較為普遍的醫院已經是常規利用自動縫合器進行內視鏡的手術。但

由於國內市場過小，與廠商接洽之後他們沒有進軍台灣市場的意願，而且本院兒童內視鏡手術風氣不盛，難以在院內複製相關的經驗。

西班牙 Hospital Universitario 12 de Octubre 的 Castro 醫師報告該院在早產兒進行腹腔鏡疝氣修補手術的經驗。小兒腹腔鏡疝氣手術在日本、歐洲及美國已經蔚為風氣，尤其是日本幾乎所有大學附設醫院大部分的疝氣手術皆以腹腔鏡進行。台灣也有許多小兒外科醫師進行腹腔鏡疝氣手術，但本院兒童腹腔鏡手術風氣不盛，尚未有相關經驗。

沙烏地阿拉伯 King Saud University 的 Alqahtani 醫師報告該院在兒童及青少年病態性肥胖進行減肥手術的長期追蹤成果。兒童病態性肥胖在美國以及阿拉伯國家是嚴重的問題，所以兒童及青少年的減肥手術有逐漸增加的趨勢，在一篇 NEJM 2016 年的研究中指出，全美有4.4萬兒童及青少年有肥胖的問題，而且因為病態性肥胖接受減肥手術的青少年逐年上升，接受手術的年齡大部分是16、17歲，無論是接受胃繞道手術或者是縮胃手術，體重降低的幅度都在26至28%之間，大部分病人的代謝症候群有獲得改善。國內兒童青少年肥胖也有上升的趨勢，尤其像本院是許多遺傳代謝性疾病全國轉介治療的中心，可以與罕病中心洽詢是否有相關需求，並且與本院減重代謝手術中心合作進行。

阿根廷 Fundacion Hospitalaria 醫院的 Martinez 醫師與團隊報告該院以3D 影像重組技術以及3D 列印技術來輔助胸廓畸形的治療，該院以3D 掃瞄器掃瞄病人外型，並針對漏斗胸病患進行術前模擬設計微創手術的矯正鋼板，針對雞胸病患設計外部壓迫的背架，針對複雜性胸廓畸形病患計畫手術重建方式。目前已經朝商業化方向進行，期待能進軍美國市場。國內目前三軍總醫院有針對漏斗胸病患以3D 列印方式預先規劃矯正板的形狀，並且列印出來在術中彎折時可當作模板，降低彎曲後可能

形狀不如預期需多次調整的狀況。本科3D 影像及3D 列印方面的運用已非常熟練，但漏斗胸手術皆以傳統手術進行，微創手術經驗甚少，可能要先跨越這道鴻溝有初步經驗之後才能夠參考運用。

美國小兒外科醫學會年會以及英國小兒外科醫學會年會

利用在美國、英國的期間參加了美國小兒外科醫學會和英國小兒外科醫學會的年會

英國小兒外科醫學會年會是歐陸英語世界僅次於歐洲小兒外科醫學會（European Pediatric Surgical Association）的重要會議，所以除了大英國協的成員和美國之外，歐洲其他國家的小兒外科醫師參加的狀況也很踴躍。今年的大會辦在英國中部的 Nottingham，是羅賓漢的故鄉。在大會之前，有專為住院醫師、fellow 和 young staff 的 Post-graduate Course，此次有兩大主題：oncology 與 colorectal surgery。指導者會提出許多有趣的病例和大家分享，並且引導大家思考臨床處理的流程。

大會依照報告題目分為幾個大的場次，包括：General Pediatric Surgery、Prize Session、Upper and Lower GI、NEC、Hepatopancreaticobiliary、Oncology、Basic Science、Global Surgery、Urology、Transitional Care、Thoracic 及 Trauma 以及許多的特別演講。

此次我在大會中報告我在 GOSH 參與的臨床研究，題目是「Thoracoscopic aortopexy for symptomatic tracheobronchomalacia」探討以胸腔內視鏡的方式來治療有症狀的氣管支氣管軟化症。氣管支氣管軟化症的成因可能是軟骨發育的異常，造成軟骨外型的不正常，或者因為先天性氣管食道廔管造成上段食道膨大，將氣管後壁往前壓迫造成呼吸道阻塞，產生吐氣時喘鳴聲、慢性咳嗽，甚至有危及生命的症狀。氣管支氣管軟化症的治療大多是以非手術為主，利用一些化痰劑促進呼吸道分

泌物的排除、胸腔物理治療以及非侵入性正壓呼吸。但若症狀無法改善或者持續有危及生命的狀況，此時可以利用手術方式，將主動脈前壁以縫線固定在胸骨之後，讓氣管直徑增加，稱作主動脈固定術。傳統上主動脈固定術是經由部分胸骨切開方式或者左側開胸來進行，但近年來隨著微創手術的發展，許多的醫院開始利用胸腔內視鏡進行微創主動脈固定術，一開始許多醫院的 case series 都有復發率高的問題，可能是因為 learning curve，以及在主動脈上入針時因為怕出血不敢吃針太深，導致組織脫離縫線。在我們的序列裡，在九年的時間中有21位病人接受胸腔內視鏡主動脈固定手術，術前這些病例都經過多專科團隊的討論決定手術方式，17名病患僅有氣管軟化，另外4名則合併支氣管軟化，術前檢查包括硬式、軟式支氣管鏡、氣管支氣管攝影，以及胸部電腦斷層。14位病患手術的適應症是危及生命的發作，5位是因為反覆肺炎，2位是因為無法脫離侵入性呼吸器。在21位病患當中，20位成功接受胸腔內視鏡主動脈固定手術，1位原本用胸腔內視鏡進行，但因術中無法將縫線固定至適當位置而改為傳統手術。2位在術中有出血的狀況，其中1位術後放置胸腔引流管引流血水。麻醉的時間平均是140分鐘。在平均一年的追蹤期間，有2位病患有縫線脫離的狀況，2位都接受傳統手術進行主動脈固定以及氣管固定手術，其中1位後來無法脫離呼吸器而接受氣管切開手術。另外尚有2位病患後來也接受氣管切開手術，危險因子以多變數方式分析發現是支氣管軟化。整個病例序列的成功率80%，歸功於術前多專科團隊的仔細篩選病人，以及術後的專業團隊照護。由於近年來氣管固定術廣泛被用在氣管支氣管狹窄的治療上，尤其是波士頓兒童醫院發表大型病例序列之後，所以與會聽眾也對我們團隊是否常規進行氣管固定手術非常的有興趣，但就 GOSH 團隊的經驗而言，不會將氣管固定術放在首位，而會先行嘗試主動脈固定術，而且會嘗試以最小侵入性的原則運用胸腔內視鏡來進行，若手術成效不

彰則會以胸骨切開術的方式進行主動脈固定以及氣管固定術。

大會設有 Denis Browne Medal 是英國小兒外科醫學會頒給對小兒外科有特殊貢獻的醫師，今年的受獎人是來自美國麻省總醫院的 Professor Donahoe，她畢業於哥倫比亞大學，之後到麻省總醫院接受訓練，也曾經至英國劍橋 Adler Hey 兒童醫院接受訓練，所以和英國小兒外科醫學會也有相當的淵源。她主要是研究荷爾蒙（anti-Mullerian hormone）在發育生物學以及癌症治療上的應用，也對性別的發育以及食道氣管先天性異常的發育有相當的研究。本院和 Professor Donahoe 有相當的淵源，本科前主任錢大維醫師（現任彰化基督教醫院兒童醫院副院長）曾赴美進修在 Professor Donahoe 實驗室進行基礎研究，這次藉由參加會議的機會也代錢副院長向 Professor Donahoe 表示祝賀。

在美國與英國小兒外科醫學會年會當中共同的演講是由美國 Ohio 州 Akron Children's Hospital 的 Dr. Todd Ponsky 所主講「Social media and the paediatric surgeon」，其內容不只是談到醫師該如何善用社群媒體，更重要的是在這個資訊爆炸的年代，生物醫學論文每兩個月就倍數增加，醫師該如何獲得最新的資訊來讓自己保持在知識的尖端，又如何讓外科知識能夠自由地傳遞流通，讓全世界都能知道最新最好的做法呢？講者的團隊的做法是他們建構了一個網路平台，可以張貼最新期刊的摘要，而且團隊也會定期針對小兒外科的議題製作專題 podcast，另外他們還想要利用人工智慧的方式來輔助最新文章的篩選。由於團隊有大學的資源，以及美國小兒外科醫學會和雜誌社的背書，看起來這個平台是越來越有規模。我也加入平台註冊免費帳號，馬上就能享受所有的資源。以他們的製作模式和成本，在台灣要有類似的平台應該很難，但能否爭取將內容翻譯編輯後作為教學使用，是可以進行的方式。

美國小兒外科醫學會年會部分，則由於今年是美國小兒外科醫學會50週年的緣故，在每個場次的開頭都有對有特殊貢獻的前輩們致敬的橋段，由一位年輕醫師來報告前輩的生平以及傑出的表現，若前輩在場也會請他站起來接受與會聽眾們的喝采，是紀念傳統並且鼓勵年輕一代站在巨人肩膀上努力往前進的體現。官方的社群媒體 hashtag #notyourparentsAPSA 更顯示了學會擁抱科技、鼓勵年輕人創新又不忘根源的精神。今年的年會也將教育性質的課程打散在議程當中，讓所有與會者都能參與。另外也請到 Google、Boston Dynamics 的外賓讓大家瞭解一下人工智慧、機器人學的最新進展。

美國雖然人口眾多，大型兒童醫院林立，但許多訓練計畫仍面臨病人減少、指標性病例下降的問題，學會也有人提出是否應強制執行訓練病例數的限制，甚至縮減訓練的容額或者增加訓練年限，以確保訓練品質。而在執業中的小兒外科醫師，卻因為工作負荷太大面臨工作倦怠、過勞等等的狀況。針對這些專科發展上的困境，學會特別辦了一場 Robert Gross 辯論，以小兒外科鼻祖為名，以「若這些因素無法解決，我不會鼓勵我的兒女從事小兒外科」，似乎大家都同意小兒外科是非常有價值而且令人感到心理上滿足的科別，但在訓練上仍有實質的難處需多方來改善。

另外也有些國內少碰觸的主題：例如請到美國有名的維權律師 Adam Foss 主講「健康的社會因素（Social Determinant of Health）」；請到 Google Cloud 的 Michael C. Muelly 醫師分享他是如何從 Stanford 大學全職的放射科醫師投入 Google Cloud 健康服務；以及請到 Boston Dynamics 的 CEO Marc Raibert 分享他們公司是如何建構動態機器人；還有請到 Johns Hopkins 醫院急症外科（Acute Care Surgery）的主任 Joseph V. Sakran 分享他從公衛角度來看槍枝氾濫的看法。

梅約診所

在美國期間，由於舍妹目前任職於梅約診所的臨床技術模擬中心，負責外科醫師的教學課程設計，我也有向她請教美國外科醫師訓練課程相關資訊。梅約診所外科住院醫師教學是由一般外科的 David R. Farley 醫師負責，他的哲學是利用低擬真度的模擬來讓住院醫師熟悉手術的解剖以及各個步驟，用的材料是唾手可得的絨布、不織布、毛線等等材質，將每個課程（例如胸管插入、環甲切開術、腸道吻合等等）做成模組化的教具，學員可以在自己有空的時間至模擬中心領取教具進行自主學習。另外在每年期初及期末會有「外科奧運會 Surgical Olympics」，對於比較資深的學員則會有「外科極限運動會 Surgical X-games」。另外一個重要的學習方式是「影片評論」，希望學員看內視鏡開刀手術的錄影時可以一邊看一邊說出他所看到的重要構造以及目前在做的動作，甚至是可能會發生危險的動作，隨著學員經驗的增加，越來越能貼近「專家」的程度，對於手術整體過程有一個心智表徵（mental representation）。

神戶兒童醫院

在 GOSH 師長的推薦之下，為了瞭解氣管及呼吸道團隊在東方環境的運作模式，我決定在進修的最後一個月前往日本神戶兒童醫院進行一個月的研修。

兵庫縣是關西近畿地方的大縣，人口有550萬，神戶市是兵庫縣的縣治所在，人口有150萬人，是日本第七大城。

神戶兒童醫院是兵庫縣內兒童醫療的轉診中心，也是神戶大學的關係醫院，在三年前從山邊的舊址搬到目前在神戶港島上的新院區。由於是新建的院區，所以所有的設置與規格都是現代化的規格，在院區旁則是神戶市質子治療中心。有趣的

是，同樣是東方文化但日本對「四」並沒有禁忌，開刀房、加護病房都設置在四樓，一二樓是門診區，三樓是醫局（醫師辦公室），五樓以上則是病房。醫局的設置也很有趣，除了擔任主管職以外的主治醫師和住院醫師共用一個開放空間，每個人僅有一個辦公書桌和頭上書架的空間。沒想到想到在一個階級分明的社會當中辦公空間是如此的扁平化。

神戶兒童醫院治療兒童呼吸道疾病有很悠久的歷史，是日本關西地區氣管疑難雜症的指定轉診醫院，常有病人從九州、鹿兒島或甚至沖繩等地轉診到神戶兒童醫院接受治療。現任的教授是前田貢作教授，科內另有五個主治醫師。

日本醫院的生活就比較接近台灣，上午七點半晨會，前一天值班的住院醫師報告所有病人的狀況，然後主治醫師會做評論並決定當天的治療方向，之後大家巡房（有點像是 social round，主要是看一下全部的病人的狀況，有特別需處理的事情巡房之後才會分頭處理），然後九點進開刀房。

由於是兒童醫院，在門診手術的開刀房內特別設有電子琴讓音樂治療師可以在小病人走進開刀房的時候聽他最喜歡的卡通歌曲。本院也有類似的措施但是是由護理師播放 YouTube 上的影片，雖然方便但影片的長度和內容無法客製化隨著小病人接受麻醉的狀況而調整。和本院很不一樣的是，在日本絕大多數的腹股溝疝氣都是用腹腔鏡修補，他們用特殊內藏一套環之的空心針頭將線環繞在腹股溝內環腹膜外的位置，然後將內環結紮。我在英國和美國看到疝氣手術也絕大多數以腹腔鏡執行，但歐美大部分是用體內縫合封閉內環的方式，美國會將疝氣囊的頸部腹膜稍作電燒處理以增強癒合之後進行體內縫合。回國之後已經開始進行微創疝氣手術。神戶兒童醫院的開刀房所有的手術常規利用錄影系統進行錄影及存檔，而且畫質相當優良，和電子病歷整合，隨時要調出手術影帶相當的容易。麻醉科和開刀房護理

站也可以中央監控所有開刀房手術進行的過程，以隨時調度人力，處理突發狀況。

四、 建議事項（包括改進作法）：

非常感謝醫院的大力支持讓我能在初升主治醫師時就能有機會到英國、美國及日本向兒童外科、兒童氣管手術的大師學習。

幾點建議事項及具體改進作法：

國內由於出生數下降，兒童數量遞減，除了小兒外科訓練變得相當困難，未來將參考神戶兒童醫院的做法，常規使用攝影燈把，將重要的手術以錄影系統拍攝起來，除了讓住院醫師可以複習看過的手術，也可以為很久沒有看過的手術進行預習，主刀醫師也可以針對自己手術的技巧進行檢討改善。另外由於內視鏡錄影主機年代較久，畫質較為普通，職已自費添購高畫質錄影機因應。

另外許多國外最先進的醫材也因為市場過小造成沒有廠商願意賠錢引進，犧牲嬰幼兒生存及醫療權。日前新聞報導衛福部承諾將統整兒童藥品、醫材短缺清單，並成立兒醫物流中心等平台，協助醫院採購及調度。衛福部醫事司長石崇良表示，困難取得兒童用藥調度平台計畫由中國醫藥大學附設兒童醫院取得第一順位，預計明年1月上路。本院無兒童醫院資格所以僅能希望衛福部兌現承諾，以及中國醫大兒童醫院能善盡全國採購調度物流中心之職責，一方面確保國內兒童與歐美日先進國家兒童享有相同生存及醫療之權益，一方面能使外科手術醫材跟上國際腳步，尤其是微創手術器械部分，能與國際前緣接軌。此項建議已由小兒外科醫學會規劃進行中。

另外在開刀房動線流程設計部分，並無特別為兒童設計規劃，僅能靠護理師的親和力與巧手，哄騙孩童進入開刀房，可能可以參考國外經驗，利用虛擬實境或者音樂治療方式來減輕兒童上麻藥之前的焦慮，已著手與開刀房護理師商討改善方案。

在麻醉部分，國外腹腔鏡手術許多都使用第二代 LMA 代替插管，而除全身麻醉外腹部手術也會以超音波施打腹橫肌神經阻斷（TAP），在手術室 briefing 後，若非早上第一台刀則會請病房讓病人喝水，在國內是難以想像的。台大兒童醫院在日前參加會議時有報告，目前腹腔鏡手術常規使用第二代 LMA（iGel），肌肉鬆弛劑大多使用 Rocuronium 配合 Sugamadex，另外 NPO 的標準也儘量符合實證研究及生理以避免脫水：clear liquid 可以允許到手術前一小時，母奶則是手術前兩小時，配方奶則為手術前四小時，固體食物則是六到八小時，除了氣體麻醉之外也配合caudal epidural block 用於腹部甚至胸腔手術以減低 opioid 類的用量。期待本院也快速跟進，讓 ERAS（enhanced recovery after surgery）的概念也能應用在小兒外科領域。此項建議細節部分已與麻醉部商討進行研擬中。

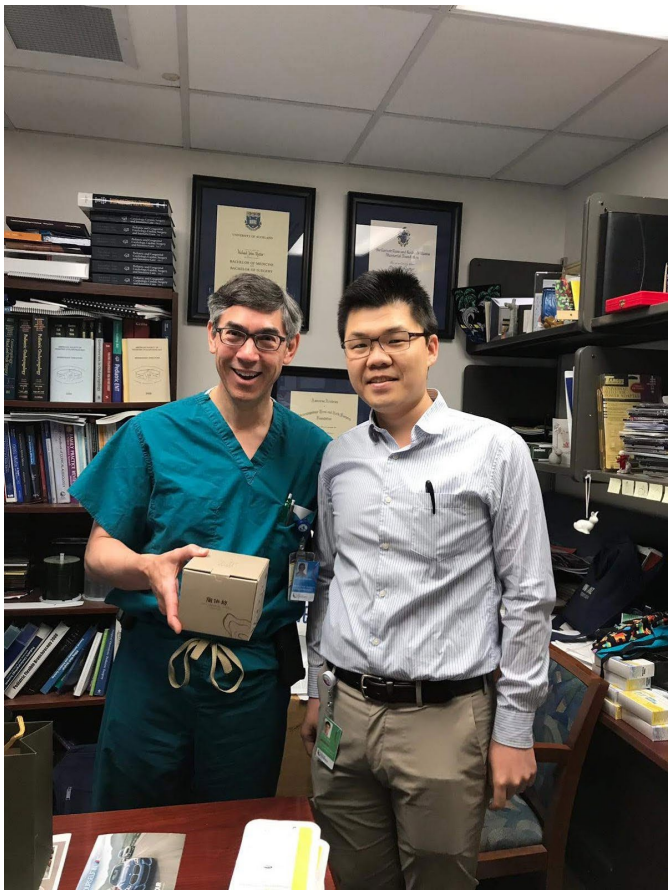
氣管手術部分，在心肺支持部分，可參考日本神戶兒童醫院採用 central ECMO 的方式，已與心臟外科吳飛逸醫師商討研議。在氣管重建技巧部分，本院之技巧已經相當純熟，無改進必要。

住院醫師教育部分，由於本院外科住院醫師素質較高、技術能力較好，以往僅有一年一次為期一天的住院醫師訓練營，並無像梅約診所一般每個禮拜保護性的教學時間進行結構化的教學，在外科部的支持下將參考梅約診所的課程，做因地制宜的微調，試行將模擬課程加入住院醫師訓練課程中，讓本院外科住院醫師訓練更加扎實。

附錄

Great Ormond Street Hospital 心臟外科醫師 Dr. Muthialu（左二）、tracheal CNS（專科護理師）Amy（右三）及 Denise（右二）、tracheal team fellow Dr. Madhavan（右一）

Great Ormond Street Hospital 耳鼻喉科醫師 Dr. Hewitt（右二）



Cincinnati Children’s Hospital 耳鼻喉科醫師 Dr. Rutter（右一）

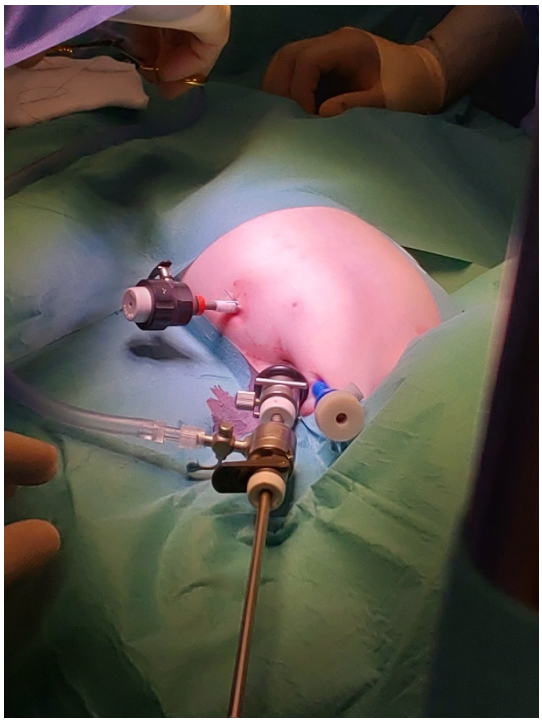
波士頓兒童醫院兒童外科醫師 Dr. Jennings（右一）

神戶兒童醫院小兒外科醫師 Dr. Maeda（右一）

Great Ormond Street Hospital 舊棟外觀

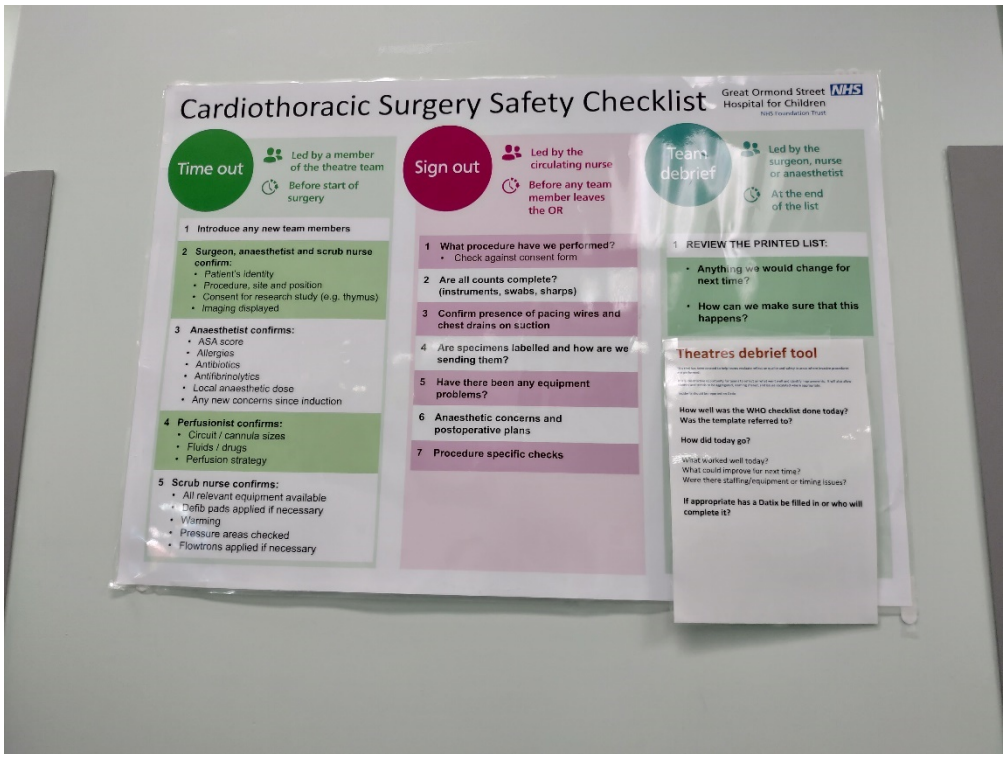
GOSH 氣管團隊辦公室一隅

GOSH 氣管團隊辦公室一隅

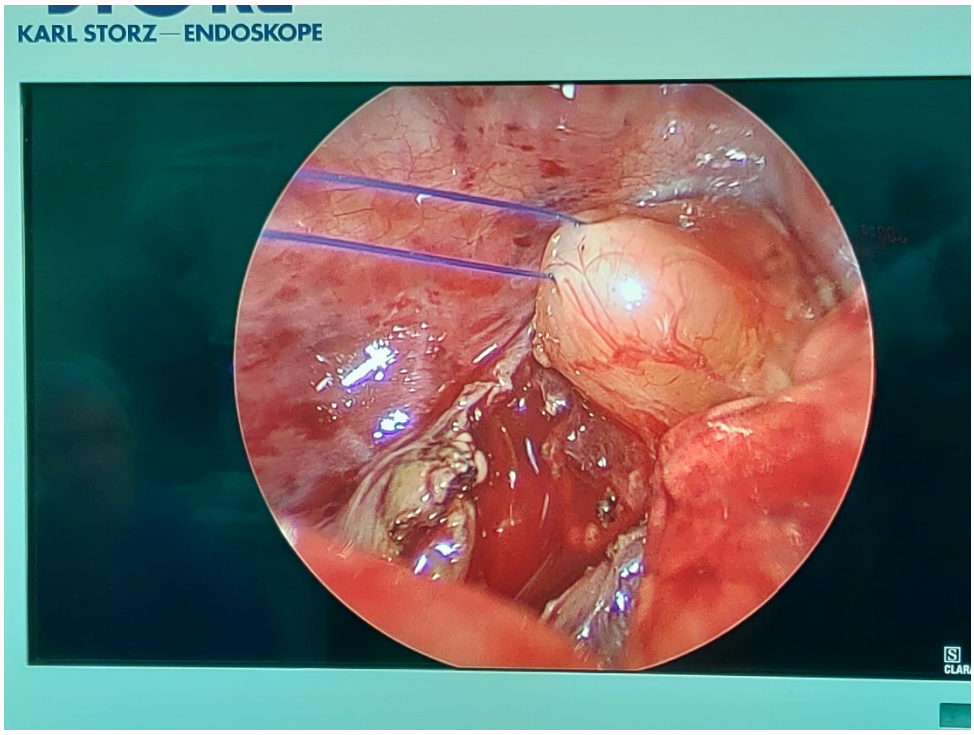


嬰兒微創胸腔鏡主動脈懸吊手術

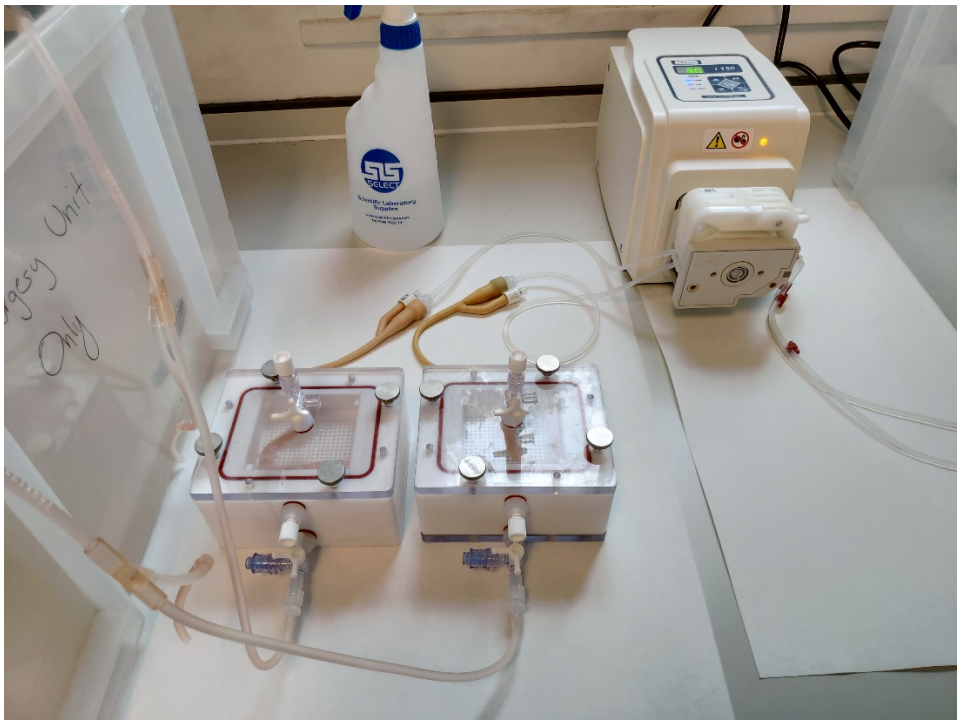
GOSH 手術恢復室一景



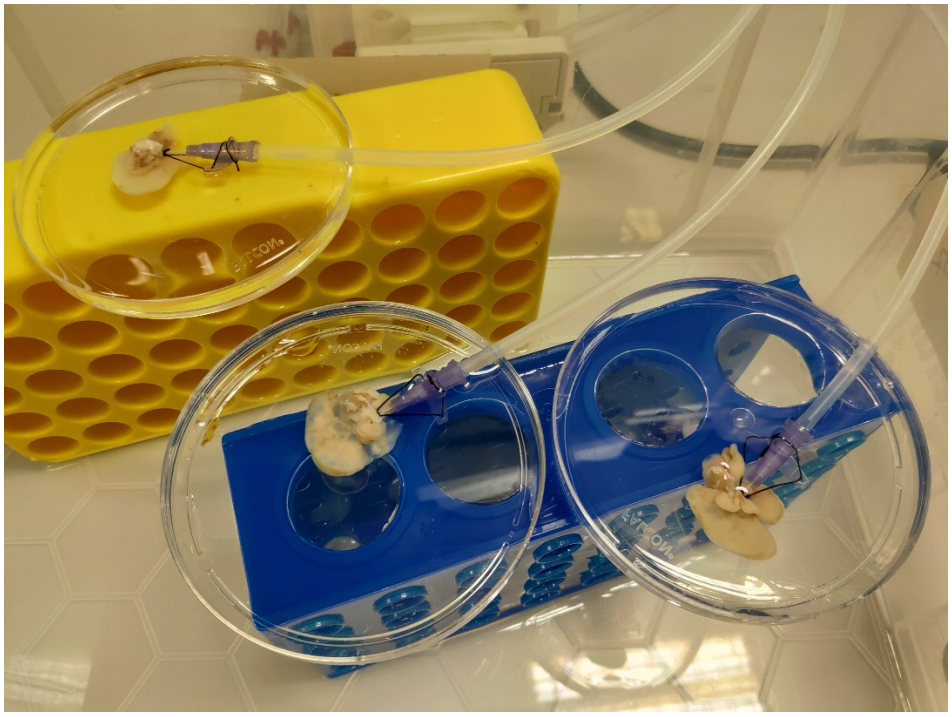
GOSH 心胸外科手術安全核對表



新生兒微創胸腔鏡食道閉鎖手術

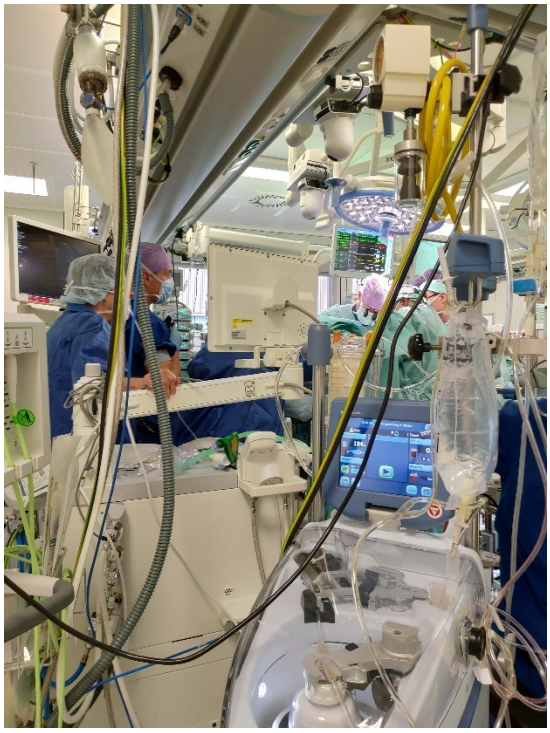


UCL-ICH 組織工程實驗室動物組織去細胞（decellularization）實驗

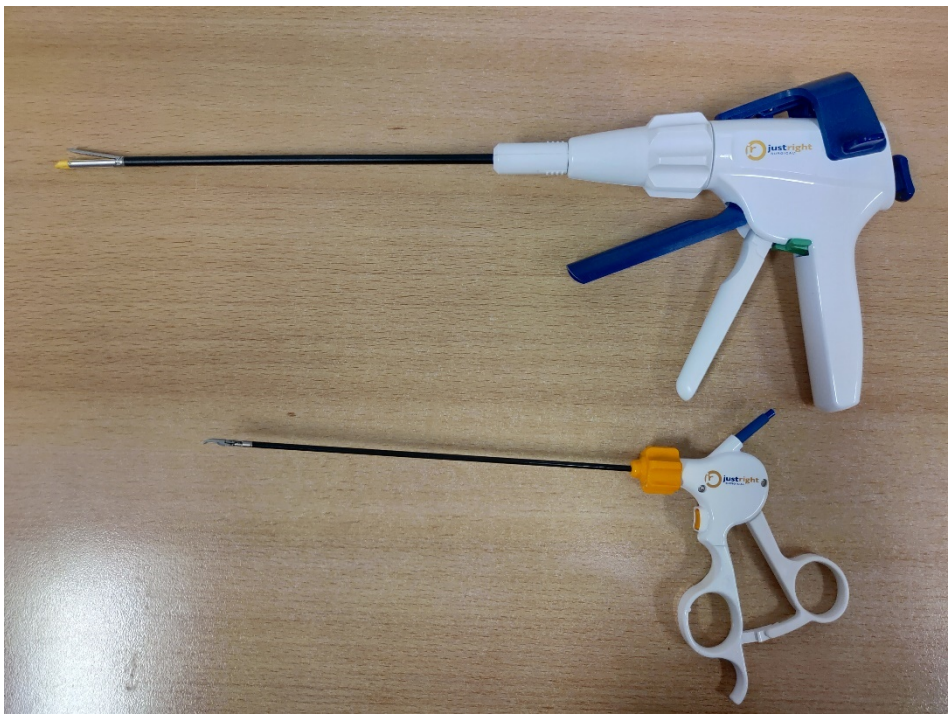


UCL-ICH 組織工程實驗室動物組織去細胞（decellularization）實驗

GOSH 心胸外醫師 Dr. Muthialu 於2018年歐洲心胸外醫學會 EACTS 報告



荷蘭鹿特丹 Erasmus MC Sophia Children's Hospital 開刀房一隅



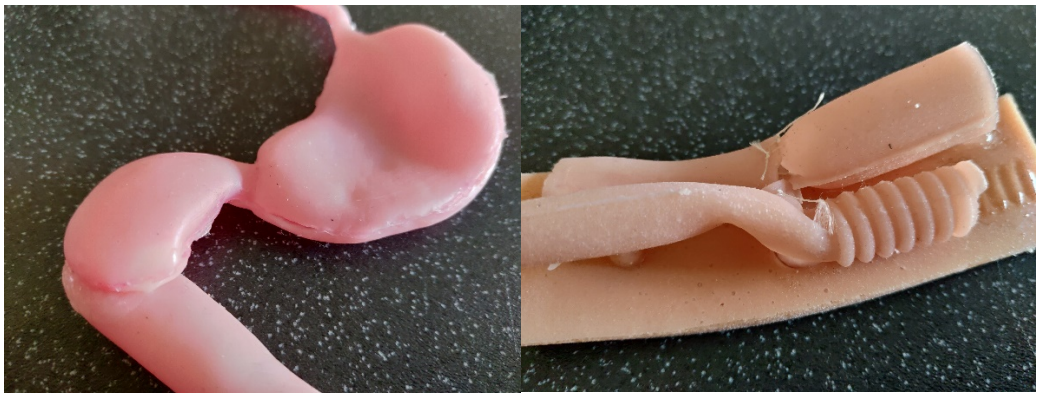
美國 Bolder Surgical 專門為小兒內視鏡手術研發的5mm 自動縫合釘（上）以及3mm 雙極電燒刀（下），台灣市場太小，洽詢原廠表示沒有尋找代理商的計畫

2018 European Colorectal Conference 於荷蘭 Njimegen 舉辦

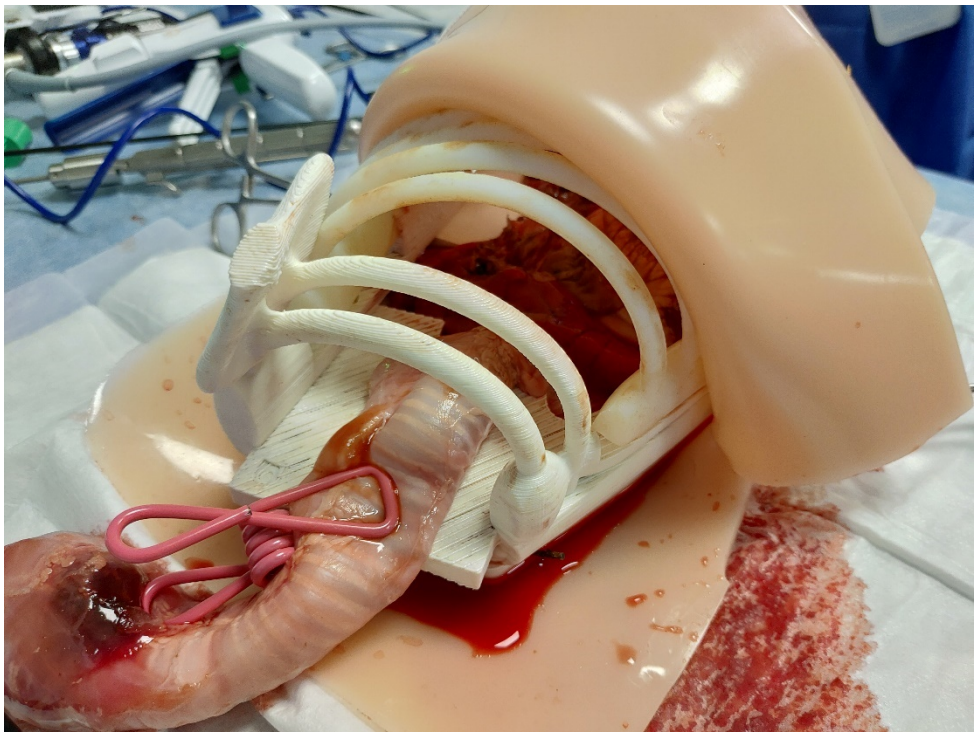
荷蘭 Njimegen 小兒外科醫師研發的小兒外科內視鏡練習器，採木板雷射切割組合而成，目前已商品化

2018 European Colorectal Conference 動物實驗同組的醫師以及指導老師（左二）

GOSH 心胸外科開刀房一隅

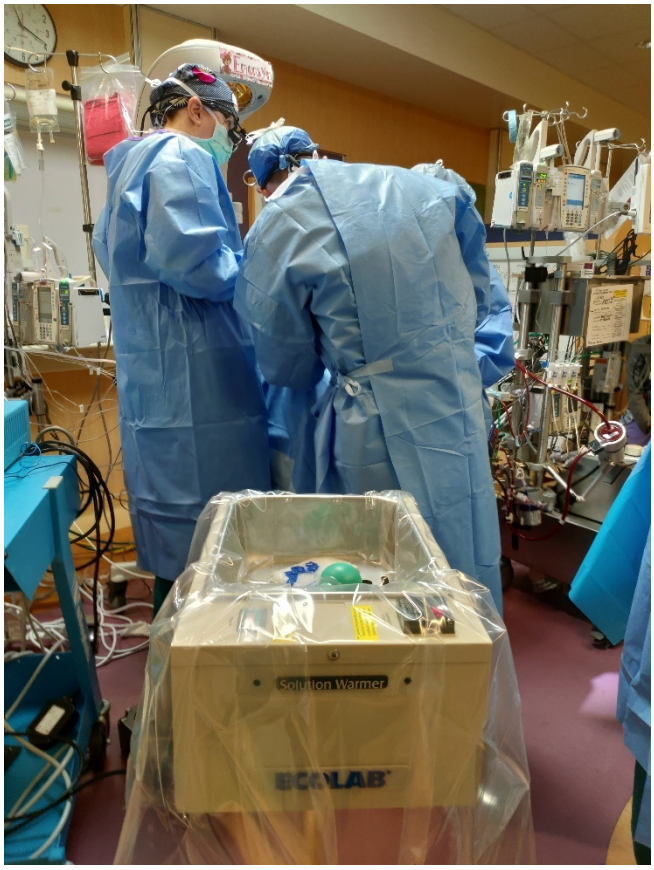


矽膠翻模之十二指腸閉鎖內視鏡練習模型（左）、食道閉鎖內視鏡練習模型（右）



於國際小兒外科內視鏡醫學會動物實驗課程所使用結合3D 列印以及動物組織之新生兒胸腔鏡模擬器

與雙和醫院魏晉弘醫師於國際小兒外科內視鏡醫學會年會合影

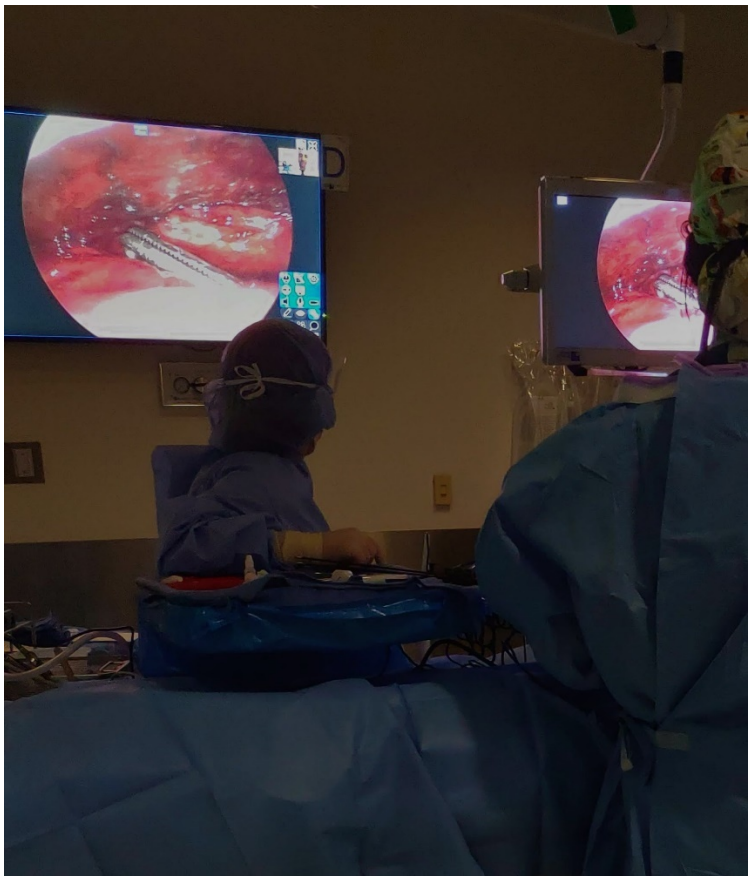


於 Cincinnati Children’s Hospital 觀摩床邊新生兒手術

波士頓兒童醫院小兒外科 Dr. Jennings 於2019美國胸腔外科醫學會發表演講

Cincinnati Children’s Hospital 耳鼻喉科開刀房一隅

參加2019年美國小兒外科醫學會年會

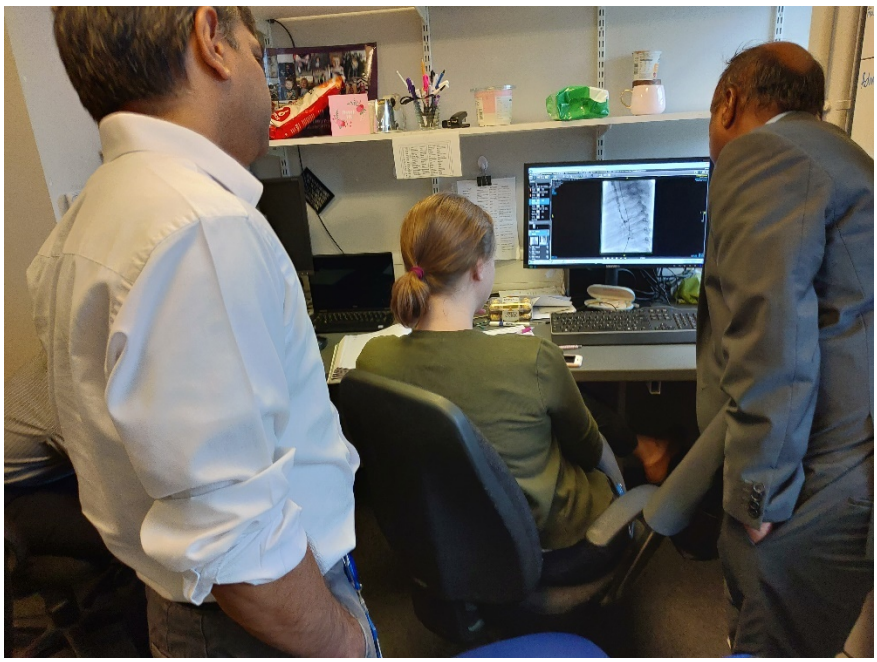


Cincinnati Children’s Hospital 小兒外科醫師 Dr. Ponsky（左方螢幕右上角影像）在國外利用手術室視訊參與手術決策

於英國小兒外科醫學會年會與師祖麻省總醫院小兒外科醫師 Dr. Donahoe 合影

參加英國小兒外科醫學會年會之教學課程

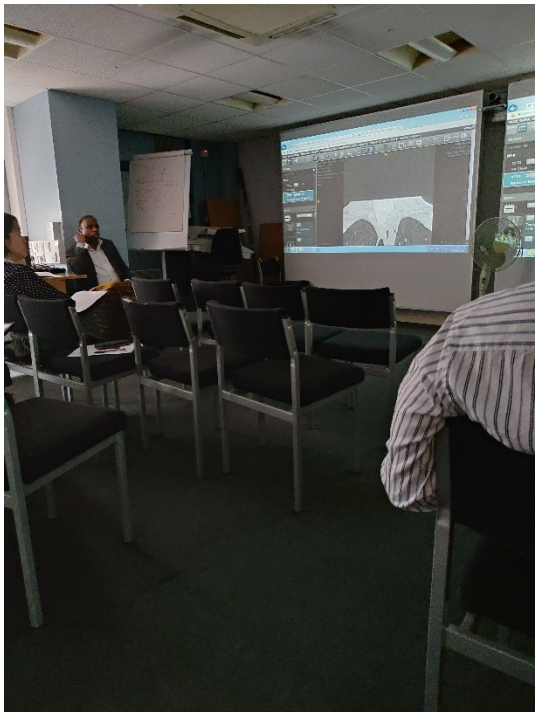
於倫敦帝國學院與雲象科技創辦人葉肇元博士合影



於 GOSH 氣管團隊辦公室參與病人影像討論

GOSH 心胸外科醫師 Dr. Muthialu（左二）帶領開刀房團隊在一天手術開始之前進行 briefing

手術中發生急救狀況需要緊急使用 ECMO 體外循環



GOSH 氣管團隊之兒童胸腔討論會

神戶兒童醫院之門診區一隅

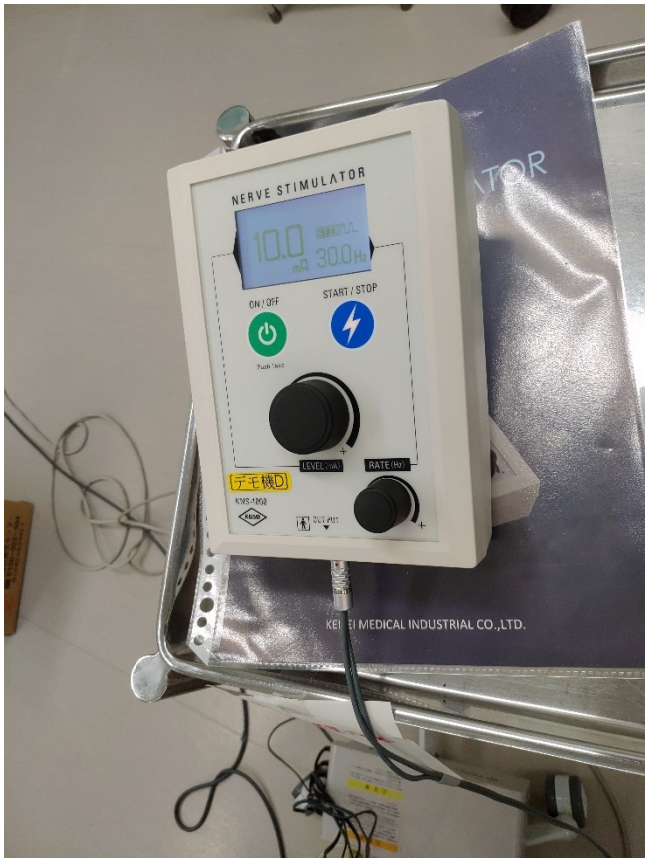
神戶兒童醫院兒童 ICU 一隅

神戶兒童醫院急診急救室一隅

神戶兒童醫院硬式支氣管鏡檢查之備物

神戶兒童醫院開刀房一隅

神戶兒童醫院開刀房一隅

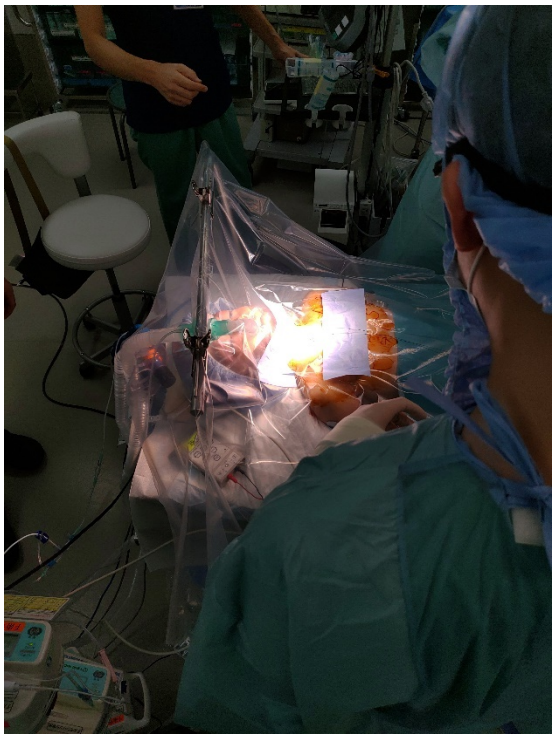


神戸兒童醫院所使用之神經刺激器

神戸兒童醫院所使用之整合性手術式錄影系統

參加日本小兒外科醫學會近畿地方會時手持式超音波展示

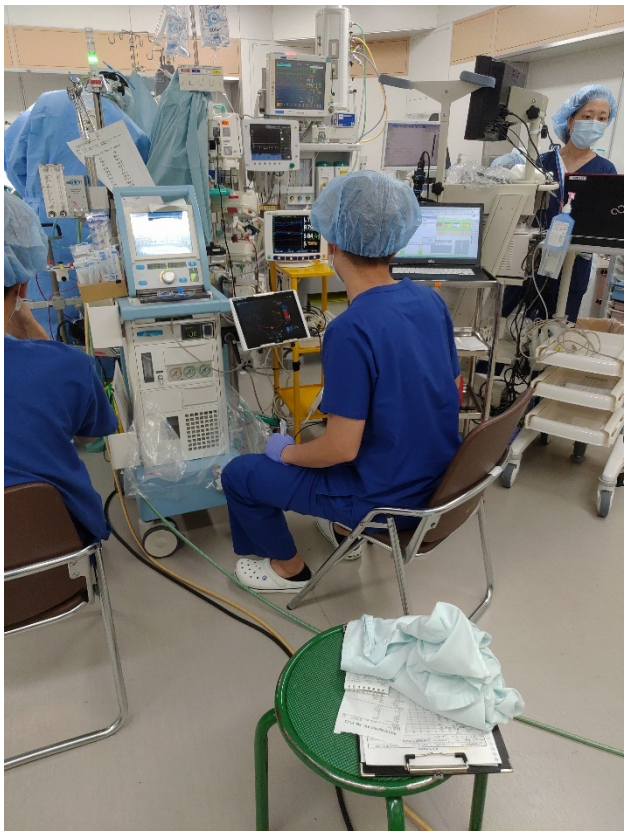
神戶兒童醫院新生兒加護病房查房



神戶兒童醫院開刀鋪單一景

神戶兒童醫院氣管手術開刀前討論會

神戶兒童醫院開刀房一隅



神戶兒童醫院氣管手術開刀時使用 ECMO 體外循環

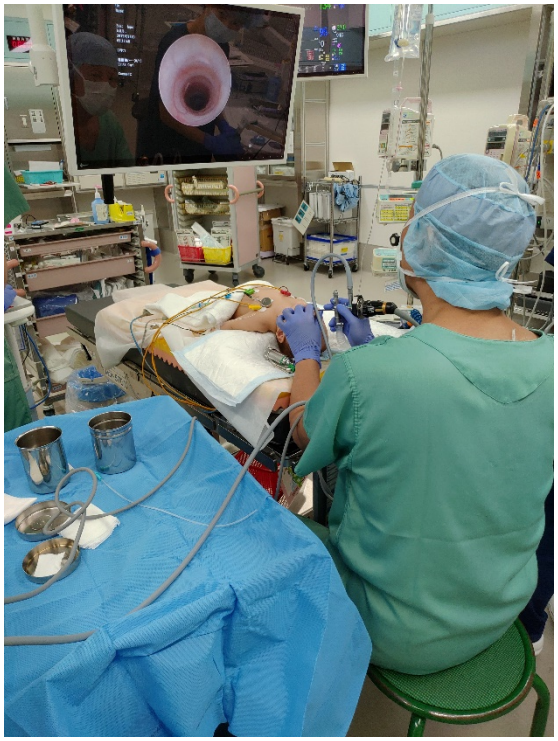
神戸兒童醫院在院內任何一臺電腦都可以看到開刀房任何一臺手術目前的影像

神戸兒童醫院開刀房護理站可以看到所有房間內的手術影像以及生命徵象監測

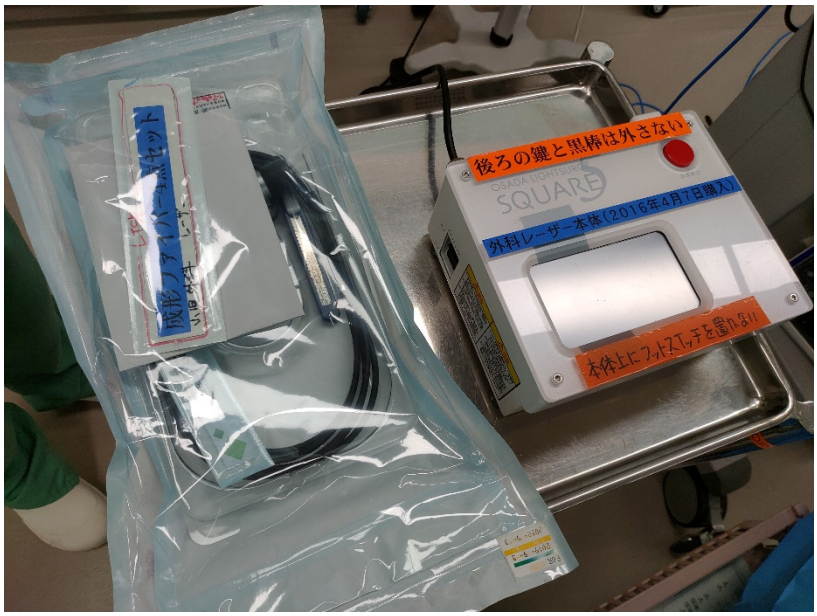
神戶兒童醫院門診腹腔鏡疝氣手術房間配置

神戶兒童醫院在加護病房進行床邊支氣管鏡之備物

神戶兒童醫院手術房內有音樂治療師，以音樂解除病童的焦慮



神戶兒童醫院小兒外科醫師 Dr. Maeda 進行硬式支氣管鏡檢查



神戸兒童醫院進行氣管內雷射之備物（非常輕便型之二極體雷射射源）

神戸兒童醫院外觀

Slide Tracheoplasty Guideline

Great Ormond Street Hospital for Children NHS Foundation Trust

Contact numbers:

- Tracheal CNS ext 8348
- Tracheal fellow ext 5717
- Out of Hours on call Cardiothoracic Surgical Registrar bleep 0530 or ext 1669

Pre-op investigations (may have been done at referring hospital)

- Chest CT scan (contrast enhanced)
- Bronchoscopy, Bronchogram and OCT (optical coherence tomography), +/- MLB
- Echo
- Chest x-ray
- Height and weight plotted on centile chart
- MDT meeting with consideration of
    - Swallowing assessment +/- video fluoroscopy if self-ventilating
    - Review by Genetics and General Paediatrician
- Consent
- Inform GP and Health Visitor (CNS)
- Bloods checklist:

FBC, U&E, Clotting, CRP	
If newborn: FISH, IgA, IgG, IgM	
Blood crossmatch & order[†]: <8kg: 2 units blood and 1 unit platelets (10mls/kg) >8kg: 2 units blood All re-do sternotomies: 2 units of blood and 1 unit of platelets (10mls/kg)	
Sputum or cough swab for MC&S, NPA	

[†] GOSH guideline: Maximum surgical blood ordering schedule (MSBOS) v5.0 (8/7/2015)

Post-operative – in theatre

- Bronchoscopy (IR or Tracheal Fellow)
- Echo (Cardiology Fellow)

Post-operative – CICU Day 1 (day of post op admission to CICU)

- Airway/ventilation:
    - Intubated and ventilated back from theatre
    - Consider extubation if minimally ventilated
        - If extubated sodium chloride 0.9% nebulisers 6 hourly to help with airway clearance (reduced ciliar function)
        - Give adrenaline nebulizer PRN (see CICU Rough Guide for doses).

- If not ready for extubation, wean ventilation as able
- Adequate sedation, paralyze if difficulties with ventilation

- Cardiovascular: Echocardiography (see check list below)
- Drains/catheters:
  - Povidone iodine irrigation via irrigation catheter (see checklist below)
  - Chest drains on suction
- Drugs:
  - Intravenous antibiotics (see checklist below)
  - Reflux prophylaxis (see checklist below)
  - Nystatin (see checklist below)
- Review and family update by tracheal team
- Post-op checklist:

Povidone iodine irrigation started and prescribed (see appendix 1 on instructions how to make the irrigation and administration rate)	
CXR: Record size and length of ETT, <u>do not move without consultant approval</u>	
Routine post op bloods	
Physiotherapy assessment	
Echo (if PA sling or intra cardiac defects and if not done in theatre)	
IVAB (intravenous antibiotics) - Agent: As current policy for post op THORACIC SURGERY (incl. chest wall and uninfected pulmonary resections)[‡] - **Duration: 7 days** (before switching to prophylactic azithromycin)	
IV ranitidine and esomeprazole prescribed for reflux prophylaxis (see CICU Rough Guide for doses). Switch to enteral ranitidine and lansoprazole for 6 months post procedure once tolerating enteral feeds.	
Nystatin (see CICU Rough Guide for doses)	

[‡] Great Ormond Street Hospital eAntimicrobial Guidelines: Guideline for antimicrobial prophylaxis in Cardiothoracic (non-transplant) Surgery. Version 4, November 2016.

Post-operative – CICU Day 2

- Airway/ventilation:
  - Consider extubation if minimally ventilated (see Day 1)
  - Physiotherapy assessment
  - CXR only if clinically indicated
  - Bed-side bronchoscopy only if clinically indicated
- Cardiovascular: Arrange echocardiography
  - post-procedural in case of chest closure (if chest open postoperatively)
  - only if clinically indicated otherwise

- Drains/catheters:
    - Cultures from chest drains at 6am (see appendix 2)
    - Continue povidone iodine irrigation
    - Leave chest drains on suction
- Drugs:
    - Continue IVAB, anti-reflux medication and Nystatin
    - If on inotropes, wean to off
    - Stop paralysis if on it but leave well sedated
- Other: Introduce feeds
- Review and family update by tracheal team

Post-operative – CICU Day 3

- Airway/ventilation: Consider extubation if minimally ventilated (see Day 1)
- Cardiovascular: see Day 2
- Drains/catheters:
    - Cultures from drains taken at 6am
    - Stop povidone iodine irrigation and change to sodium chloride 0.9% at the same rate
    - Leave chest drains on suction
- Drugs:
    - Continue IVAB, anti-reflux medication and nystatin
    - Wean sedation
    - Assess need for furosemide
- Other: Increase feeds as tolerated
- Review and family update by tracheal team

Post-operative – CICU Day 4

- Airway/ventilation: Consider extubation if minimally ventilated (see Day 1)
- Cardiovascular: see Day 2
- Drains/catheters:
    - Cultures from drains at 6am
    - Stop sodium chloride 0.9% irrigation, check results of cultures
- Drugs:
    - Continue IVAB, anti-reflux medication and nystatin
    - Wean sedation
    - Assess need for furosemide
- Other:
    - Full feeds – if extubated SALT review before first oral feeds
    - Consider removing urinary catheter
- Review and family update by tracheal team

Post-operative – CICU Day 5/6

- Airway/ventilation: Consider extubation if minimally ventilated (see Day 1)
- Cardiovascular: see Day 2
- Drains/catheters:
    - Remove irrigation catheter/line (by ICU staff)
    - Remove chest drains if able (by ICU staff)
    - CXR post drain removal
- Drugs: Continue IVAB, anti-reflux medication and nystatin
- Other: Continue full enteral feeds, if extubated SALT review before first oral feeds
- Review and family update by tracheal team

Post-operative – CICU Day 7

- Airway/ventilation:
    - If not extubated then trial of extubation +/- CPAP or HFNC
    - Bronchoscopy/bronchogram ± balloon dilatation (arranged by the tracheal team)
- Cardiovascular: see Day 2
- Drugs: Continue IVAB, anti-reflux medication and nystatin
- Other: Continue full enteral feeds, if extubated SALT review before first oral feeds
- Review and family update by tracheal team

Post-operative – CICU Day 8

- Airway/ventilation:
    - If still intubated review reason for ventilatory requirement at MDT
    - If extubated stop CPAP if possible
    - Bronchoscopy & Bronchogram ± balloon dilatation by Interventional Radiology (arranged by Tracheal Team)
- Cardiovascular: see Day 2
- Drugs:
    - Stop IVAB and nystatin, continue antireflux prophylaxis
    - Start azithromycin prophylaxis enterally three times a week (see BNFC for doses) for 6 months post procedure and then during winter
- Other: Continue full enteral feeds, if extubated SALT review before first oral feeds
- Review and family update by tracheal team

After ward transfer

- Continue full enteral feeds
    - If still NG fed, introduce oral feeds with SALT support
- Arrange Neck Ultrasound to assess vocal cord function: ?vocal cord palsy (also if patient is asymptomatic)
- Daily review and family update by tracheal team

Pre discharge checklist (CNS)

Explain need for seasonal flu vaccine	
Update GP, referring doctor and Health visitor	
Images transferred to local hospital/consultant (ward administrator)	
Follow up appointment established (tracheal MDT)	

Document control information

Lead author(s): Nagarajan Muthialu, Cardiothoracic surgeon, Tracheal Team
Additional authors: Christian Bieli, Tracheal Fellow, Tracheal Team
Document owner: Nagarajan Muthialu, Cardiothoracic surgeon, Tracheal Team
Approved by: Tracheal Team, CICU staff (Consultants, CICU Nurses Band 7), pharmacy (Lynne Cochrane), SALT (Alex Stewart)
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Next review: December 2019
Document version: 3.1
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Appendix 1

Protocol for povidone iodine irrigation

Indications

- Mediastinitis
- Post-operative slide tracheoplasty
    - **NOTE: Commence irrigation only on closed chest** (i.e. defer irrigation in patients with delayed chest closure until chest is closed)

Preparation and administration of solution

- 500ml bag of sodium chloride 0.9%
- 5mls aqueous povidone iodine 10% antiseptic solution (ensure a new bottle is always used)
- Using a clean non touch technique add the 5mls of aqueous povidone iodine 10% antiseptic solution to the 500ml bag of sodium chloride 0.9%.
- Irrigate the mediastinum with the solution at a rate of **2ml/kg/hr for children under 50 kg, maximum of 100ml/hr, or as directed** by the cardiothoracic surgeon.
- Administer with an IVAC volumetric administration pump.
- Attach a 3 way tap to the end of the irrigation tube.
- Continue with povidone iodine irrigation for 48hours then stop and change to sodium chloride 0.9% irrigation.
- Measure irrigation losses through the mediastinal drain and record hourly.
- Report any sudden changes in drainage losses to the medical team

Cautions

- Use an alternative solution in patients with a known or suspected iodine allergy e.g. chlorhexidine
- Use with caution in patients with altered renal function (absorbed iodine is excreted renally)
- Consider potential for iodine toxicity if prolonged use (>7 days) is anticipated: take a baseline iodine level and a further iodine level after 1 week to monitor for signs of toxicity. **Monitor thyroid function tests, if use is prolonged or if reinstated for postoperative mediastinitis**
- Observe for any signs of seizure activity

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Thurer, RJ et al (1974) the management of mediastinal infection following cardiac surgery. An experience utilizing continuous irrigation with povidone iodine. Journal of Thoracic and Cardiothoracic surgery.68/6, 962-968

Hauben, M et al (1993) Seizures after povidone-iodine mediastinal irrigation. New England Journal of Medicine 328/5 (355)

Dacey, M (2004) Mediastinitis. Emedicine, (1-13). http://www.emedecine.com/med/topic2798.htm

Luciani, N et al (2003) Modified "open wound" treatment for Mediastinitis .Italian Heart Journal .4/7 (468-472)

Appendix 2

Clinical guideline for sampling from chest drain tubing

See chest drain clinical guideline for more information on chest drain care

1. The sample of fluid must come from new chest drainage and not taken from the collecting chamber in the chest drainage bottle, to ensure recent drainage fluid is tested.
2. For this reason the fluid should be aspirated directly from the tubing. The chest drain must not be disconnected to obtain a sample for testing, unless at time of the chest drain insertion. This is due to risk of air entering the drain site and also the increased risk of infection. Nor must the tubing be clamped as this may cause the child to become unwell as air or fluid reaccumulates in the chest cavity (tamponade).
3. The majority of chest drainage systems now come with resealable tubing which allows aspiration of fluid using a small bore (orange needle) needle inserted through the tubing; this can be checked on the leaflet which comes with the drain or by calling the product company.
4. Discuss the procedure with the child and family and the reasons for the procedure.
5. Prepare a dependent loop in the tubing to collect fresh chest drain loss
6. Prepare equipment, gloves and apron, cleaning solution for the tubing as per hospital policy, small bore (orange needle) and syringe, sample pot, form and sleeve, for sample, dressing pack or sterile field to place equipment.
7. Wash hands and prepare equipment on the sterile field.
8. Insert needle into dependent loop of tubing at an angle of 45 degrees to prevent passing through to the other side of the tubing and to allow aspiration of collected fluid. Be careful not to cause a self-inflicted need stick injury
9. Aspirated fluid should be placed in the specimen container , labeled and sent for requested investigation
10. Check the chest drain is still working and the needle site is visibly sealed. Check that the child is comfortable
11. Document in patient care pathway

References

E C Smith/ Clinical guidelines for Chest Drain Management / January 2009

Appendix 3

Guidance for bedside bronchoscopies on CICU for nursing staff

- Indications:
    - Ventilation difficulties of unknown cause
    - Pre-extubation if previous bronchoscopy suggests difficult extubation (severe malacia, residual stenosis)
    - Check or change ET tube position if CXR not conclusive
    - To consider if no post-op bronchoscopy has been done in theater (but procedure not mandatory)

- The IR/tracheal team will confirm the time of the procedure the day before (or as soon as possible in urgent cases). This will be documented in the bedside folder by the tracheal CNS.

- Ideally, the patient should be nil by mouth for 4 hours (clear fluids) and 6 hours (milk) before the bronchoscopy.

- Please arrange for the parents to be bedside at planned time so that the IR team can take consent.

- Ask the medical team in advance to prescribe anesthetic medication (usually Fentanyl and Vecuronium, see CICU Rough Guide for doses)

- Prepare drugs and have fluid bolus available.

- Inform medical team when IR team is setting up the equipment. Ask for designated doctor to help you with the bronchoscopy.

- Inform the Nurse in charge/float nurse.

- Anesthesia is performed by the ward team, usually:
    - administer fentanyl bolus whilst everybody is getting ready for the procedure. This will allow enough time for it to work.
    - administer vecuronium bolus only if requested by bronchoscopist or ward doctor.

Great Ormond Street Hospital Chart for Paediatric Airways

			Preterm-1 month		1-6 months	6-18 months	18 mths - 3 yrs	3-6 years	6-9 years	9-12 years	12-14 years
	Trachea (Transverse Diameter mm)		5		5-6	6-7	7-8	8-9	9-10	10-13	13
PLASTIC	Great Ormond Street	ID (mm)		3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0
		OD (mm)		4.5	5.0	6.0	6.7	7.5	8.0	8.7	10.7
	Shiley	Size		3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
		ID (mm)		3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
		OD (mm)		4.5	5.2	5.9	6.5	7.1	7.7	8.3	9.0
		Length (mm) Neonatal		30	32	34	36				
	*Cuffed Tube Available	Paediatric		39	40	41*	42*	44*	46*		
		Long Paediatric						50*	52*	54*	56*
	Portex (Blue Line)	ID (mm)		3.0	3.5	4.0	4.5	5.0	5.0	6.0	7.0
		OD (mm)		4.2	4.9	5.5	6.2	6.9	6.9	8.3	9.7
	Portex (555)	Size		2.5	3.0	3.5	4.0	4.5	5.0	5.5	
		ID (mm)		2.5	3.0	3.5	4.0	4.5	5.0	5.5	
		OD (mm)		4.5	5.2	5.8	6.5	7.1	7.7	8.3	
		Length Neonatal		30	32	34	36				
		Paediatric		30	36	40	44	48	50	52	
	Bivona All sizes available with Fome Cuff, Aire Cuff & TTS Cuff	Size	2.5	3.0	3.5	4.0	4.5	5.0	5.5		
		ID (mm)	2.5	3.0	3.5	4.0	4.5	5.0	5.5		
		OD (mm)	4.0	4.7	5.3	6.0	6.7	7.3	8.0		
		Length Neonatal	30	32	34	36					
		Paediatric	38	39	40	41	42	44	46		
	Bivona Hyperflex	ID (mm)	2.5	3.0	3.5	4.0	4.5	5.0	5.5		
		Usable Length (mm)	55	60	65	70	75	80	85		
	Bivona Flextend	ID (mm)	2.5	3.0	3.5	4.0	4.5	5.0	5.5		
		Shaft Length (mm)	38	39	40	41	42	44	46		
		Flextend Length (mm)	10	10	15	15	17.5	20	20		
	TracoeMini	ID (mm)	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	
		OD (mm)	3.6	4.3	5.0	5.6	6.3	7.0	7.6	8.4	
		Length (mm) Neonatal (350)	30	32	34	36					
		Paediatric (355)	32	36	40	44	48	50	55	62	
SILVER	Alder Hey	FG		12-14	16	18	20	22	24		
	Negus	FG			16	18	20	22	24	26	28
	Chevalier Jackson	FG		14	16	18	20	22	24	26	28
	Sheffield	FG		12-14	16	18	20	22	24	26	
		ID (mm)		2.9-3.6	4.2	4.9	6.0	6.3	7.0	7.6	
	Cricoid (AP Diameter)	ID (mm)		3.6-4.8	4.8-5.8	5.8-6.5	6.5-7.4	7.4-8.2	8.2-9.0	9.0-10.7	10.7
	Bronchoscope (Storz)	Size		2.5	3.0	3.5	4.0	4.5	5.0	6.0	6.0
		ID (mm)		3.5	4.3	5.0	6.0	6.6	7.1	7.5	7.5
		OD (mm)		4.2	5.0	5.7	6.7	7.3	7.8	8.2	8.2
	Endotracheal Tube (Portex)	ID (mm)	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
		OD (mm)	3.4	4.2	4.8	5.4	6.2	6.8	8.2	9.6	10.8

Table reproduced from 'Choosing a paediatric tracheostomy: an update on current practice'
DJ Tweedie, CJ Skilbeck, LA Cochrane, J Cooke, ME Wyatt. The Journal of Laryngology & Otology, 2007

Joanne Cooke, NP Tracheostomies, GOSH. August 2009

BASIC LIFE SUPPORT OF BABIES AND CHILDREN WITH A TRACHEOSTOMY

Action to take on a blocked tube

SAFETY

STIMULATE

SHOUT

Check and open airway
Suction the tube

If blocked change immediately
Caution if stoma is less than 1 month old

Suction the tube

Assess for breathing

Rescue breathing

Signs of life
(Pulse check)

Chest compressions
if appropriate

Reassessment

Action to take if the tube fails to go in

Attempt to insert the smaller sized tube

Attempt to pass the smaller tube into the stoma using a suction catheter
(Seldinger Technique)

If unsuccessful, ventilate via the nose and mouth if the underlying condition allows

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NHS Foundation Trust

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Hospital for Children
NHS Foundation Trust

A joint competency document for staff and carers working with Long Term Tracheostomy Ventilated Children

1. Description of competencies and supporting information
2. Sign off records

These competencies have been developed by the Royal Brompton Hospital and Great Ormond Street Hospital and they describe the knowledge and skills required by carers to manage the care of a child with a tracheostomy and requiring long term ventilation.

This booklet is set out in two parts. The first part is a resource pack which covers in detail the information about the procedures and tasks relating to the care of a child with a tracheostomy and requiring long term ventilation. The second part is the core competencies. All these sections will need to be signed by a qualified professional who deems the carer competent. The carer will need to sign to say they feel confident and competent.

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NHS No: Relative/carers name:

Contact List

Child's Name_____ Parents/Care Names _____

Treating/ Discharge hospital_____

Named Nurse
Name
Email
Telephone

Tracheostomy Liaison
Name
Email
Telephone

Ventilator Liaison
Name
Email
Telephone

Health OT
Name
Email
Telephone

Social OT
Name
Email
Telephone

Community Physiotherapist
Name
Email
Telephone

Dietition
Name
Email
Telephone

Local Hosiptal
Telephone

Out of Hours contact Name
Name
Email
Telephone

Community Team Contact
Name
Email
Telephone

Continuing care nurse
Name
Email
Telephone

Social Worker
Name
Email
Telephone

Community paediatrician
Name
Email
Telephone

School Nurse
Name
Email
Telephone

Agency lead
Name
Email
Telephone

Tertiary/Specialist Centre
Telephone

NHS No: Relative/carers name:

Multidisciplinary Team Accountability Log

All members of staff signing carers of as competent in this booklet should use black ink and complete this section

Date	Full Name (Print)	Position	Initials as used in booklet

NHS No: Relative/carers name:

Demonstrate awareness of health and safety

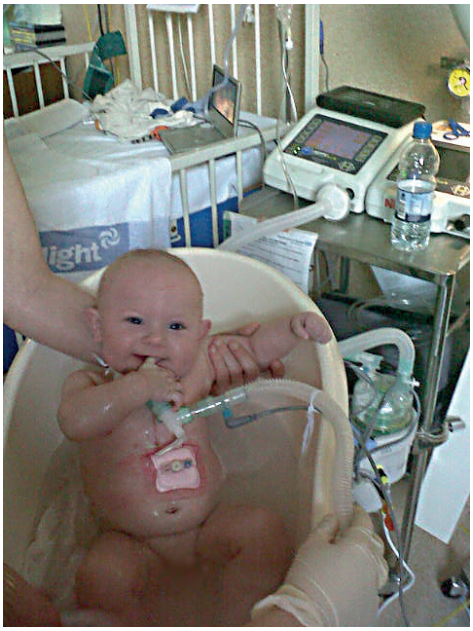
Performance criteria/ knowledge required	Comments/Guidance
1. Identify potential hazards and dangers of the ward environment: ■ Need for safe & tidy bedspace **2. Assess the child's immediate environment for health and safety:** ■ Check all equipment is in place and stored appropriately (eg. care with electrical leads/ plugs/ trip hazards) ■ Awareness of the child's motor abilities and make appropriate measures to avoid hazard (eg. seatbelts in chairs, ensure cot sides used appropriately, monitor if patient is able to remove tracheostomy) **3. Demonstrate the safety checks at the beginning of each shift** (see comments)	**Start of shift Safety Checks:** ■ **Assess child** and gather baseline information on childs well-being if trained to do so ■ Perform a set of **observations** to include tape tension to ensure tube is secure and tube in place ■ Check all **bedside equipment:** • Ambu-bag/ mask/ airway • Ventilator settings & alarm limits • Ventilator circuit (check for disconnections/blockage) • Suction available & working (check walled and portable) & correct size catheters • Ventilator batteries (available & charged) • Spare ventilator and circuit • Sufficient stock for the shift • Emergency Tracheostomy Box (see page 5) ■ **Document** safety checks completed and observations ■ **Act on any safety discrepencies immediately according to your local policy**

NHS No: Relative/carers name:

Reducing the risk of infection

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrate effective handwashing **2. Discuss how infection can spread.** ■ Bacteria or viruses can be passed by direct or indirect contact (eg. touching hands, sneezing or coughing). ■ Body fluids such as blood and saliva can contain the infecting organisms and transmission of these fluids can cause the spreading of the infection.	

Personal hygiene needs of the child

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrate how to assess the oral status of the child: ■ Look for changes in the childs mouth and lips in respect to moisture, cleanliness, infected or bleeding and ulcers. ■ Report and document and changes. **2. Safely bath a child with a tracheostomy either attached to a portable ventilator or with Swedish nose:** ■ Change tapes/tubes after the bath, this could be the daily routine. ■ Bathing should be a two person technique, where possible ■ Safety aspects regarding bathing	

NHS No: Relative/carers name:

Assessment and monitoring

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrate how to take the child's vital signs if taught to do so: ■ Heart rate (HR) ■ Breathing rate and effort ■ Oxygen saturations (SpO_2) ■ Temperature **2. Discuss normal parameters for the child and outline the course of action to be taken** **3. Know how to access emergency contact numbers and where they are displayed in the child's environment** ■ Your lead community key worker will inform you of the appropriate path to follow in case of emergency. ■ Community lead nurse ■ GP ■ Local hospital ■ 999 ■ Refer to the child's treatment plan in case of deterioration **4. Demonstrate how to recognise signs of distress or changes in clinical status, see comments**	**Care plans provide a road map to guide carers and nurses with a plan to care for a specific patient.** They should include guidance on: ■ Diet, including oral intake, gastrostomy and/or NG feeds etc ■ Tracheostomy care, including suctioning and tape and tube changes ■ Ventilation and/or oxygen requirements ■ Communication ■ Play/social development plan ■ Physical development, mobilising, seating, pressure care ■ Physiotherapy ■ Oral hygiene ■ Elimination **It is important to assess the child as well as using any monitoring available.** **Knowing what is normal for the child will be vital in knowing if there is any change in their condition.** Assessment must include ■ Observation of breathing pattern, including respiratory rate and effort Changes in condition may include: ■ Increased respiratory rate ■ Increased heart rate ■ Increased or decreased effort of breathing, look at chest movement ■ Observation of normal circulatory function, including heart rate noting the general colour and temperature of the child ■ Texture of secretions ■ Distended abdomen

NHS No: Relative/carers name:

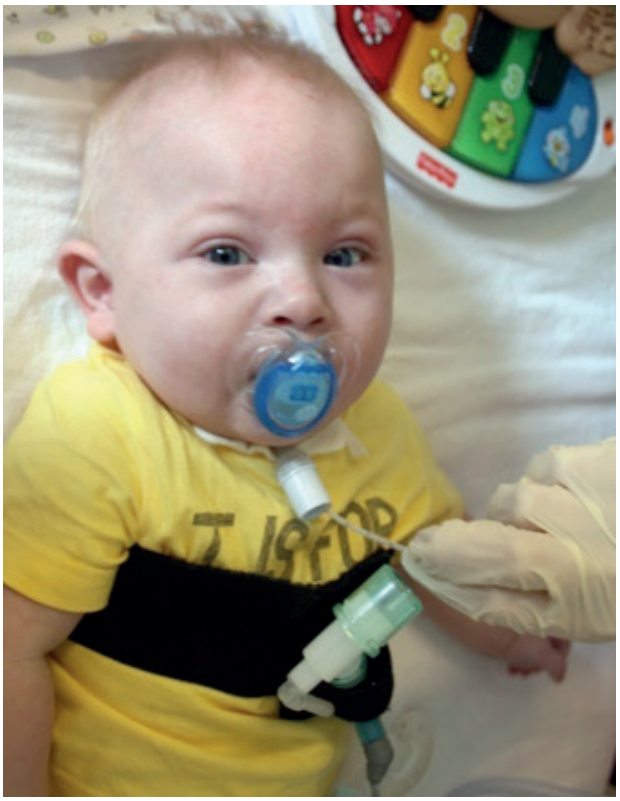
Suctioning via tracheostomy

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrate how to use portable & walled suction, and hand/foot pump: ■ Demonstrate how to charge, set and test pressures and connect suction equipment ■ Demonstrate appropriate cleaning and storage of suction equipment ■ Describe when you would use hand/ foot pump (and therefore the importance) **2. Aware of indications for suction in a child with a tracheostomy** ■ Discuss possible indications for suction (see comments) ■ Observe then suction the child when appropriate & following assessment **3. Demonstrate appropriate procedure for suctioning via tracheostomy** ■ Describes preparation: • Appropriate suction catheter size, Identify correct suction pressures and check before using, Monitoring/ assessment in situ before suctioning, Wash hands/apply alco-gel and apply clean gloves ■ Explain procedure and demonstrate appropriate suction technique • Introduce catheter without applying suction, suction to correct length, apply continuous suction whilst withdrawing catheter (do not rotate) ■ Dispose of suction equipment in clinical waste and washes hands/apply alco-gel	**Indications for suctioning:** ■ Noisy breathing (bubbling/ raspy sounds) ■ Visible secretions at the tube opening ■ Child restless or irritable (crying increases secretions) ■ Child's breathing is rapid or slower, or increased effort i.e. indrawing/ recession etc ■ Change in SpO_2/ HR ■ Child's colour changing ■ No noise via tracheostomy could indicate blockage ■ Child's nostrils may flare out with each breath ■ No chest movement **Size suction catheter by ID x2 as maximum eg. with 3.5 tracheostomy use 7.0 Fr catheter** Age — Suction pressure recommended Neonate — -8 to -10.6 Kpa (-60 to 80 mmHg) Child — -10.6 to 13.3 Kpa (-80 to 100 mmHg) Adolescent/Adult — ≤16 Kpa (<120 mmHg)

NHS No: Relative/carers name:

Suctioning via tracheostomy (continued)

4. **Demonstrate how to assess secretions appropriately**
   - Aware why a change in thickness/ colour of child's secretions may be significant
     - Risk of tracheostomy blockage & potential sign of infection
   - Describes how may respond to findings e.g. informing parents/ CCN (at home) or medical team (Also consider nebulisers, saline instillation, humidification etc.
5. **Demonstrate how to clean and store suction equipment**
   - Can describe importance of cleaning and storage
   - Seen to rinse suction tubing with sterile water and store appropriately



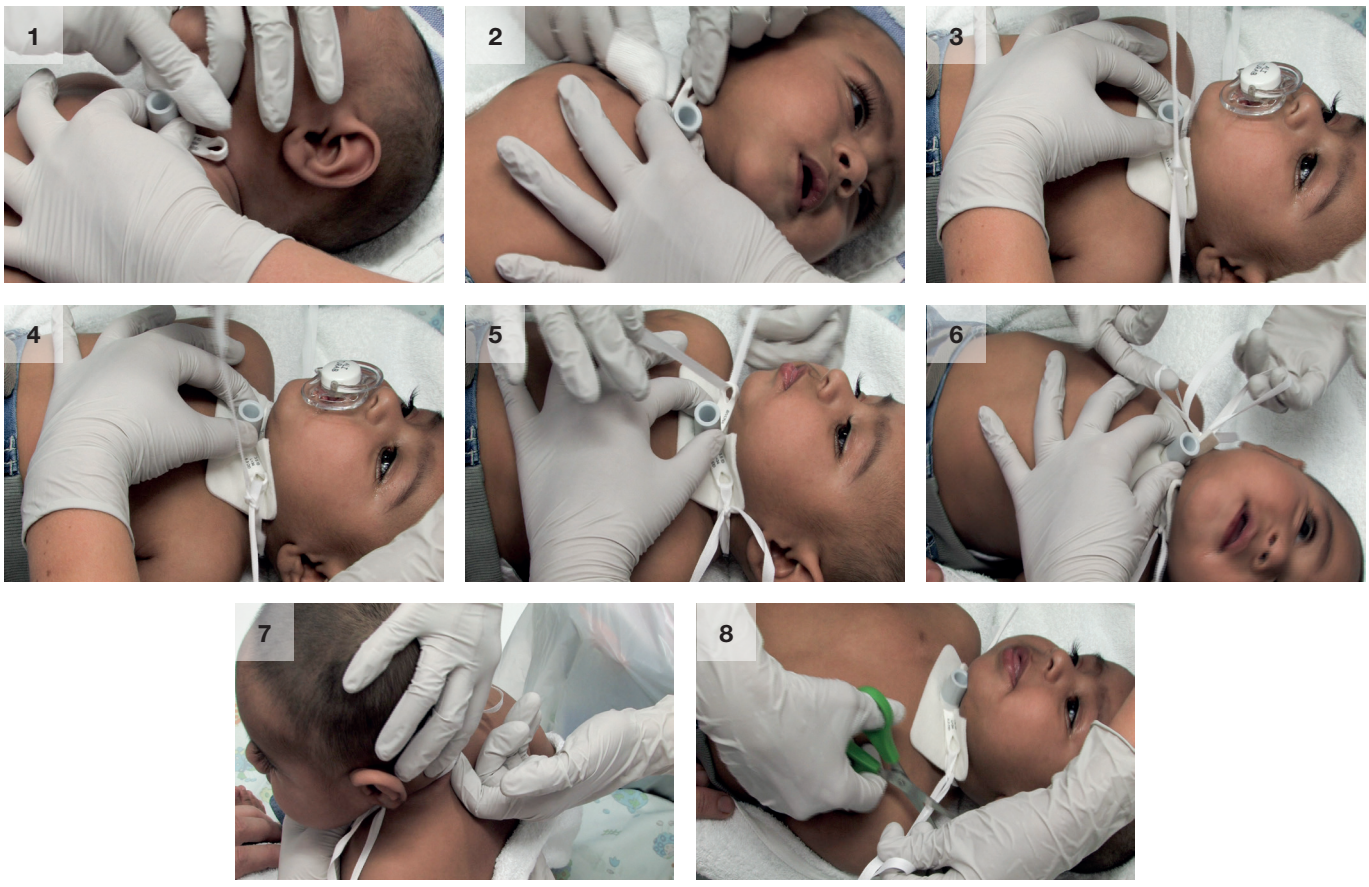
NHS No: Relative/carers name:

Tracheostomy care

Performance criteria/ knowledge required

1. **Assess tracheostomy site:**
   - Demonstrate inspection of tracheostomy site
   - Discuss signs of site infection/ skin breakdown
   - Discuss appropriate action if concerns re: stoma site e.g. swabs & report findings/ensure further review of site
2. **Clean and change ties at tracheostomy site**
   - Discuss reasons for changing tapes daily
   - List the equipment to prepare before changing ties/ tapes
   - Discuss potential problems with changing ties
   - Explain & demonstrate procedure for cleaning tracheostomy site and changing ties (Figure 1)
3. **Routine tracheostomy change**
   - Describe frequency for changing tracheostomy (based on manufacturers guidelines)
   - Frequent changes may be done in hospital to facilitate training
   - Describes and demonstrate the process as per bedside guidelines (Figure 2)
4. **Understand which tube is in use**
   - Specifics related to tube in use i.e. cuff inflation, how many times it is used

Figure 1



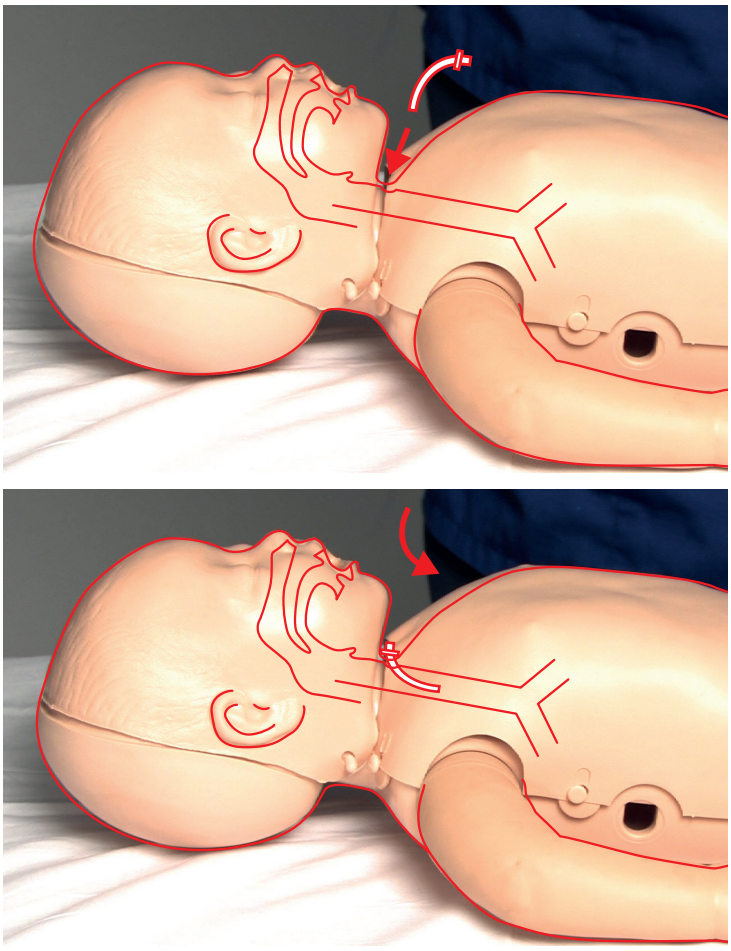
NHS No: Relative/carers name:

Tracheostomy care

Performance criteria/ knowledge required

5. **Clean and store tracheostomies appropriately**
   - Describe and demonstrate appropriate cleaning of tracheostomy used.
   - Demonstrate awareness of manufactoring cleaning procedure.
6. **Demonstrate awareness of granulomas**
   - Explain how granulomas may form and the signs seen (trauma with suction, bleeding, difficult to pass catheter etc).
7. **Care of patient with cuffed tracheostomy**
   - Explain indications for cuffed vs. uncuffed tracheostomy if cuffed tube in use.
   - Explain procedure for inflating, deflating and monitoring cuff.
   - Explain risks and indications for cuff deflation eg.aspiration, increased leak around tracheostomy. Need to deflate cuff prior to tracheostomy change.

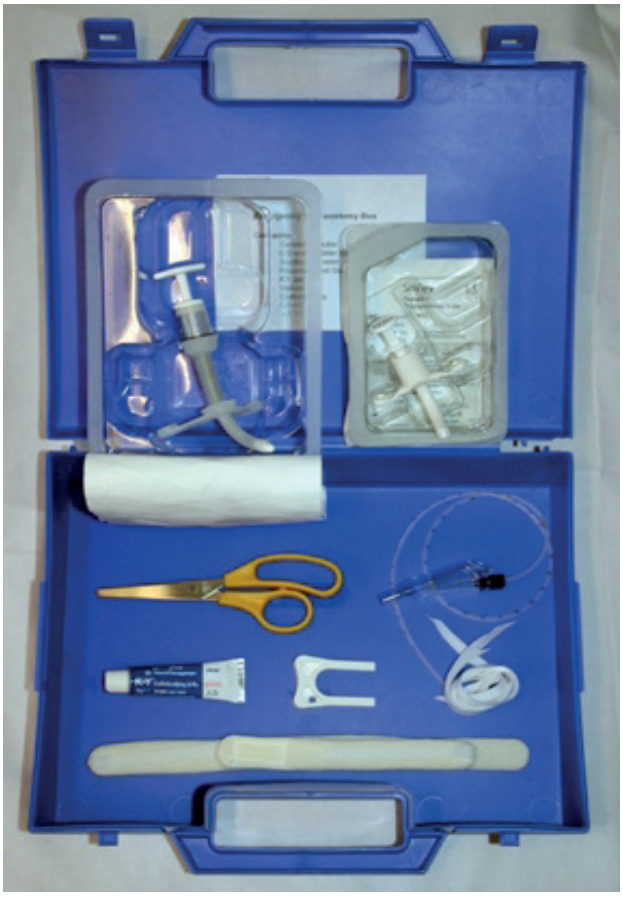
Figure 2



- Perform a clinical hand wash
- Put on gloves, apron and protective eye wear
- Lubricate new tube with a “dot” of water-based lubricant on the outside bend of the tube
- Insert obturator into the tube
- Position the rolled up towel under the child’s shoulders, as per tape changes, swaddle baby if appropriate.
- Place clean tapes behind the baby/ child’s neck
- Assistant should hold the tube in position using either their thumb and index finger, or index and middle finger.
- Tube changer should cut the ties between knot and flange
- Remove the dirty ties
- Remove the tube from the stoma with a curved action
- Quickly insert new tube with a curved action
- Remove obturator
- The assistant should take over and hold the tube in position
- The stomal area and back of the neck should be cleaned and dried with the water and gauze using a clean technique
- Secured tube with cotton ties

NHS No: Relative/carers name:

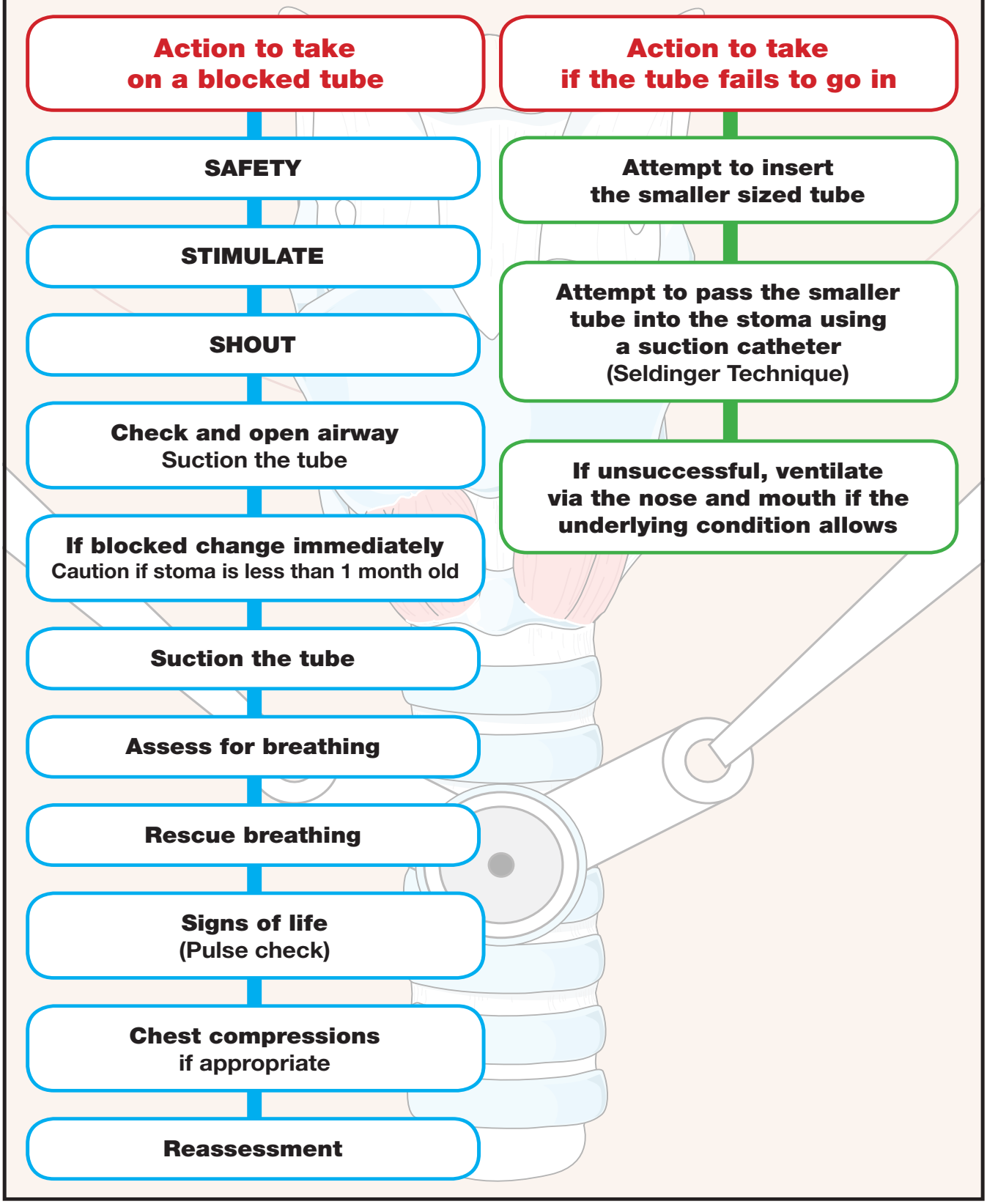
Emergency Procedures

Performance criteria/ knowledge required	Comments/Guidance
1. Procedure for a blocked tracheostomy tube: ■ Suction the tracheostomy tube. ■ If any resistance is felt or you are unable to pass a suction catheter then refer to BLS guidelines. **2. Perform a single person tracheostomy tube change:** ■ See Competency 5 for Tracheostomy tube change guidelines. ■ Discuss signs and symptoms that could lead to an emergency tube change, (see comments). **3. Discuss actions to be taken in case of a parent/family member collapsing at hospital/home:** ■ Call the emergency services, if you have received paediatric and adult BLS follow the relevant algorithm. **4. Describe the steps that should be taken in the event of a tracheostomy becoming accidentally decannulated:** ■ Help should be summoned immediately either by shouting or pulling the emergency button. ■ Replace tube with same tube or the one size smaller, revert to Competency 5 for tracheostomy tube change guidelines. **5. Complete Basic Life Support training as per Resus Council Guidelines.**	**At the start of your shift always check the Emergency tracheostomy box is complete.** Contents ■ Tracheostomy tube (correct size) ■ Tracheostomy tube (0.5 smaller must be a Shiley tube) ■ Suction catheter (Seldinger technique) ■ Scissors (blunt ended) ■ Velcro straps ■ KY Jelly ■ Disconnection wedge ■ Cotton ties  ■ **Ensure emergency box is securely shut** ■ **Items removed from packaging for display purposes only**

NHS No: Relative/carers name:

Joanne Cooke, NP Tracheostomies, GOSH. August 2009

BASIC LIFE SUPPORT OF BABIES AND CHILDREN WITH A TRACHEOSTOMY



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NHS No: Relative/carers name:

Care of the child ventilated via tracheostomy

Performance criteria/ knowledge required	Comments/Guidance

1. **Demonstrate understanding of child's need for ventilatory support:**
   - Can discuss common reasons for needing ventilatory support (i.e. neurological; neuromuscular; airway; primary lung problem; other)
   - Identifies reason for child they care for needing ventilatory support.
   - Describes what the implications of inappropriate ventilatory support could be (i.e. apnoea/arrest; increased work of breathing and compromise/ pneumothorax etc)
2. **Describe in basic terms difference between CPAP & Bilevel support and how ventilation works**
3. **Describe in basic terms how the mode(s) in use assists ventilation**
4. **Can identify the prescribed settings and records these appropriately**
5. **Aware of importance of back-up batteries.**
   - Can describe and demonstrate how to charge batteries and how to connect external batteries
   - Checks batteries on charge at start of and throughout shift
   - Can describe actions to take in event of power failure at home
6. **Be aware of frequency of ventilation circuit changes**

Now refer to ventilator specific competencies (depending on machine in use)

CPAP

- Requires the patient to make reasonable effort
- Helps by delivering a flow of gas to help keep the airways/ lungs open throughout inspiration & expiration
- DOES NOT deliver any breaths

Bilevel Support

- Can be used at higher levels of support where the child has less or no respiratory effort
- Additional support is provided on inspiration (either triggered or a set number of breaths per minute) to help move the chest.
- Expiratory pressure works in the same way as CPAP

Elisee (Resmed)	**NIPPY junior+™** (B&D electromedical)
PS.SV • inspiratory pressure support on triggered breaths • PEEP • "apnoea breaths" can be set as a back up	**PSV** – inspiratory pressure support on triggered breaths and for back-up breaths if patient not triggering (end of the breath is usually determined by the patient unless it's a back-up breath)
P.SIMV • inspiratory pressure support on triggered breaths • PEEP • additional number of breaths per minute provided by ventilator (ie. the RR, inspiratory time and pressure are set)	**PCV** – inspiratory pressure support on triggered breaths and for back-up breaths. Inspiratory time is set for all breaths
CPAP (see above – not a mode of ventilation as no breaths delivered)	

NHS No: Relative/carers name:

Monitoring and maintaining Elisee 150 ventilator

Performance criteria/ knowledge required	Comments/Guidance

1. Demonstrate and discuss how to check the alarm limits and function

2. Demonstrate and explain how to carry out the following:

- Turn ventilator on/ off
- Can tell whether ventilator is delivering support
- Can identify whether mains power or battery is in use
- Able to describe/ troubleshoot how the circuit is attached
- Can check the functioning of the ventilator prior to connecting to the child.
- Can connect and use battery power sources
- Can monitor total respiratory rate and estimated tidal volume
- How to administer and measure oxygen via ventilator (if needed)
- Able to calibrate ventilator when different circuit is used.
- You can identify when a breath is patient triggered or given by ventilator (backup/mandatory breath)

3. Can explain what alarms can indicate and how to respond to these (see comments)

Check alarms at the start of each shift and document.

- When tubing is first disconnected check that low pressure/ disconnect and/ or low tidal volume alarms are triggered
- Occlude the vent circuit whilst running and check the high pressure/ low tidal volume alarms are triggered

Ventilator alarm goes off
(with double limb circuit in use)

Low pressure (LP)/ low tidal volume (mini VT) may indicate a leak/ disconnection	High pressure (HP)/ low tidal volume (mini VT) may indicate blockage or obstruction
Assess child Possible causes include: • Leak around tracheostomy (particularly when asleep) • Decannulation **Assess equipment** • Follow circuit from child through to ventilator (ensure all connected – NB humidifier connectors etc may be slightly loose) • Is the alarm set appropriately (i.e. as previously recorded and checked at start of shift)	**Assess child** Possible causes include: • Blocked tracheostomy • Retained secretions/ increased pulmonary resistance etc **Assess equipment** • Follow circuit from child through to ventilator (ensure not kinked or obstructed) • Is the alarm set appropriately (i.e. as previously recorded)

If concerns with the machine

- Hand ventilate
- Call for help
- Change to other ventilator

NHS No: Relative/carers name:

Elisee: possible alarm causes and actions

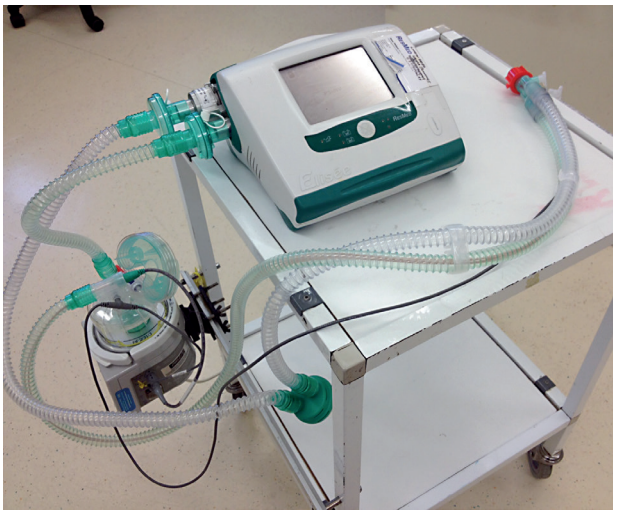
Low pressure (LP)/ low tidal volume (mini VT) may indicate a leak/ disconnection	
1 Assess child **Accidental decannulation** (i.e. tracheostomy has come out)	**Action** Immediately insert tracheostomy If difficultly follow **emergency algorithm**
2 Assess child Possible causes include: **Leak around tracheostomy** (particularly when asleep)	**Cause** - some leak may be tolerated and may be due to position of child – discuss with community ± medical teams, who can consider need for cuffed trache or upsize
3 Assess equipment **Disconnection within circuit** (Follow circuit from child through to ventilator and ensure everything is connected – NB humidifier connectors etc may be slightly loose)	**Action** • Reconnect any loose connections • Re-assess
Is the alarm set appropriately (i.e. as previously recorded and checked at start of shift)	• Check alarm settings are as prescribed and re-set if any discrepancies

High pressure (HP)/ low tidal volume (mini VT) may indicate a blockage or obstruction	
1 Assess child Possible causes include: **Blocked tracheostomy**	**Action** **Emergency algorithm:** 1. Suction 2. Emergency tracheostomy change
2 Assess child **Retained secretions/ increased pulmonary resistance etc**	**Action** • suction, consider need for nebulisers, physiotherapy • refer to advanced treatment plan • d/w community or medical team
3 Assess equipment **Circuit blockage** (Follow circuit from child through to ventilator and ensure it is not kinked or obstructed)	**1 Assess child** • Correct fault • Re-assess
Is the alarm set appropriately (i.e. as previously recorded and checked at start of shift)	• Check alarm settings are as prescribed and re-set if any discrepancies

If the child is compromised and you can't resolve the issue rapidly – hand ventilate and call for help

NHS No: Relative/carers name:

Monitoring and maintaining Elisee 150 ventilator (continued)

Performance criteria/ knowledge required	Comments/Guidance
4. Able to assemble new circuit onto ventilator and check before use ■ Able to demonstrate how to put together wet circuit (i.e. with heated humidification) ■ Able to assemble dry circuit (i.e. HME in circuit) ■ Aware of how often to change circuits and where to document ■ Can describe the bacterial filter, know where it should be placed and how often to change it. ■ Can describe the purpose of the grey Pall filter **5. Aware that ventilator manuals should be kept in bedspace and aware of arrangements for managing ventilator problems once home.** ■ Remember if you have a issue with a ventilator switch to the back up/spare ventilator	

NHS No: Relative/carers name:

Monitoring and maintaining NIPPY junior+™ ventilator

Performance criteria/ knowledge required	Comments/Guidance

1. **Demonstrate and discuss how to check the alarm limits and function**

2. **Can explain what alarms can indicate and how to respond to these** (see comments)

3. **Can silence alarms and take off mute**

4. **Demonstrates and can explain how to carry out the following:**
   - Turn ventilator on/off
   - Can check the functioning of the ventilator prior to connecting to the child
   - Can demonstrate an understanding of the screen by describing the function of each key
   - Can identify whether a breath is patient triggered or given by vent (i.e. back-up breath)
   - Can identify whether mains power or battery is in use
   - Can connect and use battery power sources
   - Can identify the rear inlet filter and demonstrate how/ when to change it

Check alarms at the start of each shift and document.

- When tubing is first disconnected check that low pressure/disconnect and/or low tidal volume alarms are triggered
- Occlude the vent circuit whilst running and check the high pressure/low tidal volume alarms are triggered.

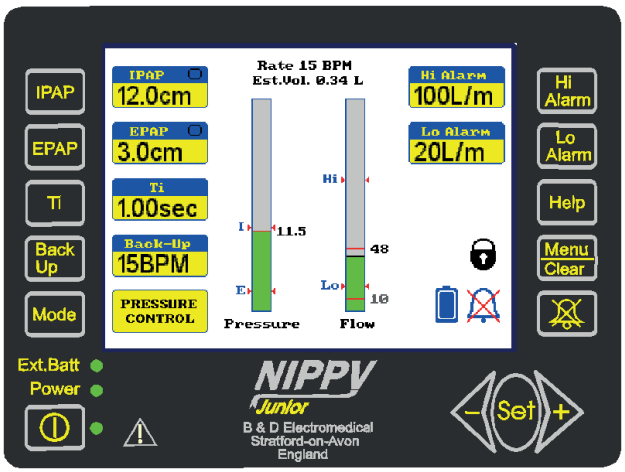
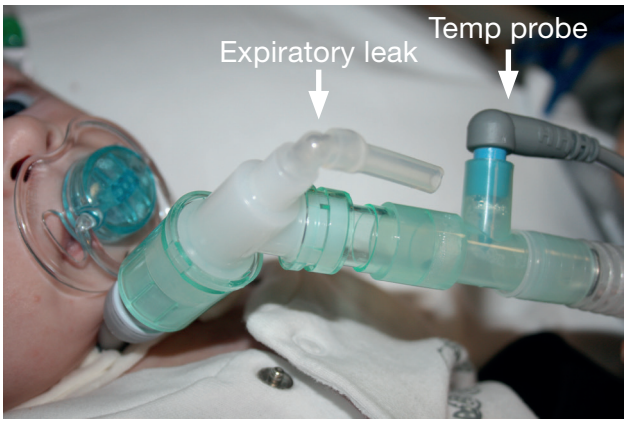
Ventilator alarm goes off

High flow alarm	Low flow alarm
Usually indicates leak somewhere e.g. disconnection somewhere in circuit or decannulation with tracheostomy attached to circuit	Usually indicates obstruction e.g. circuit blocked or tracheostomy, or increased lung resistance
Assess child Possible causes include: • Leak around tracheostomy (particularly when asleep) • Decannulation **Assess equipment** • Follow circuit from child through to ventilator (ensure all connected – ie. humidifier connectors etc)	**Assess child** Possible causes include: • Blocked tracheostomy • Retained secretions/ increased pulmonary resistance etc **Assess equipment** • Follow circuit from child through to ventilator (ensure not kinked or obstructed) • Is the alarm set

- **Hand ventilate**
- **Call for help**
- **Change to other ventilator**

NHS No: Relative/carers name:

Monitoring and maintaining NIPPY junior+™ ventilator (continued)

Performance criteria/ knowledge required	Comments/Guidance
5. Demonstrate care of ventilation circuits ■ Able to demonstrate how to put together wet circuit (i.e. with heated humidification) ■ Able to assemble dry circuit (i.e. HME in circuit) ■ Aware of how often to change circuits and where to document ■ Can identify & explain the purpose of the exhalation leak ■ Can describe the bacterial filter, know where it should be placed and how often to change it **6. Oxygen therapy** ■ Can explain how to administer oxygen via circuit **7. Explains purpose of inlets and fans & aware of how to position ventilator safely**	**Other alarms to describe:** Disconnect; Apnoea; High breath rate; Low battery/ Running on battery **Screen parameters** that should be understood: IPAP; EPAP; trigger insp; trigger exp; rate; estimated tidal volume; Ti; back up rate; mode; pressure bar & flow bar  Ensure that an expiratory leak of the correct type is present next to the tracheostomy in single limb circuits: 

NHS No: Relative/carers name:

NIPPY: possible alarm causes and actions

High flow/Breathing circuit disconnected may indicate a leak/ disconnection	
1 **Assess child** **Accidental decannulation** (i.e. tracheostomy has come out)	**Action** Immediately insert tracheostomy If difficultly follow **emergency algorithm**
2 **Assess child** Possible causes include: **Leak around tracheostomy** (particularly when asleep)	**Cause** - some leak may be tolerated and may be due to position of child – discuss with community ± medical teams, who can consider need for cuffed trache or upsize
3 **Assess equipment** **Disconnection within circuit** (Follow circuit from child through to ventilator and ensure everything is connected – NB humidifier connectors etc may be slightly loose)	**Action** • Reconnect any loose connections • Re-assess
Is the alarm set appropriately (i.e. as previously recorded and checked at start of shift)	• Check alarm settings are as prescribed and re-set if any discrepancies

Low flow may indicate blockage or obstruction	
1 **Assess child** Possible causes include: **Blocked tracheostomy**	**Action** **Emergency algorithm:** 1. Suction 2. Emergency tracheostomy change
2 **Assess child** **Retained secretions/ increased pulmonary resistance etc**	**Action** • suction, consider need for nebulisers, physiotherapy • refer to advanced treatment plan • d/w community or medical team
3 **Assess equipment** **Circuit blockage** (Follow circuit from child through to ventilator and ensure it is not kinked or obstructed)	**1 Assess child** • Correct fault • Re-assess
Is the alarm set appropriately (i.e. as previously recorded and checked at start of shift)	• Check alarm settings are as prescribed and re-set if any discrepancies

If the child is compromised and you can't resolve the issue rapidly – hand ventilate and call for help

NHS No: Relative/carers name:

Humidification for a child with a tracheostomy

Performance criteria/ knowledge required	Comments/Guidance

1. Discuss reasons for using artificial humidification in a child with tracheostomy:

- Role of upper airway in humidification
- Effect of bypassing the upper airway via a tracheostomy
- Ventilator delivers dry gases (unless humidified effectively) this or unhumidified oxygen can lead to the following problems:
  - Tracheostomy blockage/obstruction
  - Risk of lung collapse/infection/ damage
  - When children may need more humidification i.e. infection/ temperatures etc

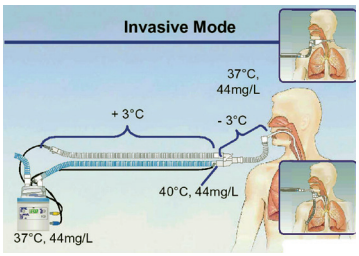
2. Identify different humidification devices

- Heater wire humidification (i.e. with thermostat)
- Heat moisture exchanger (HME) within circuit (e.g. “dry circuit”)
- Swedish nose devices when not ventilated

3. Assemble the humidification device into the ventilator circuit.

- Heater wire humidification :
  - Where to position humidifier
  - How to assemble circuit
  - How to turn on/off and set for a child with tracheostomy
  - State the temperature required and where to document this
  - How to troubleshoot

The electronic display on the main unit will display the lowest temperature either in the circuit or in the chamber. If you hold the mute button the unit will display both values.



Impairment and destruction of cilia reduces the proximal transportation of mucus. Secretions become increasingly thick and tenacious, making their expulsion difficult. This may lead to blockage of the tube. Additionally, cold inspired air increases heat loss from the respiratory tract, a particular danger for the small infant. Such problems may be overcome in the hospital environment by nebulisers and humidifiers for ventilation circuits. Heat and moisture exchangers (HME) are more suitable for definitive use, attached to the tracheostomy tube for long periods. These consist of multiple layers of water repellent paper or foam membranes, which trap heat and moisture during exhalation. Cold inhaled air is then warmed and moisturised, thus maintaining the optimum respiratory tract environment.

Several varieties of HME may be used, but a number of important aspects should be considered. Firstly, the selected HME must be appropriate to the particular child’s tidal volume (6-8 ml/kg), in order to limit resistance to airflow and prevent carbon dioxide retention. The HME must also be lightweight, to avoid traction to the tracheostomy tube which might cause skin irritation or even accidental decannulation. For similar reasons, ventilation attachments should be used with care. Additionally, the internal volume of the HME will add to respiratory dead space (already 2-2.5 ml/kg), increasing the work of breathing. This may be further exacerbated by the accumulation of secretions within the device: manufacturers therefore recommend changing the HME daily or whenever contaminated.

Three commonly used HME’s can be used with child with spontaneous breathing (these must NOT be used in conjunction with the ventilator).

These are:

- The Mini Vent HME which can be used for all small infants under 10kg

- The Trach-phone HME with no weight restrictions, this can also be used to aid phonation and allow the administration of Oxygen (up to 2 litres)

- The Thermovent T which can be used for children over 10kg.

NHS No: Relative/carers name:

Humidification for a child with a tracheostomy (continued)

Performance criteria/ knowledge required	Comments/Guidance

3. continued

- HME (heat moisture exchanger) within circuit
  - Can demonstrate how to assemble circuit and correct positioning on HME
  - Aware of how often to change HME i.e. every 24 hours
  - Discuss correct sizes depending on child's weight

4. Nebuliser therapy for a child with tracheostomy

- Can identify which of the child's drugs are nebulised
- Can assemble the nebuliser and position appropriately within the circuit
- Can demonstrate how to use the compressor to drive nebulisation
- Demonstrates how to clean and store nebuliser equipment

Example of HME as used in "dry circuit" (Figure 4). This is not to be used without a ventilation circuit

Nebulisers are added in different ways depending on the individual, the drug administered and the type of ventilator circuit (please refer to your local guidelines)

This picture (Figure 1) shows position of nebuliser for saline, salbutamol/DNase in NIPPY circuit (In single limb circuits the expiratory leak must never be taken out of the circuit):

Example (Figure 2) of position of nebuliser for antibiotics in NIPPY circuit (yellow filter only used during nebulisation) the expiratory leak must never be taken out of the circuit:

Example (Figure 3) of nebuliser position for Elisee (NB this can be used for salbutamol, saline, Dnase or antibiotics as the expiratory filter scavenges exhaled antibiotic in the double limb circuit):

Figure 1

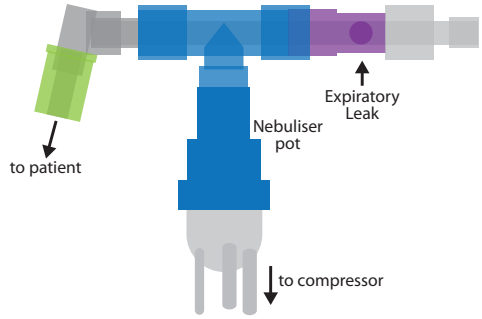


Figure 2

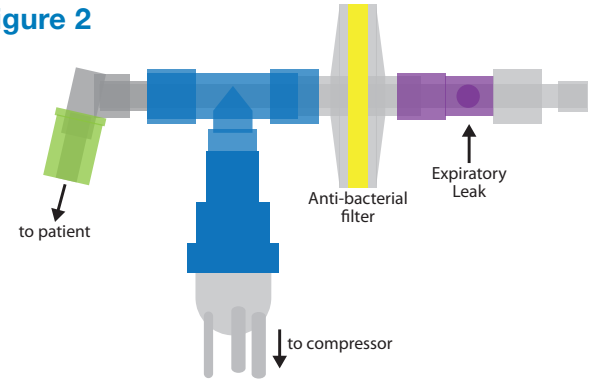


Figure 3

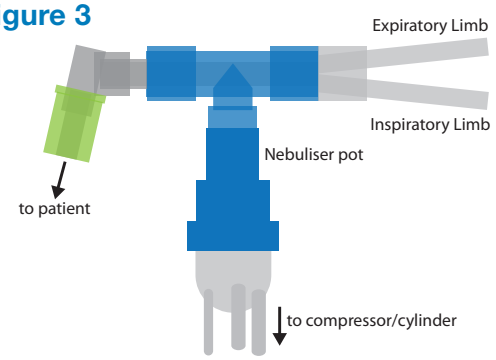
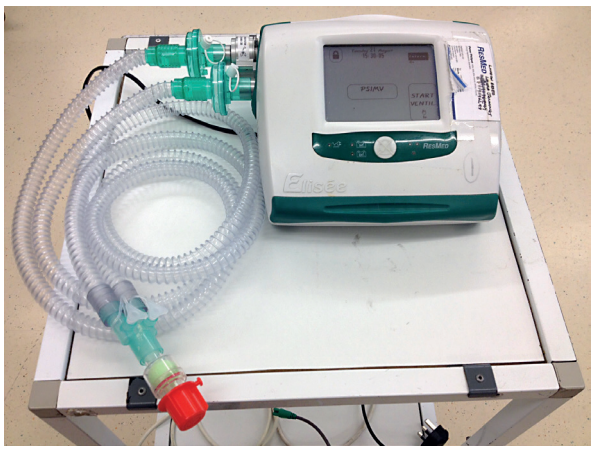


Figure 4



Refer to your local Trust policy

NHS No: Relative/carers name:

Monitor & maintain adequate oxygenation to a long term ventilated child

Performance criteria/ knowledge required	Comments/Guidance

1. **Demonstrate how to correctly place a saturation probe**
2. **Demonstrate how to measure and record the oxygen saturations of child**
3. **Demonstrate how to set the parameters and alarms on an oxygen saturation monitor**
   - Able to explain why parameters are important i.e. implications of too low or too high saturations.
   - Discuss what appropriate alarm settings may normally be for a child
   - Demonstrate awareness as to why individuals may have specific parameters for O_2 saturations
   - Training is required when a new (different model) saturations machine is used
4. **Discuss the application of oxygen via a tracheostomy using various devices**
   - Ventilator circuit (NB different for Elisee 150 and NIPPY junior+™)
   - Swedish nose (used on tracheostomy when ventilator not attached)
   - Passy-muir (speaking) valve
   - Trache mask (if appropriate)
5. **Discuss the steps to be taken if the oxygen saturation of the child is low/ poor trace.**
   - Assess child clinically for cyanosis, respiratory distress.
   - Check patient is ventilating appropriately and machine attached properly, increase O_2 if cyanosed etc.
   - Evaluate trace i.e. for interference due to movement vs. true desaturation
   - Re-site probe and reassess trace

A good quality saturations trace

A persistently poor trace must be rectified by repositioning or replacing the probe, please note that this could also indicate clinical deterioration of the child.

One of the correct sites to place a saturations probe, see manufactures guideline for specific attachment procedures

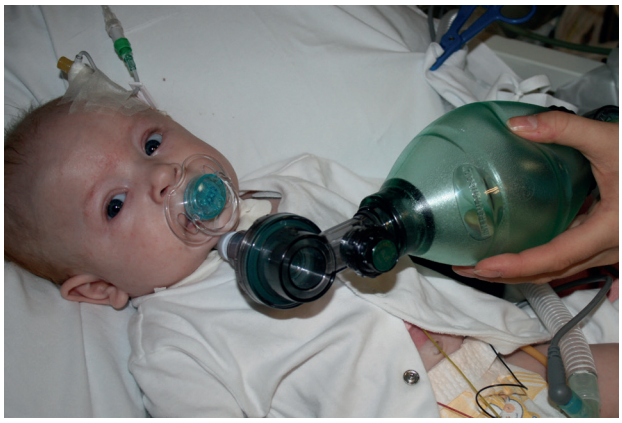
NHS No: Relative/carers name:

Hand-ventilation via tracheostomy

Performance criteria/ knowledge required	Comments/Guidance

1. Demonstrate an understanding of when hand ventilation (ie via ambu-bag or self inflating bag) may be indicated:

- Machine failure
- Acute deterioration
- Swapping of machines (if child is 24 hours dependent)
- Changing circuit (if child is 24 hours dependent)

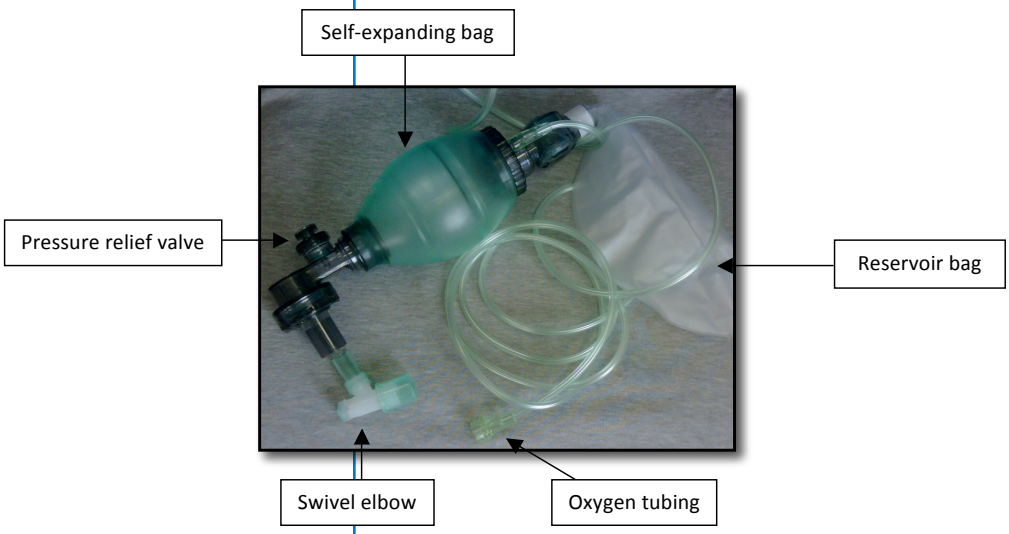


2. Demonstrate how to check and set up equipment needed to hand ventilate:

- Connected to O_2 if available
- Ensure there are no leaks apart from the pressure value

3. Demonstrate safe technique in supporting ventilation using an ambu-bag or self inflating bag:

- Remember the childs “normal” respiratory rate
- Remember the childs “normal” depth of breathing
- Each inspiration should last approx 1-1.5 secs (dependent on the child)



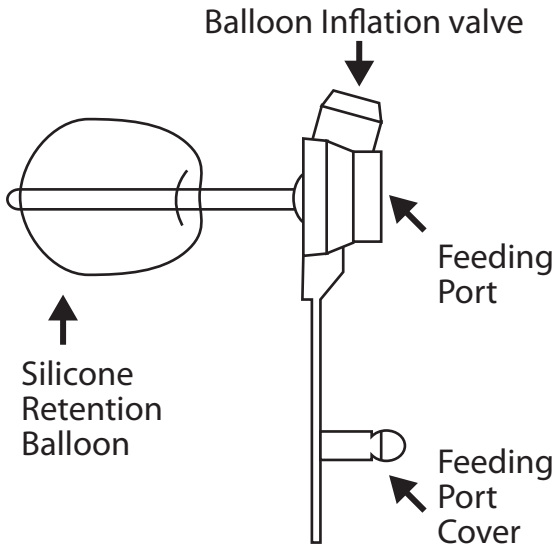
NHS No: Relative/carers name:

Oral feeding

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrates knowledge regarding signs of aspiration ■ See comments **2. Demonstrate knowledge of feeding plan and use of appropriate strategies to help encourage oral feeding** ■ See comment **3. Knowledge of signs of aversion** ■ See comment **4. Liaison with other professionals as required** ■ See comment  	**1. Signs of aspiration:** ■ Coughing, choking or desaturating on any oral intake ■ Evidence of fluids or food in tracheostomy secretions ■ "Wet" sounds to respiration post intake ■ Excessive drooling ■ Eye watering **Please notify medical team and refer to SLT (Speech & Language Therapist) if any concerns re Aspiration** **2. Strategies to help encourage oral feeding:** ■ Appropriate positioning ■ Use of specific teat or bottle ■ Timings of oral feeding ■ Follow infant or child's cues ■ Encouraging self-feeding or participation ■ Encourage messy play ■ Careful mouthcare ■ Offering the dummy with tube feeds if an infant & they have a dummy **3. Signs of aversion:** ■ Choking and gagging ■ Food/bottle refusal eg. back arching away ■ Desaturations or colour changes when teat/food presented **Please refer to SLT if any concerns re: feed aversion** **4. Other Professionals that may need to be involved:** ■ Dietition ■ Physiotherapist ■ Occupational therapist ■ Psychologist

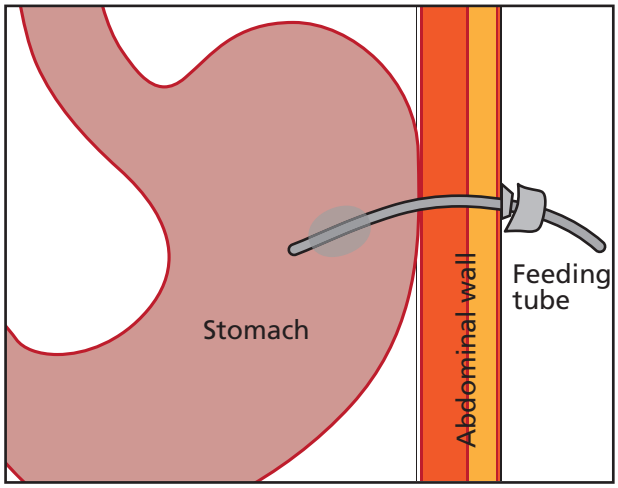
NHS No: Relative/carers name:

Gastrostomy care

Performance criteria/ knowledge required	Comments/Guidance
1. Demonstrate how to assess a stoma: ■ Check for redness ■ Odour ■ Is there leakage from stoma ■ Bleeding ■ Pain or discomfort ■ Does there appear to be growth of extra/new skin at the stoma (over granulation) **2. Demonstrate how to clean a gastrostomy site:** ■ See comments **3. Demonstrate how to check the gastrostomy button balloon/PEG tube:** ■ The water in the balloon is renewed weekly ■ Gather all equipment needed (x2 5ml syringe,use water not saline, distilled water or sterile water for babies under 9 mths age) ■ Remove old water using a 5 ml syringe, fitting syringe into the balloon inflation port (due to natural evaporation there may be 4 mls removed) ■ Replace with 5 mls	**How to Clean gastrostomy site:** ■ Wash hands before and after ■ Clean the site twice daily (morning and night) ■ Use unscented soap ■ Clean around the area, with gauze (cotton buds may be useful) ■ Dry the skin well ■ If PEG Rotate the tube once daily (360 degrees) 

NHS No: Relative/carers name:

Gastrostomy care (continued)

Performance criteria/ knowledge required	Comments/Guidance
4. Demonstrate/explain the correct position of a MicKey button gastrostomy: [if relevant] **5. Demonstrate the administration of a bolus feed:** ■ Wash hands ■ Collect equipment required for your child (Delivery system for feed ie. syringes/ extensions sets, feed and distilled water ■ Clean a working surface on which to prepare the feed as per Dietitians instructions ■ Check the expiry date of feed ■ Attach the extension set ■ Flush tube with cooled boiled water ■ Connect the bolus set to your feeding tube ■ Pour feed into the bolus set and elevate above the child's head. Always give the bolus over 10-15 minutes ■ At the end of the feed disconnect the giving set and flush the tube with cooled boiled water ■ Wash hands **6. Demonstrate the application of a continuous feed:** ■ Wash hands ■ Collect equipment required ■ Clean a working surface on which to prepare the feed as per Dietitians instructions (check the expiry date of feed) ■ Prime the giving set and set up pump (set rate and amount to give) ■ Connect/attach giving set to your feeding tube ■ Start feed ■ When feed has been completed flush tube with 5-10 mls of water ■ Remove the extension set and close the safety plug **7. What to do in an emergency (ie. tube comes out, tube blockage):**	**Position of Gastrostomy**  ■ Gastrostomy is a surgical opening, made through the abdominal wall into the stomach, through which a feeding tube can be passed. ■ They usually have a balloon end which sits inside the stomach and stops the button falling out. **Emergency Equipment to be carried at all times**

NHS No: Relative/carers name:

Gastrostomy care (continued)

What to do in an emergency:

Gastrostomy Tube falls out

- If possible, put the clean, old device back in the stoma/tract (make sure the balloon is deflated) and secure it in place with tape
- If the tube falls onto the floor, do not place it back into the stoma. Replace with NG tube, an inch in length into the stoma and tape down then go to hospital
- If you are unable to replace the old device or have no replacement, put a dressing over the stoma and get help immediately, because within a few hours the tract will begin to close up
- If the balloon has burst or the tube has not fully come out push back in place and try re-inflating balloon. If the balloon has burst then tape tube in place and get help from community nurse or local hospital

Gastrostomy Tube blockage

- Flush tube with warm water in a large syringe (flushing and aspirating back and forth)
- Try using sparkling water (10-15 mls) in a 50 ml syringe into the tube, leave it there for 30-60 minutes before flushing it out with water, consider that the tube may be kinked
- Do not use excessive pressure to flush
- If you are unable to unblock the tube contact your community nurses or hospital
- To prevent blockage flush with 10-15 mls of sterile or cooled boiled water (depending on size of child) through the feeding set before and after every feed and medications

NHS No: Relative/carers name:

Travel and transport

Performance criteria/ knowledge required	Comments/Guidance

1. **Identify all emergency equipment:**
   - Check and recharge equipment as necessary
   - Check the child's emergency bag and equipment
   - Ensure sufficient ventilator battery power is taken
2. **Obtain consent from parents/medical staff:**
   - Where possible you must also gain consent from the patients
   - Explains the benefits of trips out of the hospital environment
   - Must ensure that you gain consent before you begin any treatment or care
   - Doctors must be made aware in case there are any medical concerns or tests booked
3. **Calculate required amount of oxygen for the duration of the outing:**
   - Length of journey (in Minutes) x Litres per minute prescribed = Total volume of O_2 need for trip (in Litres)
   - Volume of O_2 cylinder (in Litres)/Litres per minute Used = Time, in Minutes that the cylinder will last
   - Always ensure adequate O_2 volume is taken in case your journey time is extended
4. **Demonstrate taking the child out on a trip including using the buggy, safely secure the equipment:**
   - Build your confidence by visiting the play room first or the hospital school with all the required equipment
   - As your confidence grows, trips off the hospital grounds can be taken unsupervised
   - Before taking the child out for a day trips you must be fully competent in all aspect of care including Basic Life Support
   - On return REMEMBER to plug all electrical equipment into mains to recharge
   - REMEMBER in case of an acute deterioration outside the hospital 999 must be call immediately. Make sure an interim medical summary is taken out with the child

Equipment needed for a trip off the ward or out of the house:

- Emergency Tracheostomy box
- O_2 (if needed)
- Suction machine (battery power)
- Ambu bag
- Ventilator (including carry case)
- Appropriate specialist buggy
- Saturations monitor
- Hand suction pump
- Suction catheters

BOC Medical Cylinder data chart:

Cylinder code	Capacity in litres
AZ	170
C	170
D	340
CD	460
E	680
J	6800

Journey time X prescribed O_2 requirement = Total amount needed for journey, double the amount for safety

i.e. the child is on 2L/min O_2 and it going out for one hour or 60mins so he needs 120ltrs, double this to 240ltrs to cover you in the event of an emergency.

NHS No: Relative/carers name:

Promote child's neurodevelopment

Performance criteria/ knowledge required	Comments/Guidance
1. Identify members of the MDT who should be liaised with to promote the child's development ■ While they are an in-patient. ■ When they are discharged.	a. SLT, OT, Physio, Dietition, Play Specialist, Specialist Nurse, hospital Social Worker, Welfare Rights Advisor, Psychologist, School Teacher, Family Liaison Team, Nursery Nurses b. Community equivalents, discharge planning nurse, Specialist Nurse, School/Specialist Teacher
2. Discuss the environmental factors that may affect the child's development during their stay on the ward.	Child in isolation, visiting rules (parents, siblings, other family), co-morbidities (eg. syndromes, cerebral palsy), play/ school access, 24/24 activity and décor/space (compared to a home environment)
3. Describe the child's potential communication difficulties and strategies that may be used to address these.	**Difficulties:** compromised voice, co-morbidities, culture/ language **Strategies:** liaise with SLT, communication cards, interpreter, speaking valve (liaise with SLT/Physio), baby sign/makaton, family carers
4. Describe the child's potential play/cognitive difficulties and strategies that may be used to address these.	**Difficulties:** restrictions eg. sitting/weak muscles/ environment, co-morbidities, culture, premorbid activity **Strategies:** liaise with OT and play specialists, normalising play, play sessions, school, increase opportunities for play in daily framework
5. Describe the child's potential motor/mobility (indoor and outdoor) difficulties and strategies that may be used to address these.	**Difficulties:** weak muscles, limited positioning, equipment, co-morbidities, environmental considerations (stairs/ infection control/transportation) **Strategies:** liaise with Physio, seating, trolleys, buggies, car/ bus, exercises, play
6. Describe the child's potential social/personal difficulties and strategies that may be used to address these.	**Difficulties:** family opportunity to be carer, access to wider family/friends, environment (cultural practices), dignity/ privacy, space, language, access to school/nursery **Strategies:** liaise with Family Liaison Team, empower parents, opportunities for play and personality development, appropriate interactions, access to school/play time
7. Identify your role in promoting the child's development.	Being aware of above issues, helping to access the strategies identified, be mindful of parental roles and responsibilities
8. Discuss the importance of maintaining a day and night routine.	Consistency, protected time (with parents/for socialisation/ for developmental play), establish child's own routine independent of ward/nursing agenda, empower patient/ family. Develop a daily framework/timetable

NHS No: Relative/carers name:

Knowledge of medications

Performance criteria/ knowledge required	Comments/Guidance
1. Identify the uses of medication for the individual child: ■ Identify potential side effects of the medication **2. Identify factors which may indicate the child requires medication and refer this concern to parent, guardian or professional:** ■ Pain ■ Discomfort ■ Changes in vital signs ■ Fever **3. Identify different ways in which medications can be given:** ■ Oral ■ Nasogastric tube ■ NasoJejunal tube ■ Gastric feeding tube • PEG or Button ■ Nebulised (see competency 11 for setting up a nebuliser circuit) • Attached to the ventilator • Disconnected from the ventilator	**List the above patients current medication and purpose**

NHS No: Relative/carers name:

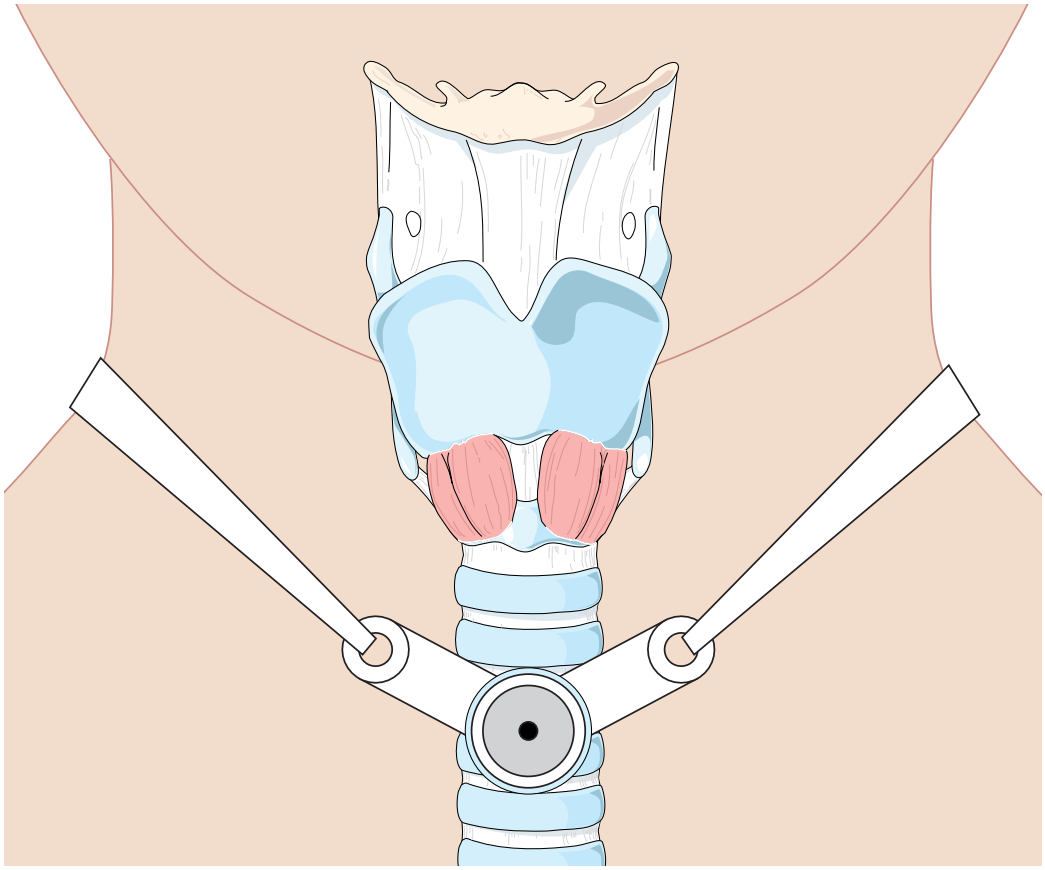
Comments and Notes

NHS No: Relative/carers name:

Comments and Notes

NHS No: Relative/carers name:

A joint competency document for staff and carers working with Long Term Tracheostomy Ventilated Children



Sign Off Records

Child's Name:	
Hospital Number:	
Date of birth:	
Consultant:	
Ward:	

NHS No:

Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
Demonstrate awareness of Health and safety					
1. Identify potential hazards and dangers of the ward environment.					
2. Assess the child's immediate environment for health and safety.					
3. Demonstrate the safety checks at the beginning of each shift.					
Reducing risk of infection					
1. Demonstrate effective hand washing.					
2. Discuss how infection can spread.					
Personal hygiene needs of the child					
1. Demonstrate how to assess the oral status of the child.					
2. Safely bath a child with a tracheostomy either attached to a portable ventilator or with Swedish nose.					

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NHS No:

Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
Assessment and monitoring					
1. Demonstrate how to take the child's vital signs if taught to do so.					
2. Discuss normal parameters for the child and outline the course of action to be taken.					
3. Know how to access emergency contact numbers and where they are displayed in the child's environment.					
4. Demonstrate how to recognise signs of distress or changes in clinical status.					
Suctioning via Tracheostomy					
1. Demonstrate how to use portable & walled suction and hand/foot pump.					
2. Aware of indications for suction in a child with a tracheostomy.					
3. Demonstrate appropriate procedure for suctioning via tracheostomy.					
4. Demonstrate how to assess secretions appropriately.					
5. Demonstrate how to clean and store suction equipment.					

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NHS No:

Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
Tracheostomy care					
1. Assess tracheostomy site.					
2. Clean and change ties at tracheostomy site.					
3. Routine tracheostomy change.					
4. Understand which tube is current in use.					
5. Clean and Store tracheostomies appropriately.					
6. Demonstrate awareness of granulomas.					
7. Care of patient with cuffed tracheostomy.					
Emergency Procedures					
1. Procedure for a blocked tracheostomy tube.					
2. Perform a single person tracheostomy tube change.					
3. Discuss actions to be taken in case of a parent/family member collapsing at hospital/home.					
4. Describe the steps that should be taken in the event of a tracheostomy becoming accidentally decannulated.					
5. Complete Basic Life Support training as per Resus Council Guidelines.					

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Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
Care of the child Ventilated via Tracheostomy					
1. Demonstrate understanding of child's need for ventilatory support.					
2. Describe in basic terms difference between CPAP & Bilevel support and how ventilation works and records these appropriately.					
3. Describe in basic terms how the mode(s) in use assists ventilation.					
4. Can identify the prescribed settings.					
5. Aware of importance of back-up batteries.					
6. Be aware of frequency of ventilation circuit changes.					
Monitoring and maintaining Elisee 150 ventilator					
1. Demonstrate and discusses how to check the alarm limits and function.					
2. Demonstrate and explain how to carry out the following.					
3. Can explain what alarms can indicateand how to respond to these.					
4. Able to assemble new circuit onto ventilator and check before use.					
5. Aware that ventilator manuals should be kept in bed space and aware of arrangements for managing ventilator problems once home.					

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NHS No: Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
Monitoring and maintaining NIPPY junior+™ ventilator					
1. Demonstrate and discuss how to check the alarm limits and function.					
2. Can explain what alarms can indicate and how to respond to these.					
3. Can silence alarms and take off mute.					
4. Demonstrates and can explain how to carry out the following.					
5. Demonstrate care of ventilation circuits.					
6. Oxygen therapy.					
7. Explains purpose of inlets and fans & aware of how to position ventilator safely.					
Humidification for a child with a tracheostomy					
1. Discuss reasons for using artificial humidification in a child with tracheostomy.					
2. Identify different humidification devices.					
3. Assemble the humidification device into the ventilator circuit.					
4. Nebuliser therapy for a child with Tracheostomy.					

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NHS No:

Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
5. Appropriate Use of the Heat and Moisture Exchanger, with the various boxes as has already been done					
Monitor and maintain adequate oxygenation to a long term ventilated child					
1. Demonstrate how to correctly place a saturation probe.					
2. Demonstrate how to measure and record the oxygen saturations of child.					
3. Demonstrate how to set the parameters and alarms on an oxygen saturation monitor.					
4. Discuss the application of oxygen via a tracheostomy using various devices.					
5. Discuss the steps to be taken if the oxygen saturation of the child is low/poor trace.					
Hand-ventilation via Tracheostomy					
1. Demonstrate an understanding of when hand ventilation may be indicated.					
2. Demonstrate how to check and set up equipment needed to hand ventilate.					

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NHS No:

Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
3. Demonstrate safe technique in supporting ventilation using a self inflating bag.					
Oral Feeding					
1. Demonstrates knowledge regarding signs of aspiration.					
2. Demonstrate knowledge of feeding plan and use of appropriate strategies to help encourage oral feeding.					
3. Knowledge of signs of aversion.					
4. Liaison with other professionals as required.					
Gastrostomy Care					
1. Demonstrate how to assess a stoma.					
2. Demonstrate how to clean a gastrostomy site.					
3. Demonstrate how to check the MicKey button balloon/PEG tube.					
4. Demonstrate/explain the correct position of a MicKey button gastrostomy (if relevant).					
5. Demonstrate the administration of a bolus feed.					
6. Demonstrate the application of a continuous feed.					

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NHS No: Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
7. What to do in an emergency (i.e. Tube comes out, tube blockage).					
Travel and transport					
1. Identify all emergency equipment.					
2. Obtain consent from parents /medical staff.					
3. Calculate required amount of oxygen for the duration of the outing.					
4. Demonstrate taking the child out on a trip including using the buggy, safely secure the equipment.					
Promote child's neurodevelopment					
1. Identify members of the MDT who should be liaised with to promote the child's development.					
2. Discuss the environmental factors that may affect the child's development during their stay on the ward.					
3. Describe the child's potential communication difficulties and strategies that may be used to address these.					

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NHS No: Relative/carers name:

Competencies section required to be completed	Observed/ discussed (date & Sign)	Performed under supervision (date & sign)	Achieved (trainer sign & date)	Trainee sign & date when confident re: competency	Remarks
4. Describe the child's potential play/cognitive difficulties and strategies that may be used to address these.					
5. Describe the child's potential motor/ mobility (indoor and outdoor) difficulties and strategies that may be used to address these.					
6. Describe the child's potential social/ personal difficulties and strategies that may be used to address these.					
7. Identify your role in promoting the child's development.					
8. Discuss the importance of maintaining a day and night routine.					
Knowledge of medication					
1. Identify the uses of medication for the individual child.					
2. Identify factors which may indicate the child requires medication and refer this concern to parent, guardian or professional.					
3. Identify different ways in which medications can be given.					

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NHS No: Relative/carers name:

Patient Hospital No: Relative/carers name:

Tracheostomy and Ventilation Competency Certificate

I certify that I (name of assessor) _____

have a current NMC registration or I am affiliated with a Professional governing body. I am experienced and have attained my own competency in Tracheostomy and Ventilator care and teaching, in order that I am able to assess and sign off the competency of the carer below.

Print full name _____ Designation _____

Signature _____ Date _____

I certify that I (name of carer) _____

have undergone a period of theory and practical training and am confident and competent in the procedures detailed in this booklet. I will only use this training in respect of the child specifically named on the front of this booklet and I will not carry out any procedures which have not been covered by this training.

I will continue according to local policy, ensure that my practice is kept up to date with regular checks and training. If there are any concerns I will seek appropriate advice and guidance in order for me to continue to operate within these competencies.

Print full name _____ Designation _____

Signature _____ Date _____

I certify that (carers name) _____

has undergone a period of training and has been deemed competent to practice the procedures outlined in this booklet.

Print full name _____ Designation _____

Signature _____ Date _____

A copy of this document, when complete, must be kept in the child's medical notes.

Tracheostomy: General Information

Paediatric tracheostomy is a rewarding but challenging procedure. Over the last several years, there has been a perceived increase in tracheostomy related complications reported throughout the UK.

To investigate this further we conducted our own audit of all paediatric tracheostomy patients followed at our institution in order to identify the number and nature of reported adverse events with the goal of reducing their incidence.

Adverse events occurring both in hospital and in the home setting were included.

Our audit revealed an alarming rate of complications in this population. Each tracheostomised child is in a potentially dangerous situation, at risk of minor and life threatening but generally avoidable complications.

Management of the paediatric tracheostomy requires a working knowledge of the child's underlying medical condition, respiratory status and indication for the tracheostomy. Of utmost importance is that all practitioners caring for these children should be appropriately trained and have adequate knowledge of all aspects of tracheostomy care.

Common Reasons for Paediatric Tracheostomy;

There are many reasons why we at this Institution would insert a tracheostomy, below are the most common reasons;

- **Cystic Hygroma** An anomaly of the lymphatic system. It is a soft, smooth, non-tender mass of almost fat like consistency. It is grey and oedematous in appearance. It can involve the neck, mucosal surfaces of the mouth, tongue, larynx and pharynx causing a potential airway obstruction.
- **Haemangioma** A swelling containing abnormal blood vessels that can form at all levels of the respiratory system.
- **Laryngo-malacia** The structures of the larynx are particularly soft and collapse inwards as the child breathes. This can cause varying degrees of obstruction, in extreme cases or if this is in addition to another airway problem we may insert a tracheostomy. As the child gets older the larynx becomes more rigid and the condition may resolve allowing for decannulation.
- **Papillomatosis** Benign wart-like lesions that are caused by Human Papilloma Virus. Their growth and the extent of disease varies considerably in children, but essentially the lesions can occupy and obstruct any part of the child's airway from the mouth and nose right through to lower airway structures.
- **Sub-Glottic stenosis** is a narrowing of the upper part of the trachea just below the larynx/ voice box. This may be congenital or acquired usually from prolonged intubation periods and or trauma at the time of tube insertion. Depending on the extent a child may recover from this or will require reconstructive surgery later in life.
- **Tracheal/ Bronchial stenosis** Narrowing of the tracheal diameter, which may be congenital or acquired, possibly through trauma or previous surgery. If the narrowing is high enough the trachea may be stented by the tracheostomy tube, if not separate tracheal/bronchial stents may have to be inserted to support the affected areas.

- **Tracheo-malacia** An area of softening in the trachea, which may collapse inwards as the child breathes and may obstruct respiration. This condition usually resolves with time as the trachea enlarges and becomes more rigid. The tracheostomy tube may be useful in stenting the area of the collapse. Some children may require positive pressure ventilator support if the lower tracheal area is collapsing.
- **Broncho-malacia** An area of softening in one or both of the bronchus, which may collapse inwards as the child breathes. As with all malacia this condition usually resolves as the child becomes older. Until this time the child may require positive pressure ventilator support.
- **Trauma** Direct trauma (for example burns/injury) to the upper airway or surrounding structures can cause a potential airway obstruction and or narrowing.
- **Vocal cord immobility** Immobile vocal cords may be caused by injury during intubation/ and or surgery, or due to an underlying neurological condition. Dependent on whether the cords are fixed open or closed the airway may be compromised.
- **Tumour** Tumours of any part of the respiratory passage may cause an airway obstruction due to the potential nature, growth and shape.
- **Long-term respiratory support** A tracheostomy may be required to facilitate long-term respiratory support, which would otherwise have to be managed with an endo-tracheal tube. The latter would lead to a variety of problems: including security of the tube, stimulation and development of the child, it would also mean hospitalisation. A tracheostomy is the preferred long-term option.
- **Supporting** the airway during head/neck surgery
- **Protecting** the airway from potential aspiration due to possible impaired neurological function/ damage to structures following surgery

Paediatric tracheostomy tubes;

The first types of tracheostomy tubes were made of sterling silver. As other synthetic materials have developed they have improved the flexibility and comfort of paediatric tracheostomy tubes. (Tweedie, Skilbeck and Cooke, 2014)

- **Tracheostomy Size Chart**
  All tracheostomy tubes have similar parts. In particular paediatric tubes are designed to accommodate the paediatric and neonatal neck shape; they provide stability and a means of securing the tube in place. (Johanna please can you link to this)

- **15mm termination port** A universal 15mm port providing the means of connecting additional equipment, such as speaking valves and HME's or ventilatory equipment. It also provides an extension to prevent occlusion from the child's chin (not present on the GOS Rusch®, Silver tubes).

- **Cannula** Paediatric tubes generally have a single cannula to allow for maximum internal diameter. However tubes are available with both an inner and outer cannula for older children; the cannula can be fenestrated to allow air to pass upwards through the vocal cords to aid phonation. The tube choice will be determined by the TNP/ENT Surgeons at the time of surgery.

- **Obturator (introducer)** this should always be used when inserting the tracheostomy tube, as it provides rigidity to the tube, allowing a smoother insertion.

The list below briefly outlines the tubes that are most commonly used at GOSH. Practitioners are to seek advice from the TNP, ENT team, and manufacturer if more information is required;

Bivona®

This is the most commonly used tube at GOSH, largely replacing other varieties on grounds of comfort and versatility. These tubes do have metal in them, caution with MRI scanning.

- The range is based around a standard shaft, manufactured from opaque, white siliconised PVC. It is latex free and hydrophobic, hindering protein adhesion and thereby limiting secretion build up and bacterial colonisation.

- For this reason, these tubes can remain in place for up to 28 days. The silicone is reinforced with wire, producing a tube that is flexible conforming to the shape of the trachea, but resists kinking.

- An integrating 15mm swivelling adapter reduces torque on the shaft and is universally compatible with ventilation appliances.

- There are two versions: Paediatric (of standard length) and Neonatal (shorter length). With three types of flange shape and size to suit all neck shapes and ages.

Flextend®

- The tubes come in a variety of styles, some with independent flexing proximal and distal shafts, which are beneficial for children requiring ventilation or with neck masses.

Hyperflex®

- Some tubes also have adjustable flanges so that the shaft length can be altered which is useful to bypass distal anomalies, or to fit an abnormally short trachea- this is a temporary tube as the securing button can easily be opened by children. The TNP will design and customise a tracheostomy based on the required style/dimensions.

Most Paediatric tubes are uncuffed but if ventilation cannot be achieved fully, or there is risk to the lower airways from secretions then a cuffed tube may be considered;

The Fome cuff®

- A self-inflating tube, providing a high level of protection from aspiration whilst providing optimal comfort for the child. Practitioners must ensure that they are familiar with the specifics of this tube when removing and inserting it as it is very different from other tubes. A 3 way tap needs to be used when removing and inserting it. (This will be determined by the TNP on an individual basis- seek advice)

The Tight To Shaft® (TTS)

- A high-pressure low volume cuff. The cuff is filled with sterile water not air. Care must be taken not to overfill the cuff, and practitioners should use minimal volumes in which to achieve effective ventilation. The cuff requires regular deflations (This will be determined by the TNP on an individual basis- seek advice)
- The TTS cuff can be deflated completely to assume the profile of an Un-cuffed tube, which makes it very useful when weaning children from the ventilator. This is not a first line tube if ventilator support is required & other tubes may be appropriate.

Bivona® tubes can be sterilised and re-used. Do not dispose of the obturator after insertion. (maximum of five times or when the integrity of the tube is intact). New 'in hospital and at home' cleaning recommendations are now available from the TNP or the company direct.

The Great Ormond Street Hospital tube

This series is no longer produced, some families bought up a large amount of stock, so practitioners may still see them coming into the hospital.
There are two versions: flat and extended (external fenestrated extension). The extended version is suitable

Shiley®

Not commonly used at GOSH. This product range is manufactured from opaque, thermo sensitive, latex-free PVC, with a thin-walled shaft, tapered tip and universal 15mm connector.

Tubes are available in *neonatal*, *standard paediatric* and *long paediatric* varieties, with optional cuffs for the paediatric series. The sizing system used for the Shiley® range was updated several years ago: the internal diameter (mm) is now quoted for reference, in line with other manufacturers' products.

From our experiences a weekly tube change is recommended.

The Shiley® tube has been superseded by the Bivona® as the product of first choice in this department. However, a long paediatric tube (size 5.0 to 6.5) is not made by other manufacturers, such that the Shiley® remains a unique option for a limited number of children who require a tube which is midway between typical paediatric and adult lengths.
They also offer the alternative when children who have a Bivona tube in situ to insert a Shiley tube for the scan.

At GOSH we also use the Shiley as the backup tube during the emergency procedures as they can be inserted without the obturator (see the GOSH Resuscitation guideline)

Smiths Portex™

- Not commonly used at GOSH. There are two versions available, one without a termination and the other with a 15mm standard termination. This enables them to be used with anaesthetic and ventilatory equipment.

- They are made of a clear PVC material with a blue radio-opaque line. Paediatric sizes range from 3.0mm ID to 7.0mm ID. Cuffed and fenestrated (to facilitate vocalisation) versions are available.

Silver tubes

The Sheffield © tube is the only silver product commonly used at Great Ormond Street Hospital.

A number of silver tubes have been developed. Their designs and general principles remain unchanged for a number of years now. While seldom used by children in GOSH, silver tubes have some important qualities that confer advantages over plastic varieties in certain circumstances.

Most significantly, the tubes can be manufactured with very thin walls, permitting the use of an inner tube without compromising airflow.

This can be removed and cleaned without taking out the whole tube. Silver tubes may remain *in* situ for up to one month, a particular advantage for those children requiring long-term tracheostomy.

However, silver tubes have certain disadvantages. For example, they are rigid and do not conform to the trachea, which some children find uncomfortable.

Additionally, each tube is unique; the unit cost is high (although far fewer tubes are required in the long term) and the components are not interchangeable, creating compatibility problems. Sizes are measured in the French Gauge (FG) and are not comparable to the metric measurements of the plastic tubes. See sizing chart for further details.

They are not compatible with MRI scanning and they may distort CT images of the head and neck.

For resuscitation and ventilator purposes a Smiths Portex ™ male/female adapter of appropriate size will be required in such situations.

Tracheostomy Accessories

There are many products available to facilitate the care and management of a child with a tracheostomy. As with many items, several companies manufacture their own brands of the same piece of equipment. The variation in design or function of the equipment can affect the decision to select or reject. Careful consideration should be given to the specific needs of the individual child before the accessory is purchased.

Speaking valves

A tracheostomy alters a child's ability to communicate (speak) by affecting the passage of air through the voice box (larynx) and mouth for speech. Air from the lungs passes out of the tracheostomy tube instead of passing up through the larynx and out of the mouth.

A speaking valve is a one-way valve that sits on the end of the tracheostomy tube. The valve opens as the child breathes in and closes as the child breathes out, directing air up through the larynx and out of their mouth. This allows the child to create sounds.

Not all children will tolerate a speaking valve, as a good air leak around and above the tube is essential. The speaking valve must **NOT** be used whist the child is asleep or when using a cuffed tracheostomy tube.

Some variations include the facility for oxygen delivery.

Several manufacturers, for example Smiths Portex™, Shiley®, and Rusch® make these. They are designed to facilitate speech in the child with a tracheostomy.

A joint decision is made between the ENT Consultant, TNP and the SALT to use a speaking valve, as changes often need to be made to the existing tracheostomy tube to accommodate it. They **must not** be fitted or used without a full assessment by the child's SALT or TNP.

We commonly use the Rusch valve® valve for the initial assessment, and then use a Passy Muir® for longer term use.

Tracheostomy humidification;

Maintenance of the humidity and warmth of inspired air is an essential part of tracheostomy management, as the normal functions of the upper respiratory tract have been bypassed.

HME's

Consist of multiple layers of water repellent paper or foam membranes, which trap heat and moisture during exhalation. Cold inhaled air is then warmed and moistened, maintaining the optimum respiratory tract environment.

Several varieties of HME may be used, but a number of important aspects should be considered;

- The HME must be lightweight to avoid traction on the tracheostomy tube as this may cause skin irritation or even accidental decannulation.
- The internal volume of the HME will add to respiratory dead space, increasing the work of breathing.
- The HME is changed daily or whenever contaminated.

There are several types available and care should be taken to ensure that the correct HME based on the weight of the child is used.

The Gibeck Mini Vent®

Used for Infants under 1 year (usually under 10kgs), which are specially designed for smaller tidal volumes causing minimal resistance to breathing. The device protrudes forwards accommodating the neonatal/infant 'no neck'.

Thermovent T® from Portex Smiths Medical

Used for Children over 10kg

Trachphone® from Platon Medical.

There are no specific TV restrictions but Practitioners should assess suitability for smaller infants. Oxygen can be delivered via this HME, suctioning can also be carried out through the device without having to remove it, so is useful when some groups of children requiring supplementary Oxygen therapy are sensitive to suctioning /and or removal of the supply.

It can also be used as a phonation device when a speaking valve cannot be tolerated.

Saline nebulisers

The ill/hospitalised child may require extra humidity and this can be delivered as a Nebuliser or by a continuous humidity system.
Nebulisers provide aerosol droplets in a saturated vapour. The advantage of using water droplets in the respiratory tract is not well documented or understood and some argue that excessive saturation of the lower airways may cause atelectasis and impair the function of distal cilia (Conway 1992; Harris, 1967). For this reason Nebulisers should be used as an addition to and not replace a primary method of humidification. Refer to the GOSH nebulizer guidelines.

Continuous Humidity

Continuous Humidity via Water humidifiers are particularly useful when there is a higher requirement for humidification, for example, when the child requires a high minute volume during an acute respiratory illness, new tracheostomy or post anaesthesia.

Care must be taken when assessing the effectiveness of water humidifiers; water droplets must be visible along the whole of the elephant tubing.

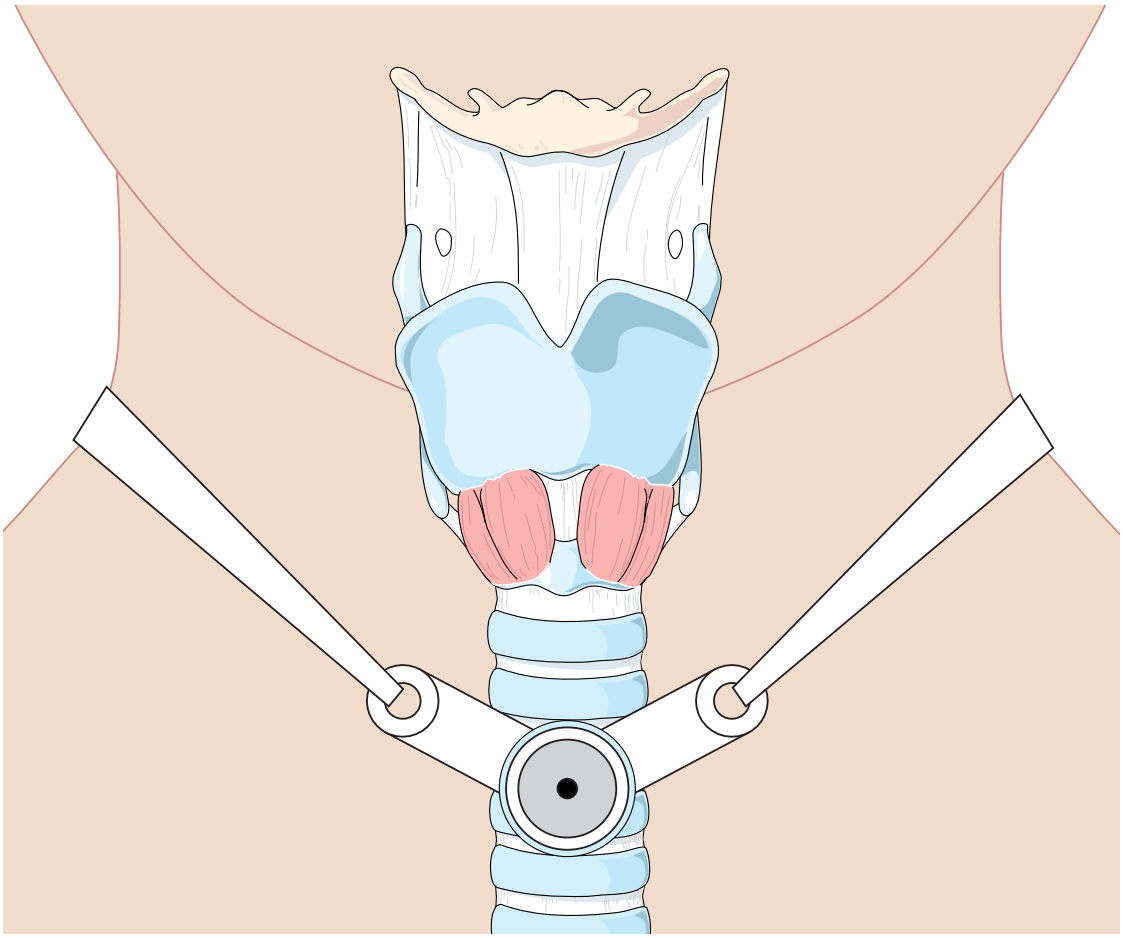
Warmed humidity must be used for small and vulnerable infants.

It is also important that the tracheostomised child remains systemically hydrated and practitioners should consider increasing the child's intake during times of illness such as vomiting, diarrhoea, pyrexia, etc. (Refer to main tracheostomy guidelines for more information).

Appendix 4: Carer Competencies for Tracheostomy Care at Home

Great Ormond Street Hospital for Children NHS
NHS Trust

Paediatric Tracheostomy Care



Carer Competencies & Discharge Planning

Child's Name:	
Hospital Number:	
Date of birth:	
Consultant:	
Ward:	

Printed copies of this document may not be up-to-date. Always obtain the most recent version from GOSH Document Library

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Introduction

This training package is intended to provide a structure and framework for teaching parents/ carers to care for their child with a tracheostomy at home. Additionally it defines competencies that carers need to achieve prior to their child's discharge.

1st carer: Name: _____

Relationship to child: _____

2nd carer: Name: _____

Relationship to child: _____

Training schedule:

Date & Time	Session	Carer & Trainer	Location
1 October 2004 14:00	Tracheostomy tape changes	Both carers to observe CNS	Peter Pan Ward
2 October 2004 13:00	Tracheostomy tape changes	Mum to hold tube for tape changes	Peter Pan Ward

example example

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Suctioning

Performance Criteria:

Competence Achieved (Trainer to enter initials)	
Carer 1	**Carer 2**

Carer is able to understand the need for suctioning, and is aware of potential complications

Remarks: _____

Carer is able to recognise when their child needs suctioning and is able to correctly use the equipment.

Remarks: _____

Carer is able to demonstrate the correct method and technique of suctioning

Remarks: _____

Care is able to safely recognise the need for suctioning, is able to independently carry out suctioning applying the correct technique throughout

Remarks: _____

Evaluation of Teaching:

When both carers and practitioners are satisfied that the technique of suctioning has been carried out competently and allows independant practice, sign here.

Carer 1:	**Date:**
Carer 2:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Tape Changes

Performance Criteria:

Competence Achieved (Trainer to enter initials)	
Carer 1	**Carer 2**

Carer is aware of the need to change tapes daily, and has observed a tape change and stoma check.

Remarks: _____

Carer demonstrates correct positioning of their child and is able to prepare all equipment.

Remarks: _____

Carer is able to support the tube throughout a tape change.

Remarks: _____

Carer is able to carry out a tape change with assistance.

Remarks: _____

Carer is able to carry out a tape change independantly.

Remarks: _____

Evaluation of Teaching:

When both carers and practitioners are satiisfied that the technique of tape changes has been carried out competently and allows independant practice, sign here.

Carer 1:	**Date:**
Carer 2:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Tube Changes

Performance Criteria:

	Competence Achieved (Trainer to enter initials)	
	Carer 1	**Carer 2**
Carer is able to identify tube in use and any specifics relating to it, such as cuff care, duration of use, cleaning directions.		

Remarks: _____

Carer is able to identify the need for a routine and/or emergency tube changes.		

Remarks: _____

Carer has observed a tube change and is able to demonstrate correct positioning and prepare equipment.		

Remarks: _____

Carer is able to carry out a tube change with assistance from medical staff.		

Remarks: _____

Carer is able to to perform a tube change independently.		

Remarks: _____

Evaluation of Teaching:

When both carers and practitioners are satiisfied that the technique of tube changes has been carried out competently and allows independant practice, sign here.

Carer 1:	**Date:**
Carer 2:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Emergency Care

Competence Achieved (Trainer to enter initials)	
Carer 1	**Carer 2**

Performance Criteria:

Carer is aware of potential emergency situations.

Remarks: _____

Carer is familier with the emergency equipment to be carried and familier on their use.

Remarks: _____

Carer to be taught and to practice on a mannikin.
Basic life support session, to include the action to take on a blocked tube and the action to take if a tube cannot be inserted (seldhinger technique).

Remarks: _____

Evaluation of Teaching:

When both carers and practitioners are satisfied that the action to take in an emergency has been carried out competently and allows independant practice, sign here.

Carer 1:	**Date:**
Carer 2:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Communication Record

Date	Communication	Signature (print name and designation)

Affix Patient Label

Tracheostomy Care

Carer Competencies & Discharge Planning

Statement of competence

I agree that I have received full training and am now competent to provide care independently.

Carer 1:	
Signature:	**Date:**

Carer 2:	
Signature:	**Date:**

I agree that the above carers are competent in the care of

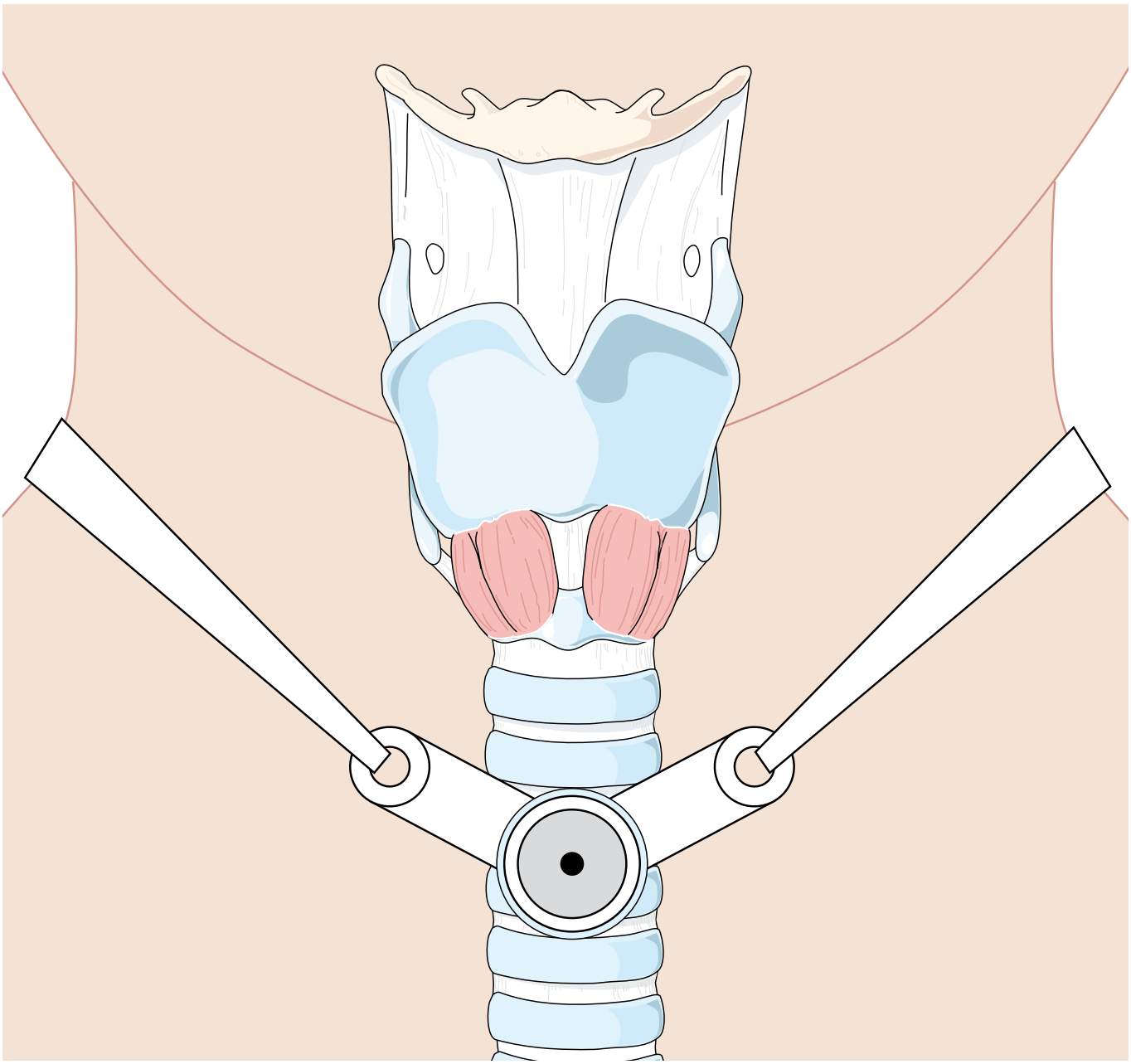
Name:	**Name:**
Signature:	**Signature:**
Position:	**Position:**
Date:	**Date:**

A copy of this document, when complete, must be kept in the child's medical notes.

Appendix 4: Staff Competencies for Tracheostomy Care at Home

Great Ormond Street Hospital for Children NHS
NHS Trust

Paediatric Tracheostomy Care



Staff Competencies & Discharge Planning

Staff Member Name:

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Introduction

This training package is intended to provide a structure and framework for teaching parents/ staff to care for the child with a tracheostomy at home. Additionally it defines competencies that staff need to achieve prior to the child's discharge.

Staff member: Name: _____

Training schedule:

Date & Time	Session	Staff & Trainer	Location
1 October 2004 14:00	Tracheostomy tape changes	Staff to observe CNS	Peter Pan Ward
2 October 2004 13:00	Tracheostomy tape changes	Staff to hold tube for tape changes	Peter Pan Ward

example example

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Suctioning

Performance Criteria:

Competence Achieved (Trainer to enter initials)

Staff are able to understand the need for suctioning, and are aware of potential complications

Remarks: _____

Staff are able to recognise when their child needs suctioning and are able to correctly use the equipment.

Remarks: _____

Staff are able to demonstrate the correct method and technique of suctioning

Remarks: _____

Staff are able to safely recognise the need for suctioning, are able to independently carry out suctioning applying the correct technique throughout

Remarks: _____

Evaluation of Teaching:

When staff and practitioners are satisfied that the technique of suctioning has been carried out competently and allows independant practice, sign here.

Staff member:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Tape Changes

Performance Criteria:

Competence Achieved (Trainer to enter initials)

Staff are aware of the need to change tapes daily, and have observed a tape change and stoma check.

Remarks: _____

Staff member demonstrates correct positioning of their child and are able to prepare all equipment.

Remarks: _____

Staff are able to support the tube throughout a tape change.

Remarks: _____

Staff are able to carry out a tape change with assistance.

Remarks: _____

Staff are able to carry out a tape change independantly.

Remarks: _____

Evaluation of Teaching:

When staff and practitioners are satisfied that the technique of tape changes has been carried out competently and allows independant practice, sign here.

Staff member:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Tube Changes

Performance Criteria:

Competence Achieved (Trainer to enter initials)

Staff are able to identify tube in use and any specifics relating to it, such as cuff care, duration of use, cleaning directions.

Remarks: _____

Staff are able to identify the need for a routine and/or emergency tube changes.

Remarks: _____

Staff have observed a tube change and are able to demonstrate correct positioning and prepare equipment.

Remarks: _____

Staff are able to carry out a tube change with assistance from medical staff.

Remarks: _____

Staff are able to to perform a tube change independently.

Remarks: _____

Evaluation of Teaching:

When staff and practitioners are satiisfied that the technique of tube changes has been carried out competently and allows independant practice, sign here.

Staff member:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Emergency Care

Performance Criteria:

Competence Achieved (Trainer to enter initials)

Staff are aware of potential emergency situations.

Remarks: _____

Staff are familier with the emergency equipment to be carried and familier on their use.

Remarks: _____

Staff to be taught and to practice on a mannikin.
Basic life support session, to include the action to take on a blocked tube and the action to take if a tube cannot be inserted (seldinger technique).

Remarks: _____

Evaluation of Teaching:

When staff and practitioners are satisfied that the action to take in an emergency has been carried out competently and allows independant practice, sign here.

Staff member:	**Date:**
Trainer:	**Date:**

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Communication Record

Date	Communication	Signature (print name and designation)

Affix Patient Label

Tracheostomy Care

Staff Competencies & Discharge Planning

Statement of competence

I agree that I have received full training and am now competent to provide care independently.

Staff member:	
Signature:	**Date:**

I agree that the above staff are competent in the care of

Name:	**Name:**
Signature:	**Signature:**
Position:	**Position:**
Date:	**Date:**

Please keep in your personal development records

Appendix 1: Types of Gastrostomy Devices

Malecot

Latex catheter type tube, (See Latex Allergy Policy and Procedure Guideline) often used when an open or surgical gastrostomy or laparoscopic gastrostomy is formed, whilst having surgery for gastro-oesophageal reflux (Nissen's Fundoplication). This is a temporary device that is usually removed after six weeks, once the wound has healed, and replaced with a low profile balloon device (button), or a balloon gastrostomy tube.

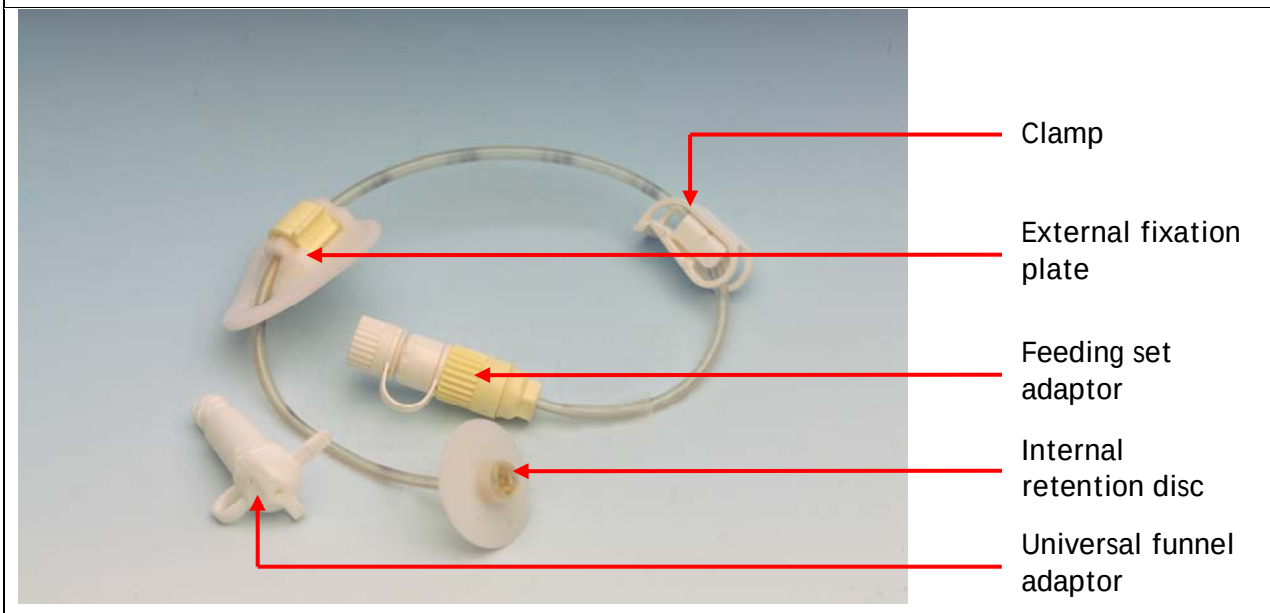
Figure 1: Malecot Tube (GOSH©2007)

Percutaneous Endoscopic Gastrostomy (PEG)

This is often the device of choice. It is inexpensive and can remain in place for eighteen months to two years. The children requiring a PEG have often had naso-gastric feeding for some time, and may require long-term nutritional support from enteral feeds. This device should not be used in children with known gastro-oesophageal reflux as this procedure may exacerbate the problem. If the patient still requires enteral feeds when the device needs to be renewed, the child and/or parents have a choice of whether to have a replacement PEG or have a low profile balloon device instead.

The PEG consists of an internal retention disc, external tube, integral clamp, external fixation plate with clamp, and luer lock adaptor. The most common size to be used is 9CH, but occasionally size 15CH is used. To access the tube for flushing and administering medicines, a universal funnel adaptor or other suitable adaptor is required. Many companies publish a free booklet with details of how to care for the PEG, and provide the ordering information for spare parts. The feed sets can be attached directly onto the PEG luer lock adaptor. This provides a secure connection to the feed set, and should avoid the feed set coming apart during administration of feeds.

Figure 2: Percutaneous Endoscopic Gastrostomy (PEG) (GOSH©2007)



Low Profile Balloon Gastrostomy (Button)

These are popular with parents and older children as they are much more discreet devices from a body image perspective. They are simple to use, and parents/carers often take on the responsibility for changing the device when required. It is important to be aware that each manufacturer uses different designs of access ports and therefore the appropriate extension set for each make of device must be used.

Button devices are used in well-established gastrostomy stomas. For example six weeks after an open gastrostomy has been formed (usually in association with surgery for severe reflux i.e. Nissen's fundoplication). The Malecot is removed and a button or gastrostomy tube inserted. More often it is the second device in children requiring long term feeding, who have had a percutaneous endoscopic gastrostomy (PEG) for some time. As the time for replacing the PEG approaches the parent/carer(s) and, if appropriate, the child will have a choice of which device they would like as a replacement.

There is a wide range of 'button' devices on the market; one of the main differences in these ranges is:

Obturated Devices:

These usually have a mushroom shaped enlarged tip, which must be stretched by an introducer to allow insertion. The mushroom tip acts as the internal retention device. Manufacturers provide a specially designed introducer for their product. These devices should only be inserted by a doctor or nurse who has had appropriate training.

Non-Obturated Devices:

These have a balloon tip which acts as the internal retention device. Once inserted, the balloon is filled with sterile water to inflate, thus preventing the tube from being dislodged. It is essential to get the size of the device correct at the time of insertion to prevent leakage from around the balloon. This can happen if the shaft is too long. Conversely, if the shaft is too short, causing pressure on the skin, there is a risk of the child developing a pressure ulcer.

All buttons have a range of extension sets and accessories and come in a range of diameter

sizes from 12Fr to 24Fr, and shaft length from 1.7cms to 4.4cms. It is important to use a measuring device to ascertain the correct length of button for each patient. The device needs to fit without being too tight which could lead to skin breakdown through pressure, or too loose which would lead to stomach contents leaking onto the skin causing excoriation. Manufacturers usually supply a single-use measuring device for this purpose.

A range of extension sets is available and there is also a medication set for the administration of oral drugs.

Buttons are usually made of silicone, and have an external stabiliser, to prevent the device from migrating into the tract. There are two ports. The side port is the balloon valve and is for balloon inflation only, and the central port is for connecting the appropriate extension set to allow the feeding set to be connected. The extension sets have a locking mechanism that prevents the set from being dislodged from the button. There is also an anti-reflux valve, which opens only when the extension set is attached, and prevents gastric contents from flowing back from the access port.

If the button is a replacement device PEG, the first fitting will be under general anaesthetic (GA), at the time of removal of the PEG. The PEG is usually a size 9CH, and the first size of mini-button is a 12FR; therefore the stoma will need minor stretching to accommodate the new button. Subsequent button changes can take place in the home, often by the carer or community paediatric nurse, or at a hospital outpatient appointment.

These devices last for approximately nine months to one year.

Figure 3: Low Profile Balloon Gastrostomy (Button, Non-Obturated)
(GOSH©2007)

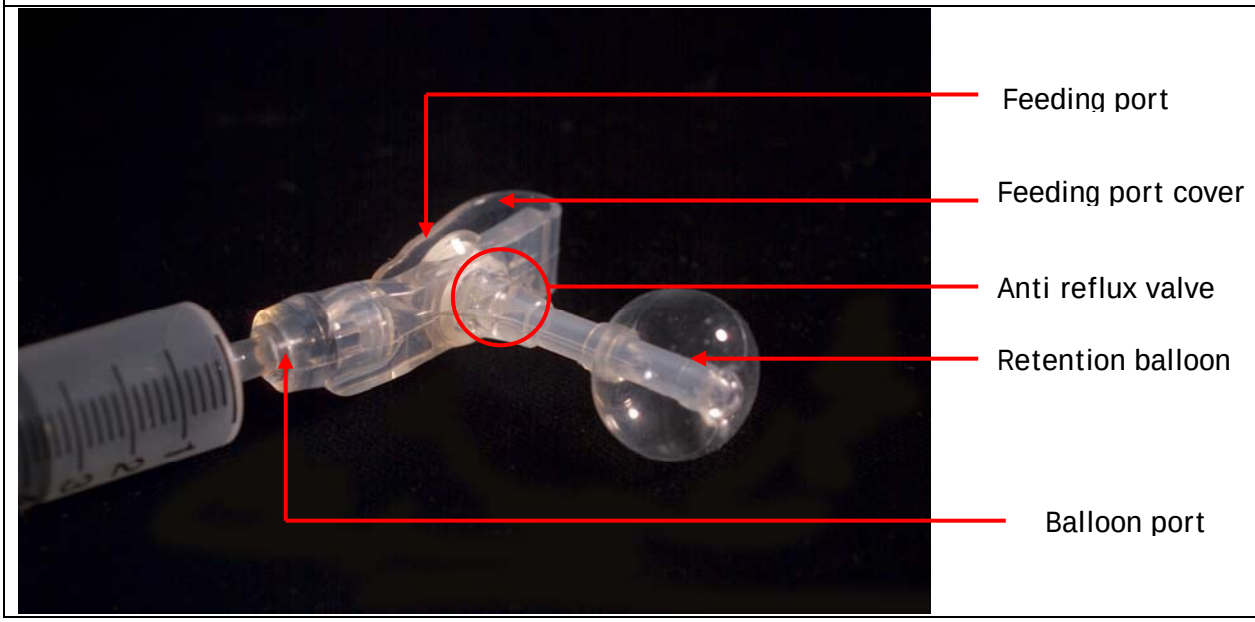
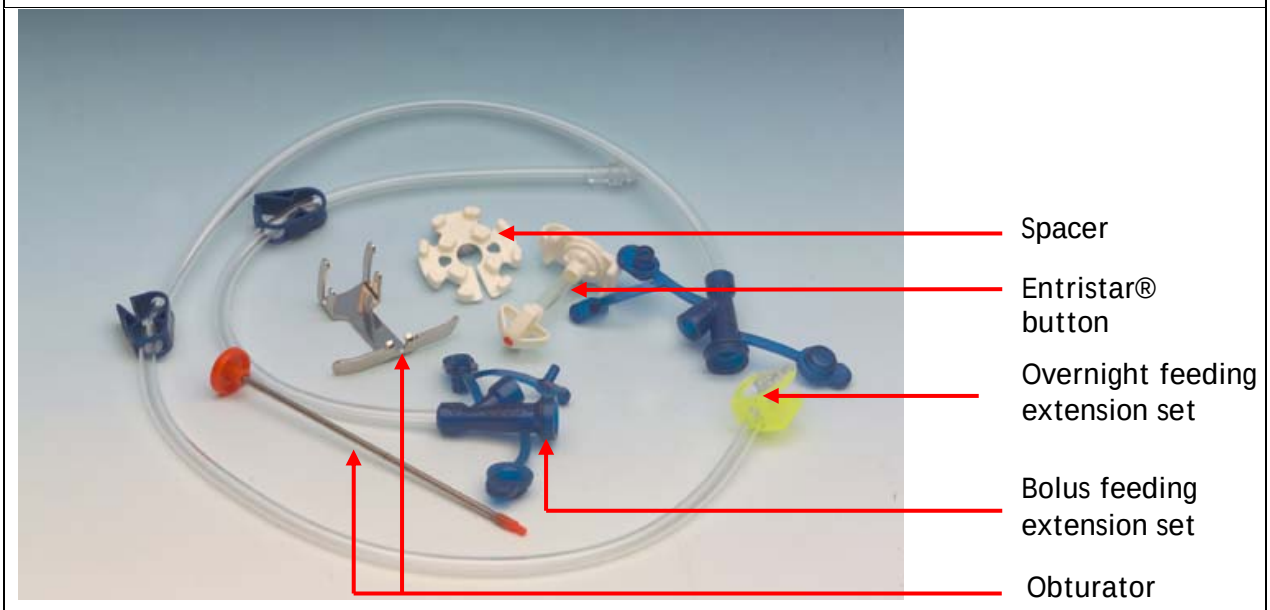


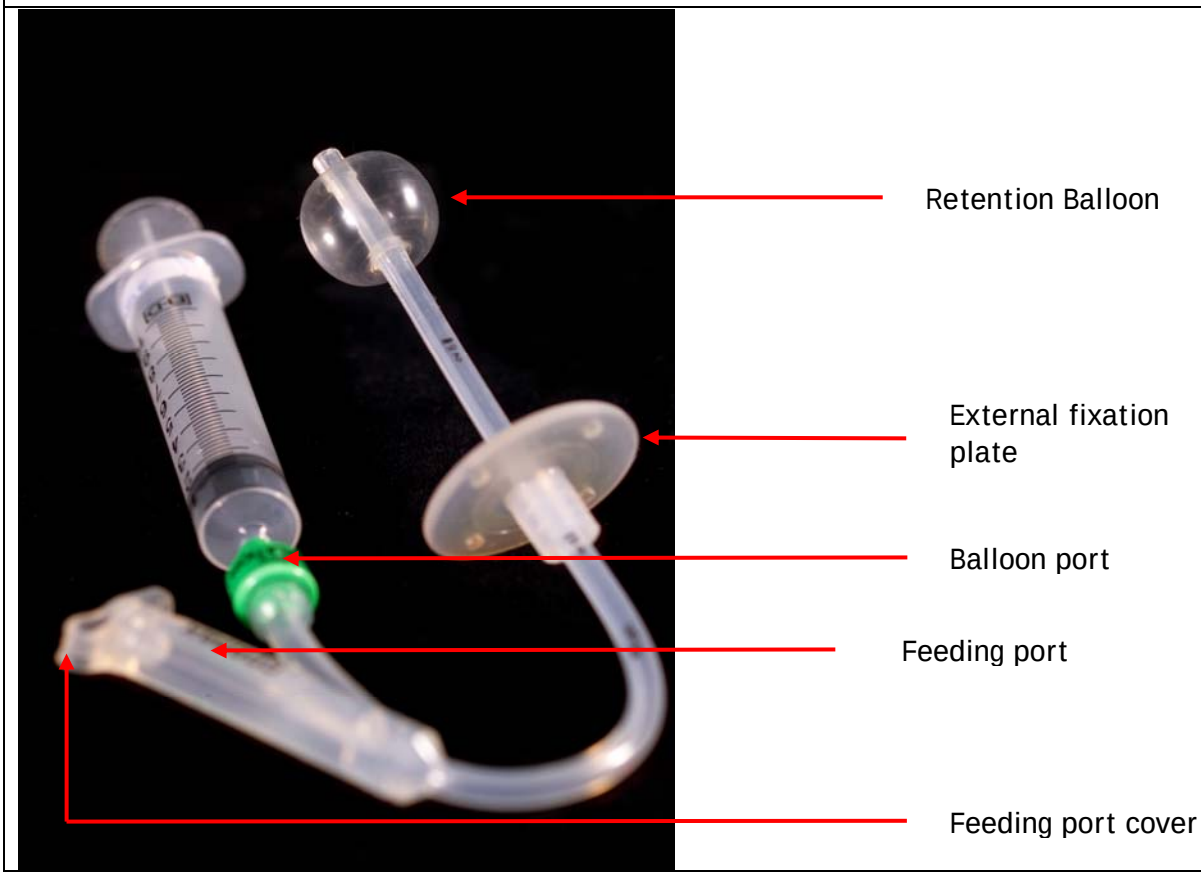
Figure 4: Low Profile Balloon Gastrostomy (Button, Obturated) (GOSH©2007)



Balloon Gastrostomy Tube

These tubes are useful for short-term use; they last up to three months. Balloon gastrostomy tubes are simple devices, with no need for extension sets, and there is a large range of them on the market.

Figure 5: Balloon Gastrostomy Tube (GOSH©2007)



Percutaneous Endoscopic Gastrostomy with Jejunal Tube (PEG-J) (GOSH©2007)

The PEG-J device is useful for children who, for a variety of reasons cannot tolerate gastrostomy feeds, or are in danger of aspiration. The PEG-J is made up of a 15Ch PEG with a transgastric jejunal tube. The jejunal tube is fed through the PEG tube. The external appearance therefore is of one tube exiting the stoma. There is a Y-connector providing both gastric and jejunal access.

The gastric port is useful for administration of medicines and for decompression of the stomach. The jejunal port is for administration of feeds. The feeds via jejunal tubes should be continuous, e.g. overnight, and must never be given as bolus feeds due to the risk of 'dumping' syndrome.

Feeding by this route is not without difficulties, however. The stomach, which usually acts as a reservoir regulating the rate at which feed enters the jejunum, is bypassed and this can cause the child considerable discomfort. Digestion usually begins in the stomach so hydrolysed feeds may need to be given. The stomach's natural defences are also by-passed so there is increased risk of gastro-intestinal infection.

This patient has a

New TRACHEOSTOMY

Patient ID:

Patient Label / Details

Tracheostomy:

Add tube specification
including cuff or inner tube

_____mm ID, _____ mm distal length

Suction:

_____ FG Catheter to Depth _____ cm

Indicate on this diagram any sutures in place

UPPER AIRWAY ABNORMALITY: Yes / No

Document laryngoscopy grade and notes on upper airway management or patient specific resuscitation plans

Due 1st tracheostomy change: ___ / ___ / ___ (by ENT ONLY)

In an Emergency: Call 2222 and request the Resuscitation Team and ENT surgeon
Follow the Emergency Paediatric Tracheostomy Management Algorithm on reverse

Emergency Paediatric Tracheostomy Management

Basic Response

SAFETY - STIMULATE - SHOUT FOR HELP - OXYGEN

SAFE:	**Check Safe area, Stimulate, and Shout for help, CALL 2222 (hospital) or 999 (home)**
AIRWAY:	**Open child's airway: head tilt / chin lift / pillow or towel under shoulders may help**
OXYGEN:	Ensure **high flow oxygen** to the **tracheostomy AND the face as soon as oxygen available**
Capnograph:	Exhaled carbon dioxide waveform may indicate a patent airway (secondary responders)

SUCTION TO ASSESS TRACHEOSTOMY PATENCY

Remove any attachments: humidifier (HME), speaking valve and change inner tube (if present)
Inner tubes need re-inserting to connect to bagging circuits

Can you pass a SUCTION catheter?

Yes → **The tracheostomy tube is patent**
Perform tracheal suction
Consider partial obstruction
Consider tracheostomy tube change

CONTINUE ASSESSMENT (ABCDE)

No

EMERGENCY TRACHEOSTOMY TUBE CHANGE

Deflate cuff (if present). Reassess patency after any tube change
1st – same size tube, 2nd – smaller size tube
*** 3rd – smaller size tube sited over suction catheter to guide**
IF UNSUCCESSFUL – REMOVE THE TUBE

IS THE PATIENT BREATHING? - Look, listen and feel at the mouth and tracheostomy/stoma

Yes → **RESPONDS: continue oxygen, reassessment and stabilisation**

Plan for definitive airway if tube change failure

No

5 RESCUE BREATHS – USE TRACHEOSTOMY IF PATENT

Patent Upper Airway – deliver breath to the mouth
Obstructed Upper Airway – deliver breath to tracheostomy/stoma

CHECK FOR SIGNS OF LIFE ? – START CPR

15 compressions : 2 rescue breaths
Ensure help or resuscitation team called

Advanced Response

Primary emergency oxygenation

Standard **ORAL airway** manoeuvres **may be appropriate**.
If so **cover the stoma** (swabs / hand).
Use:
- Bag-valve-face mask
- Oral or nasal airway adjuncts
- Supraglottic airway device e.g. Laryngeal Mask Airway (LMA)

Tracheostomy STOMA ventilation
- Paediatric face mask applied to stoma
- LMA applied to stoma

Secondary emergency oxygenation

ORAL intubation may be appropriate with a downsized ET tube
Uncut tube, advanced beyond stoma
Prepare for difficult intubation
'Difficult Airway' Expert and Equipment**

Attempt **intubation of STOMA**
3.0 ID tracheostomy tube / ETT
'Difficult Airway' Expert and Equipment**

****EQUIPMENT: Fibreoptic scope, bougie, airway exchange catheter, Airway trolley**

***3-smaller size tube sited over suction catheter to guide: to be used if out of hospital**

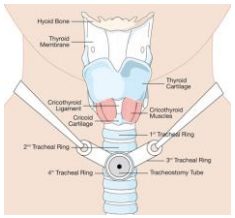
This patient has a

TRACHEOSTOMY

Patient ID : *Patient Details*

Tracheostomy: Add tube specification including cuff or inner tube
_____mm ID, _____ mm distal length

Suction: **_____ FG Catheter to Depth _____ cm**



UPPER AIRWAY ABNORMALITY: Yes / No please give details of any expected difficulty

Emergency Paediatric Tracheostomy Management

Basic Response

SAFETY - STIMULATE - SHOUT FOR HELP - OXYGEN

SAFE:	**Check Safe area, Stimulate, and Shout for help, CALL 2222 (hospital) or 999 (home)**
AIRWAY:	**Open child's airway: head tilt / chin lift / pillow or towel under shoulders may help**
OXYGEN:	Ensure **high flow oxygen** to the **tracheostomy AND the face as soon as oxygen available**
Capnograph:	Exhaled carbon dioxide waveform may indicate a patent airway (secondary responders)

SUCTION TO ASSESS TRACHEOSTOMY PATENCY

Remove any attachments: humidifier (HME), speaking valve and change inner tube (if present)
Inner tubes need re-inserting to connect to bagging circuits

Can you pass a SUCTION catheter?

Yes

The tracheostomy tube is patent
Perform tracheal suction
Consider partial obstruction
Consider tracheostomy tube change

CONTINUE ASSESSMENT (ABCDE)

No

EMERGENCY TRACHEOSTOMY TUBE CHANGE

Deflate cuff (if present). Reassess patency after any tube change
1st – same size tube, 2nd – smaller size tube
*** 3rd – smaller size tube sited over suction catheter to guide**
IF UNSUCCESSFUL – REMOVE THE TUBE

IS THE PATIENT BREATHING? - Look, listen and feel at the mouth and tracheostomy/stoma

No

5 RESCUE BREATHS – USE TRACHEOSTOMY IF PATENT

Patent Upper Airway – deliver breath to the mouth
Obstructed Upper Airway – deliver breath to tracheostomy/stoma

CHECK FOR SIGNS OF LIFE ? – START CPR

15 compressions : 2 rescue breaths
Ensure help or resuscitation team called

Yes

RESPONDS:
continue oxygen, reassessment and stabilisation

Plan for definitive airway if tube change failure

***3-smaller size tube sited over suction catheter to guide: to be used if out of hospital**

Emergency Paediatric Tracheostomy Management

Basic Response

SAFETY - STIMULATE - SHOUT FOR HELP - OXYGEN

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Yes → **RESPONDS: continue oxygen, reassessment and stabilisation**

Plan for definitive airway if tube change failure

No

5 RESCUE BREATHS – USE TRACHEOSTOMY IF PATENT

Patent Upper Airway – deliver breath to the mouth
Obstructed Upper Airway – deliver breath to tracheostomy/stoma

CHECK FOR SIGNS OF LIFE ? – START CPR

15 compressions : 2 rescue breaths
Ensure help or resuscitation team called

Advanced Response

Primary emergency oxygenation

Standard **ORAL airway** manoeuvres **may be appropriate**.
If so **cover the stoma** (swabs / hand).
Use:
- Bag-valve-face mask
- Oral or nasal airway adjuncts
- Supraglottic airway device e.g. Laryngeal Mask Airway (LMA)

Tracheostomy STOMA ventilation
- Paediatric face mask applied to stoma
- LMA applied to stoma

Secondary emergency oxygenation

ORAL intubation may be appropriate with a downsized ET tube
Uncut tube, advanced beyond stoma
Prepare for difficult intubation
'Difficult Airway' Expert and Equipment**

Attempt **intubation of STOMA**
3.0 ID tracheostomy tube / ETT
'Difficult Airway' Expert and Equipment**

****EQUIPMENT: Fibreoptic scope, bougie, airway exchange catheter, Airway trolley**

***3-smaller size tube sited over suction catheter to guide: to be used if out of hospital**

Bivona Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant.

SPECIAL INSTRUCTIONS

Ferromagnetic coil precludes use during MRI, please change to a Shiley tube for scans

Ideal for children requiring long-term ventilation

Disconnection wedge must be used to facilitate separation from the tube

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation

Tube can be sterilised in HSDU and re-used (5 times)

Ensure introducer kept with tube

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter (same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors

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Bivona Flextend Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant.

SPECIAL INSTRUCTIONS

Ferromagnetic coil precludes use during MRI, please change to a Shiley tube for scans

Ideal for children requiring long-term ventilation

Disconnection wedge must be used to facilitate separation from the tube

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation

Tube can be sterilised in HSDU and re-used (5 times) Ensure introducer is kept with tube

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter (same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors

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Shiley Uncuffed Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque thermo sensitive PVC with a thin walled shaft, tapered tip and universal 15mm termination

SPECIAL INSTRUCTIONS

This tubes does **NOT** contain any metal and should be the tube used for MRI of the Head and Neck

Changed – PRN

Weekly Tube Changes

Shiley Tubes are not reusable and should **NOT** be sterilised and used again

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Emergency Box

Tube of the same size (Paed/Neo)
Tube one size smaller
Suction Catheter (same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors

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Bivona TTS (Tight To Shaft) Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant. The cuff, when inflated, creates a seal between the tube and the trachea, protecting against aspiration and optimizing ventilation.

SPECIAL INSTRUCTIONS

Deflate 2 Hourly (minimise tracheal damage)

High Pressure Cuff
Only Inflate with Water

Inflate cuff to the desired amount, based on ventilation/ lower airway protection requirements.

Each child will require different amounts.

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation

Tube can be sterilised in HSDU and re-used (5 times) Ensure introducer is kept with tube

Clear Cuff

Fill with sterile water

"A Glass of Water is Clear"

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter (same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors
TWO IV Syringes (one to remove tube, one to reinflate)
Water for Injection Ampule

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Bivona Aire Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant. The cuff, when inflated, creates a seal between the tube and the trachea, protecting against aspiration and optimizing ventilation.

SPECIAL INSTRUCTIONS

4 hourly pressure checks with a manometer

Only inflate with Air.

Inflate cuff to the desired amount, based on ventilation/ lower airway protection requirements.

Each child will require different amounts.

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation
Ensure introducer is kept with tube

BLUE

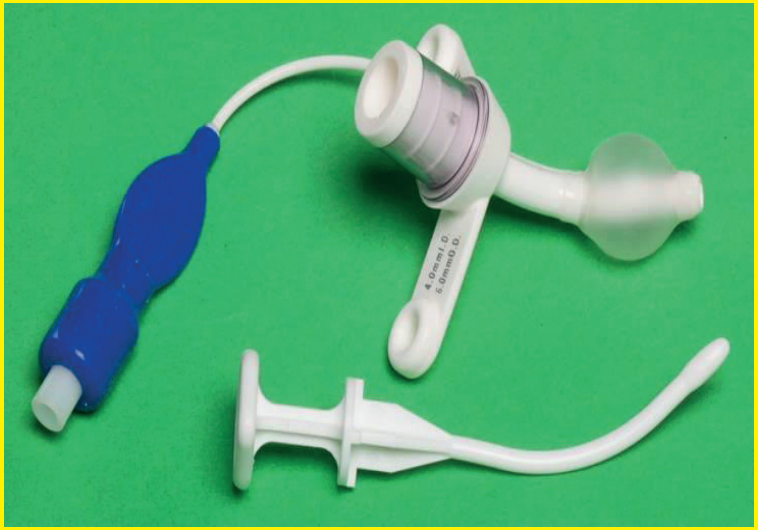
CUFF

Fill with

Air

"The Sky is

Blue"



STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter
(same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors
TWO IV Syringes
Water for Injection Ampule

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Bivona Fome Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant. The cuff has auto-expanding foam which fills and conforms to the unique contours of the patient's trachea.

SPECIAL INSTRUCTIONS

3-Way Tap Readily Available
Self-Inflating Cuff

IMPORTANT

The cuff is self-inflating, to remove or insert the tube; the cuff must be deflated and 'held' by turning off the three-way tap. DO NOT attempt to remove or insert the tube without deflating and turning off the tap

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation

Tube can be sterilised in HSDU and re-used (5 times) Ensure introducer is kept with tube

Contact NP/ENT if the port is cut

RED CUFF

Danger

"Care

for this

tube with

Caution"

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter
(same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors
TWO IV Syringes
A Three-Way Tap
Spare Fome Tube – Same Size (Paed/Neo- is available) – Not in box – for Elective Changes

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Bivona Hyperflex Tracheostomy Tube

Tube Contains Metal

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made from opaque white silicone PVC. The silicone is reinforced with wire, producing a flexible tube that conforms to the shape of the trachea, and has a fixed flange which is kink resistant.

SPECIAL INSTRUCTIONS

Ferromagnetic coil precludes use during MRI

ADJUSTABLE FLANGE PERMITTING ALTERATION OF TUBE LENGTH

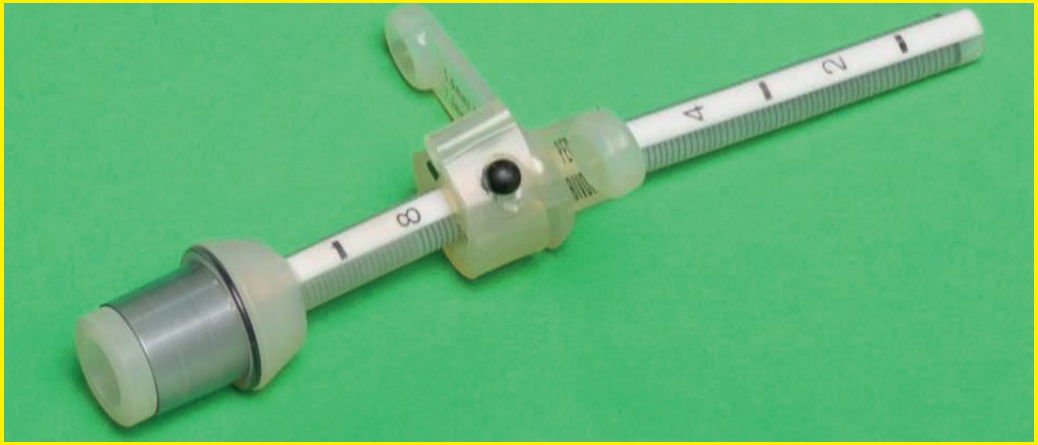
UNSAFE holding clip, therefore check the length does not alter (not for home use). Not recommended for longterm use. Must customise a fixed flange tube ASAP using customisation sheet.

Changed – Monthly or PRN

The latex free-hydrophobic tube hinders protein adhesion thereby limiting secretion build up and bacterial colonisation

Tube can be sterilised in HSDU and re-used (5 times)

Ensure introducer is kept with the tube



Tube size ..... fg NEO/PAED (delete as appropriate)

Suction Length ..... cm **Catheter Size ..... fg**

Last Tube Change .../.../...

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

STOMA CARE

Daily/PRN tape changes must be carried out.

Use of cotton tapes and Trachi-Dress

Correction tension – one finger space between tapes and child's neck

Emergency Box

Tube of the same size (Paed/Neo)
Tube ½ size smaller (Shiley)
Suction Catheter
(same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors

Depends on length - may keep a spare standard Bivona tube available ask NP/ENT)

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Montgomery 'T' Tube

Great Ormond Street Hospital for Children
NHS Foundation Trust

Made of soft silicone tube that is shaped like a 'T'. The distinctive shape of the T-tube allows part of the tube to support (or stent) the upper airway, whilst the lower parts act like a tracheostomy tube, allowing the child to breathe easily and expel secretions.

SPECIAL INSTRUCTIONS

Ensure the correct portex adaptor is available for the Ambu Bag

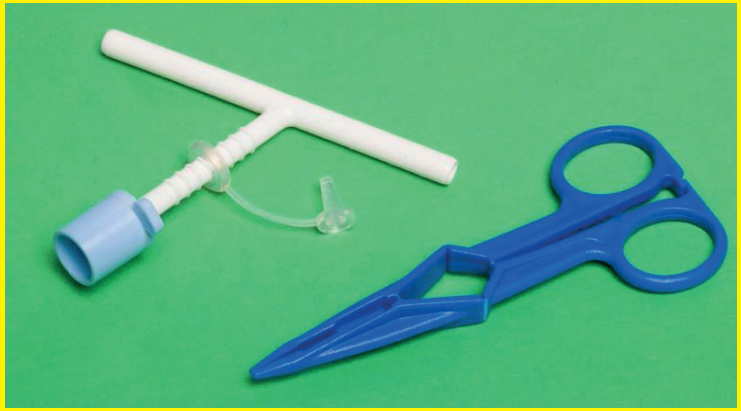
The anterior limb can be occluded/left open. Be familiar with resuscitation techniques – refer to CPC guidelines

DO NOT REMOVE the T Tube unless in an emergency – replace with a tracheostomy tube

Ensure that the ring is on the anterior limb AT ALL TIMES - this prevents the tube from falling into the stoma

Changed – PRN

Can be left in situ for months at a time and the tube is only changed under General Anaesthetic



Tube size ..... fg NEO/PAED (delete as appropriate)

Suction length upper limb (to include anterior limb) ..... fg

Suction length lower limb (to include anterior limb) ..... fg

Catheter size ..... fg

Contact Jo Cooke ANP bleep 0712 or ENT On Call bleep 1020 if you have any concerns

STOMA CARE

Daily Clean

Slip the ring forward and clean and dry all around the T Tube.

Replace the ring so it is pressed up against the skin

Emergency Box

Tube of the same size – refer to sizing chart to get equivalent size and convert Fg to mm (Paed/Neo -)
Tube ½ size smaller
Suction Catheter (same size as suctioning)
KY Jelly
Tracheostomy Tapes
Round Ended Scissors
Male to Female adaptor – must fit snuggly into T Tube
Blue clamps

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Dosing Table for Operative Prophylaxis

General Principals

- All dosing recommendations are for patients with normal renal and/or hepatic function
- All dosing recommendations are based on prophylaxis in patients not on antibiotic therapy for existing infection

Drug	Pre-incision Dose	Re-dose	Max Single Dose
Piperacillin-Tazobactam	100 mg/kg	In 2 hrs	3375 mg
Ampicillin	50 mg/kg	In 2 hrs	2000 mg
Ampicillin/sulbactam	75 mg/kg (a+s components)	In 2 hrs	3000 mg
Cefazolin	40 mg/kg	In 3 hrs	2000 mg (3,000 mg if >100 kg)
Cefuroxime	50 mg/kg	In 3 hrs	2000 mg
Cefoxitin	40 mg/kg	In 3 hrs	2000 mg
Cefotaxime	50 mg/kg	In 3 hrs	2000 mg
Aztreonam	30 mg/kg	In 4 hrs	2000 mg
Clindamycin	10 mg/kg	In 6 hrs	900 mg
Gentamicin <40 kg	4.5 mg/kg	In 12 hrs	160 mg
Gentamicin >40 kg	4.5 mg/kg	In 24 hrs	360 mg
Vancomycin	15 mg/kg	In 8 hrs	NO MAX
Ciprofloxacin	10 mg/kg	In 12 hrs	400 mg
Ceftriaxone	50 mg/kg	In 12 hrs	2000 mg
Metronidazole	15 mg/kg	In 12 hrs	1000 mg

Source: http://centerlink.cchmc.org/specialgroups/infection-control/dosing-table-for-operative-prophylaxis

Updated 1/2019 v1.0

General Principles

- All dosing recommendations are for patients with normal renal and/or hepatic function.
- Consider consultation with ID and pharmacy in cases of multiple allergies, complex infection history, hepatic or renal dysfunction, and with ongoing pre-operative antibiotic therapy.

Pre- and intra-operative antibiotics

*For patients **NOT** currently on antibiotics:*

- Pre-operative dose should be completed within 60 minutes prior to the incision.
- Patients who screen positive for MRSA should be given a singly pre-operative dose of vancomycin in addition to routine prophylaxis
- Re-dose prophylactic antibiotic according to times in the table or if the patient has experienced excessive blood loss.

*For patients currently **ON** antibiotics:*

- If treatment antibiotics appropriate for perioperative antimicrobial prophylaxis (AMP), continue schedule/follow intraoperative redosing table for timing of next dose.
- If treatment is not appropriate for perioperative AMP, consider routine pre-op prophylaxis in addition to concurrent therapy.
- Patients who screen positive for MRSA should be given a singly pre-operative dose of vancomycin in addition to routine prophylaxis

Post-operative continuation

- For routine prophylaxis, antibiotics should not be continued after the incision is closed.
- Redosing in the OR prior to closure should be considered if closure is anticipated within 30 minutes of the usual redosing time.
- The first post-operative dose is timed off of last dose given prior to incision closure.
- Operative guidance table does not apply to post-op dosing or intervals.

Medical Management of Pneumonia with Pleural Effusion

Observation

Criteria for Observation Only:

- Effusion too small to drain (<10 mm)
- Effusion drainable, but pt. on antibiotics, no respiratory distress, effusion resolving on serial CXR

Plan:

- Baseline CRP, repeat in 24 hours
- Repeat CXR in 24 hours if clinically indicated

Drain

Criteria to Drain:

- Patient with suspected "large" effusion and respiratory compromise
- To obtain fluid to further characterize effusion

Diagnostic Tap

Patient Scenario:

- Patient not on antibiotics and mild respiratory distress (identify pathogen)
- Clinical presentation atypical for parapneumonic effusion (r/o malignancy, clarify exudate vs. transudate)

Plan:

- Tap performed by Pulm or IR
- Pleural fluid measurements: pH, glucose, LDH, cell count/differential, gram stain & culture

Chest Tube Placement

Patient Scenario:

- Patient in respiratory distress
- Effusion staged as complicated by U/S or pleural fluid indices (and progressing)

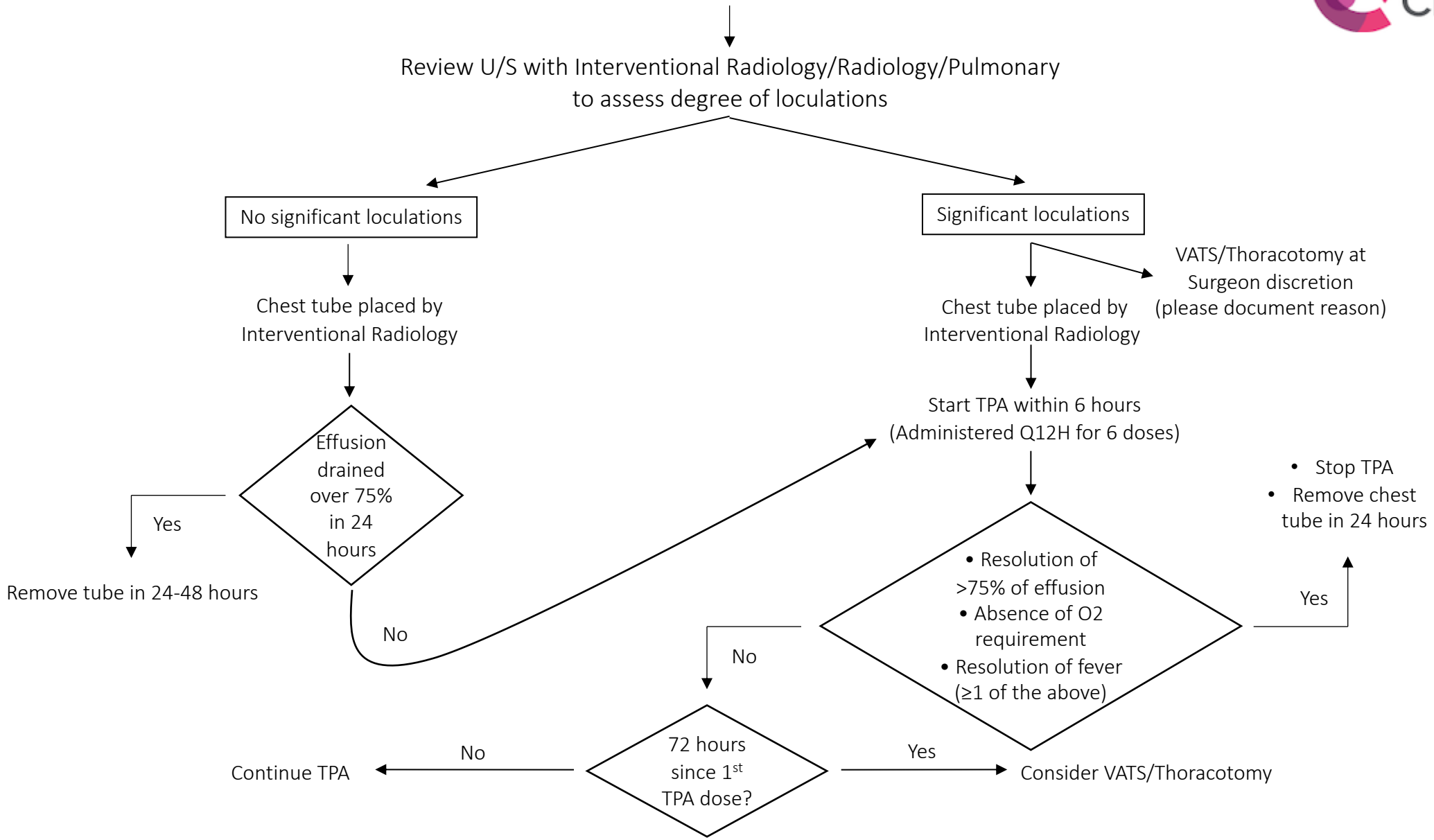
Plan:

- IR Consult
- Surgery Consult
- Pleural fluid measurements: pH, glucose, LDH, cell count/differential, gram stain & culture

See next Page

Updated 1/2019

Surgical Consult



Source:

- St. Peter SD, et al. Thoracoscopic decortication vs tube thoracostomy with fibrinolysis for empyema in children: a prospective, randomized trial. *J Pediatr Surg* 2009;44:106-111.
- Gates RL, et al. Drainage, Fibrinolytics or Surgery: A Comparison of Treatment Options in Pediatric Empyema. *J Pediatr Surg* 2004;39:1638-1642.

Updated 1/2019

Updated 1/2019

TPA Administration Guidelines

1. Please make sure the patient nurse, charge nurse, and primary team are aware that you are going to be instilling TPA into the chest tube.
2. Order the TPA in EPIC (type “alteplase” into orders – select order for “alteplase for chest tube”)
3. When the TPA is at the bedside, do a medication check with the nurse at bedside – verifying that it is the correct patient and medication, crosschecking with the patient’s ID band.
4. Ensure that there is a blue IV cap on the stopcock to keep the system closed and sterile.
5. Scrub the blue stopcock with chlorhexidine.
6. Attach the TPA syringe, and instill into the chest. Remove syringe, leaving blue IV cap.
7. Turn stopcock so that it remains closed and leave the TPA in the chest for an hour.
8. An hour later, turn stopcock to allow chest tube to drain.

Cincinnati Children’s

History and physical exam consistent with pyloric stenosis

- Progressive non-bilious emesis
- Palpation of olive in epigastrium

↓

Labs: Hypochloremic, hypokalemic metabolic alkalosis
Ultrasound: Muscle width > 3 mm, length >14 mm

↓

Plan:
- Admit to Surgery
- If clinically dehydrated, bolus NS (see adjacent schematic)

↓

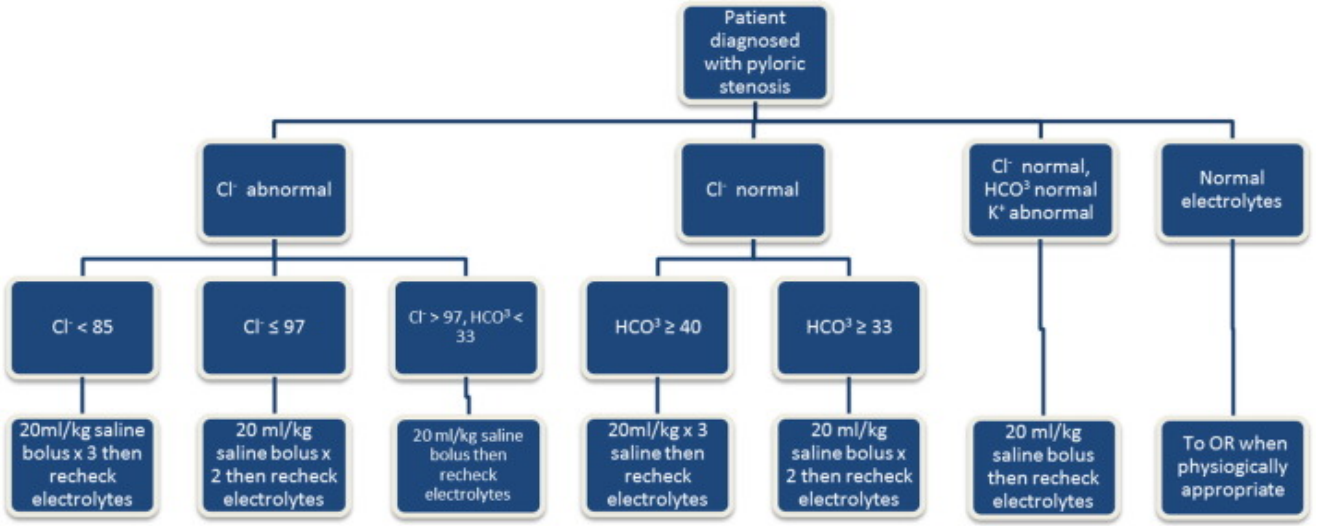
- MIVF at 1.5 x maintenance with D5 ½ NS
- Add 10 meq KCl once UOP established

↓

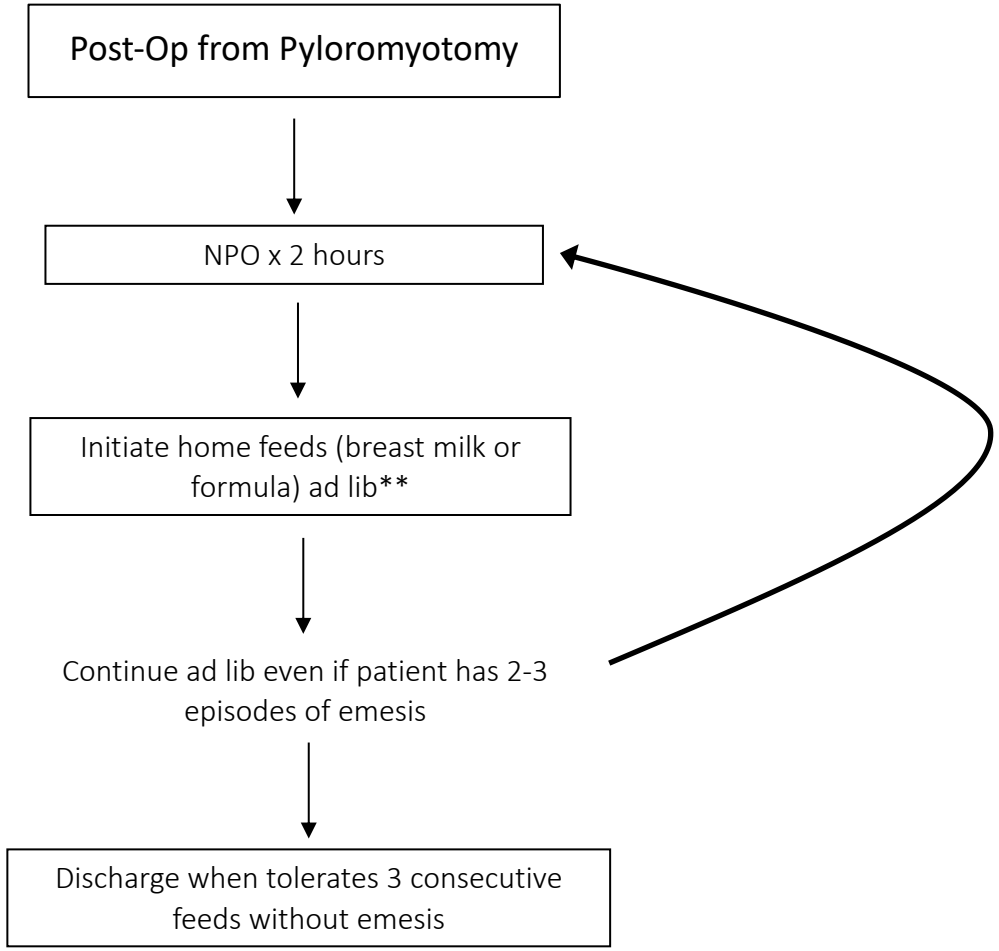
To OR when HCO3<30, Cl>100, and K normal (Ancef on call)

Suggested Resuscitation:

Source: Dalton BGA, et al. Optimizing fluid resuscitation in hypertrophic pyloric stenosis. J Pediatr Surg 2016;51(8):1279-1282.



Updated 1/2019 v1.0



If persistent emesis, can make patient NPO x 2 hours and then re-start feeds

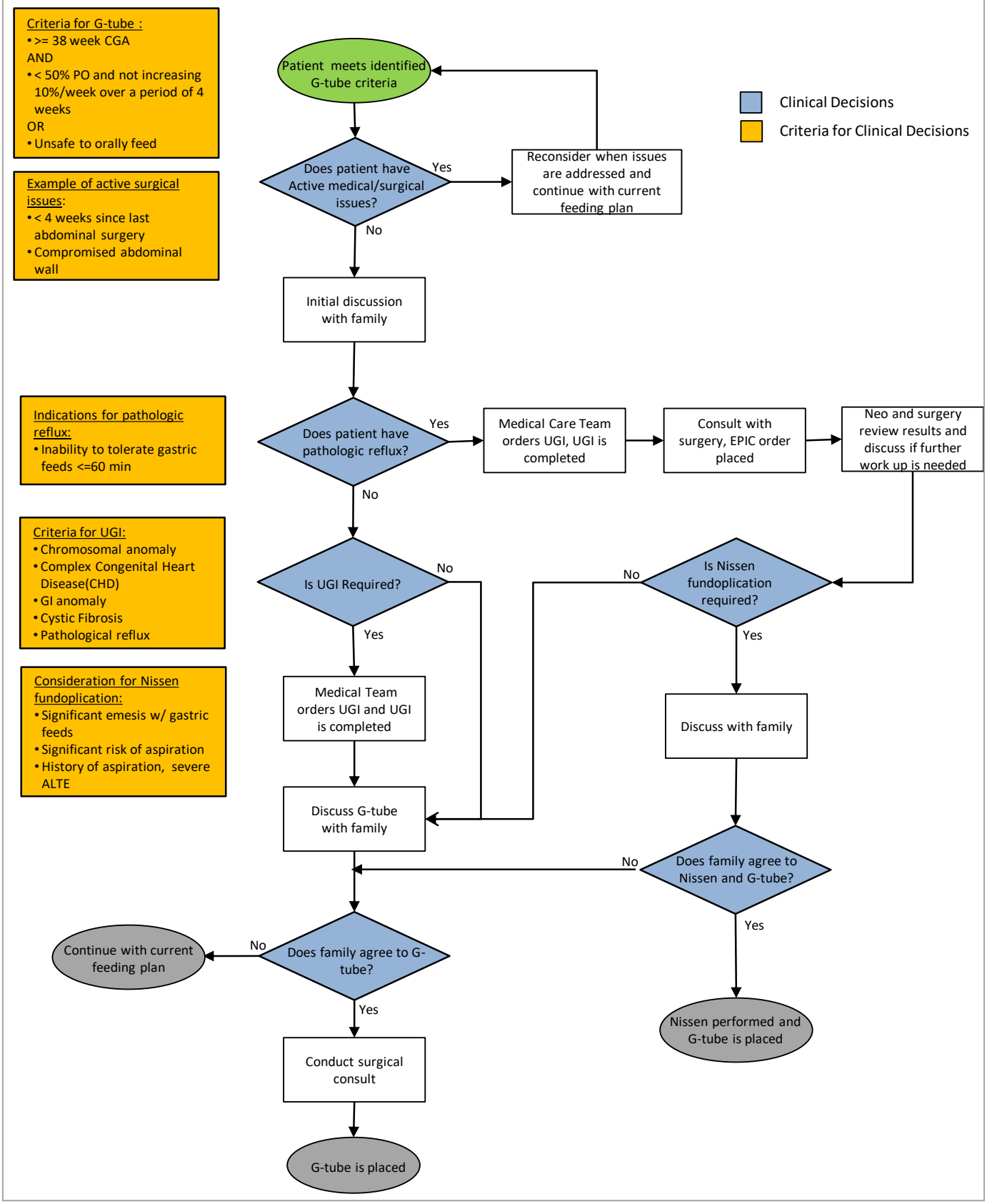
***Note: Ad lib feeding is associated with equivalent or shorter hospital stay (compared to protocolized feeding), although patients on ad lib feeds may have more emesis.*

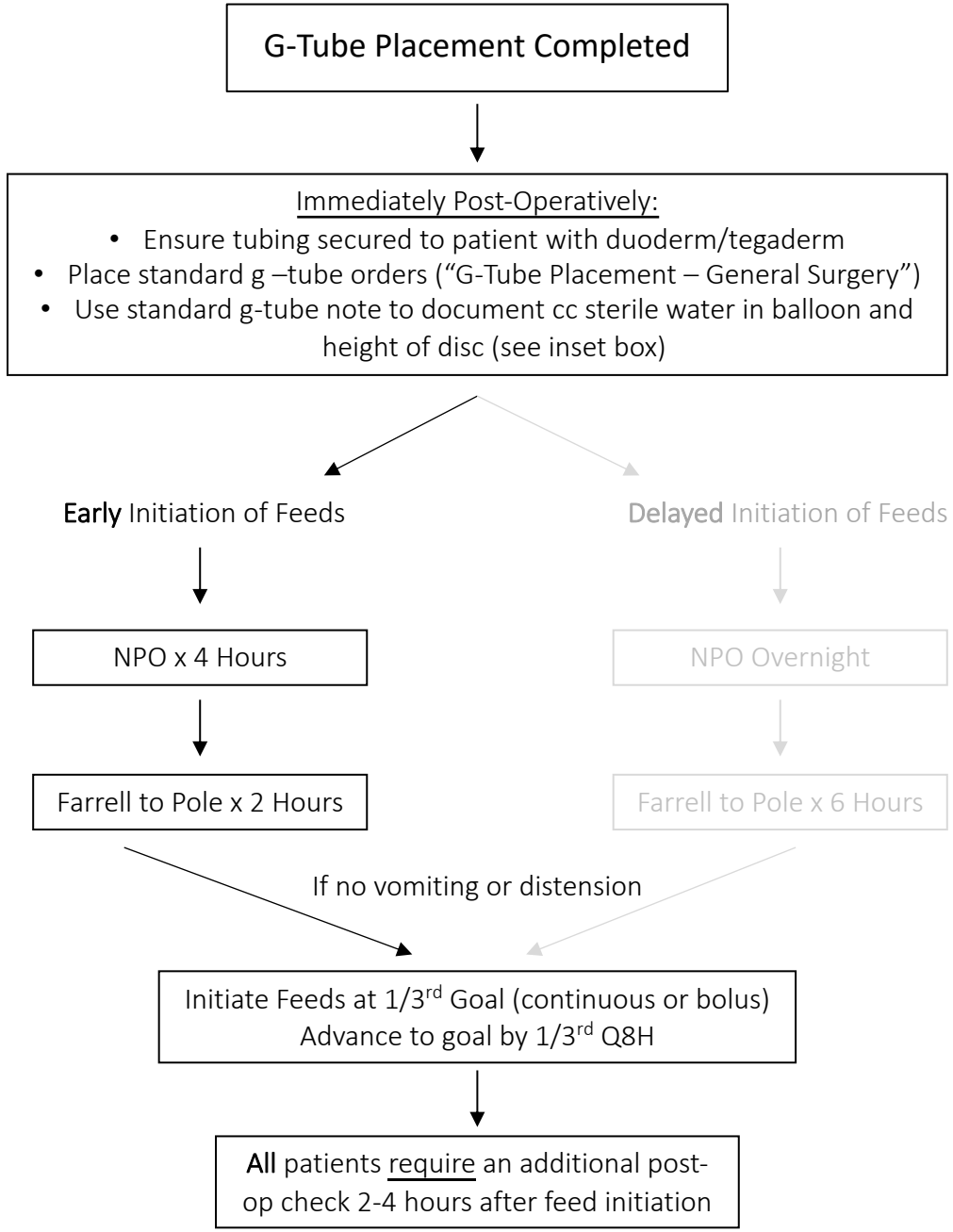
Sources:

- Markel TA, et al. A randomized trial to assess advancement of enteral feeds following surgery for hypertrophic pyloric stenosis. *J Pediatr Surg* 2017;52(4):534-539.
- Adibe OO, et al. Protocol versus ad libitum feeds after laparoscopic pyloromyotomy: A prospective randomized trial. *J Pediatr Surg* 2014;49(1):129-132.
- Graham KA, et al. A review of postoperative feeding regimens in infantile hypertrophic pyloric stenosis. *J Pediatr Surg* 2013;48:2175-2179.

Updated 1/2019 v1.0

Neonatology and General Surgery decision algorithm for gastrostomy tube placement in NICU patients unable to orally feed at corrected gestational age of 38 weeks





Standard Notes

1). If using isolated g-tube/button template:

- Type "ip standard" into text box that reads "Insert SmartText".
- Choose appropriate note (g-tube vs. g-button)

2). If g-tube inserted as part of a larger procedure:

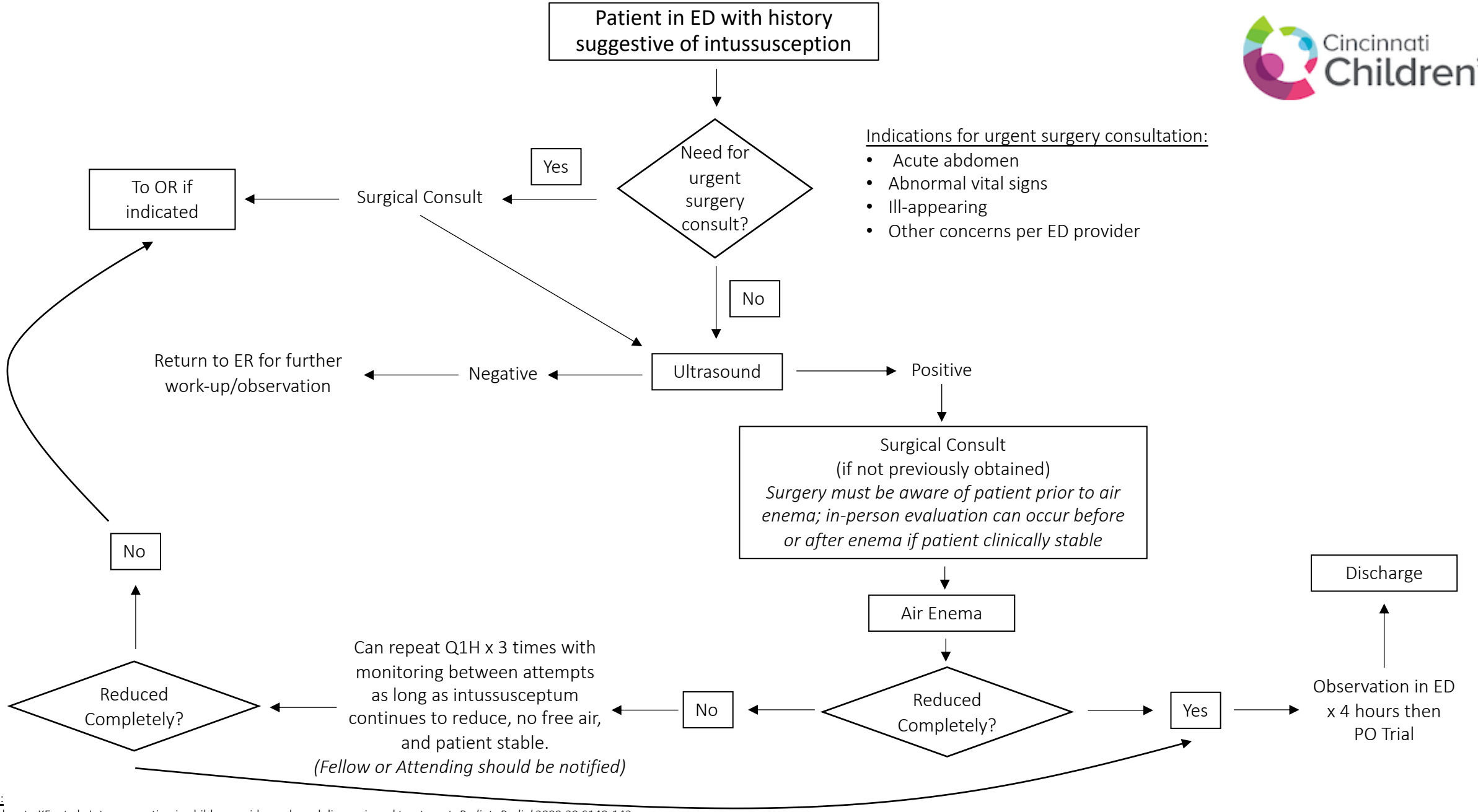
- Use dot phrase "newgtube" or "newgtubebutton" to insert phrase into "Findings" section of op note

Be sure to include number of cc sterile water in balloon and height of disc at conclusion of case in the note

Sources:

- Islek A, et al. Percutaneous Endoscopic Gastrostomy in Children: Is Early Feeding Safe? *JPGN* 2013;57(5): 659-662.
- Corkins MR, et al. Feeding After Percutaneous Endoscopic Gastrostomy in Children: Early Feeding Trial. *JPGN* 2010;50(6):625-627.
- Hendrickson RJ, et al. Feeding Advancement and Simultaneous Transition to Discharge (FASTDischarge) after laparoscopic gastrostomy. *J Pediatr Surg 2019;53:2326-2330.*

Updated 2/2019 v1.0



Sources:

- Applegate KE, et al. Intussusception in children: evidence-based diagnosis and treatment. *Pediatr Radiol* 2009;39:S140-143.
- Navarro OM, et al. Intussusception: the use of delayed, repeated reduction attempts and the management of intussusceptions due to pathologic lead points in pediatric patients. *Am J Roentgenol* 2004;182:1169-1176.
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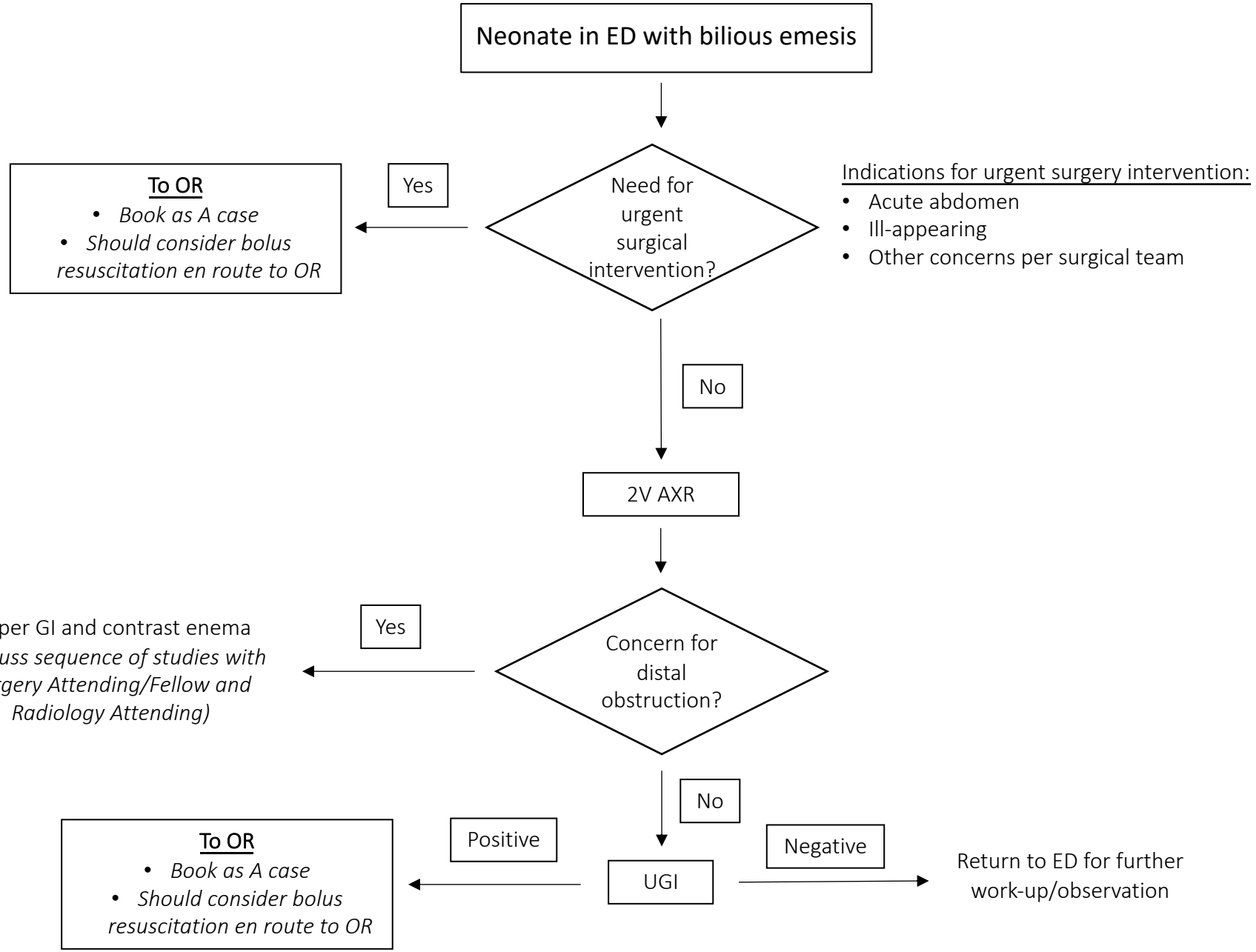
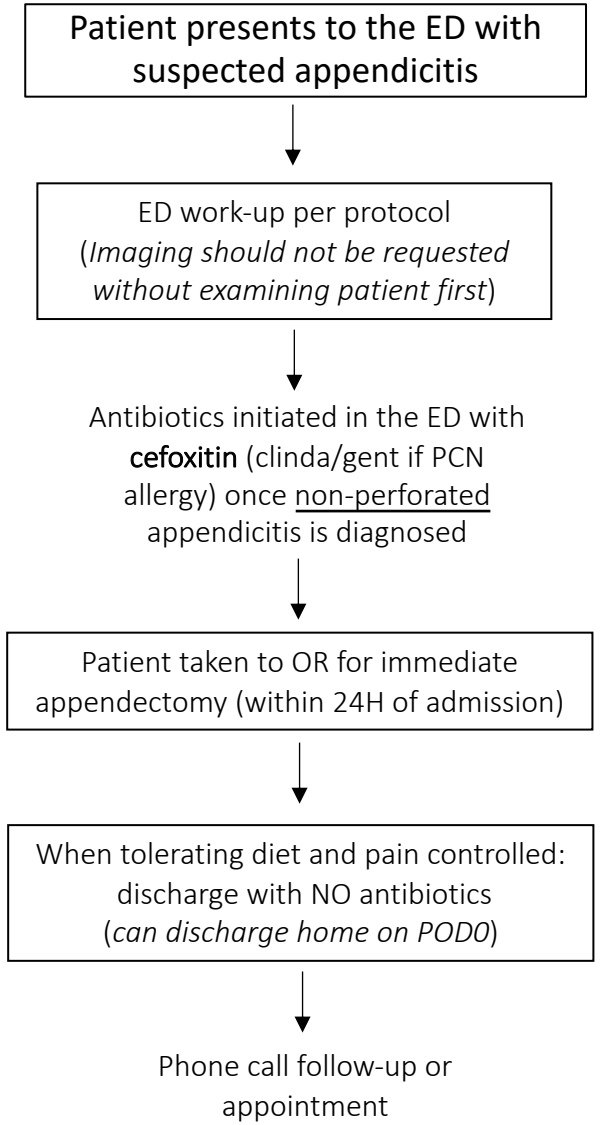
Updated 2/2019 v1.0

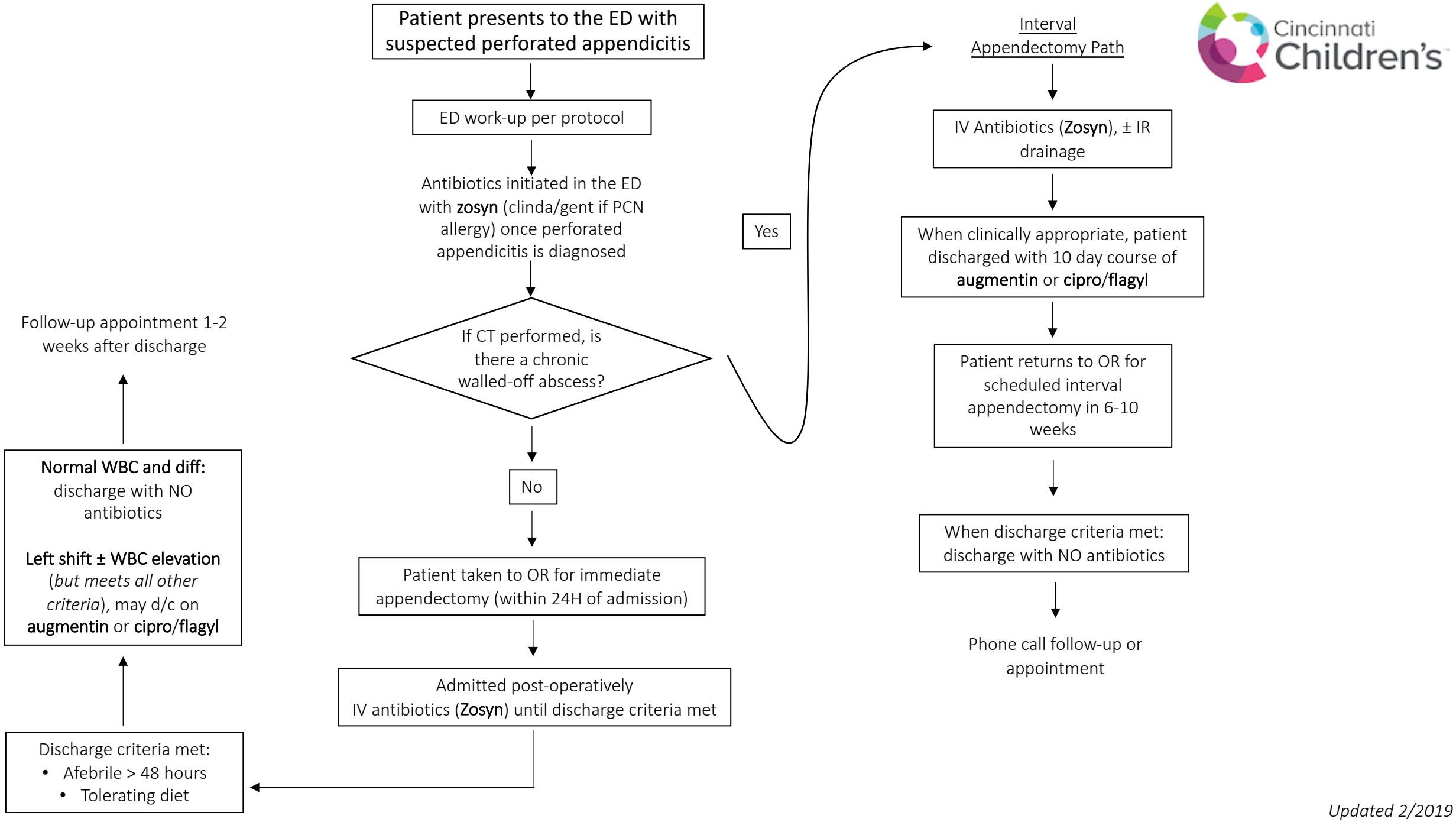


Updated 1/2019

In most patients, history, physical exam and ultrasound are sufficient for diagnosis. CT scan should be reserved for concerns of complicated appendicitis and diagnostic dilemmas (and should be discussed with a fellow or attending).

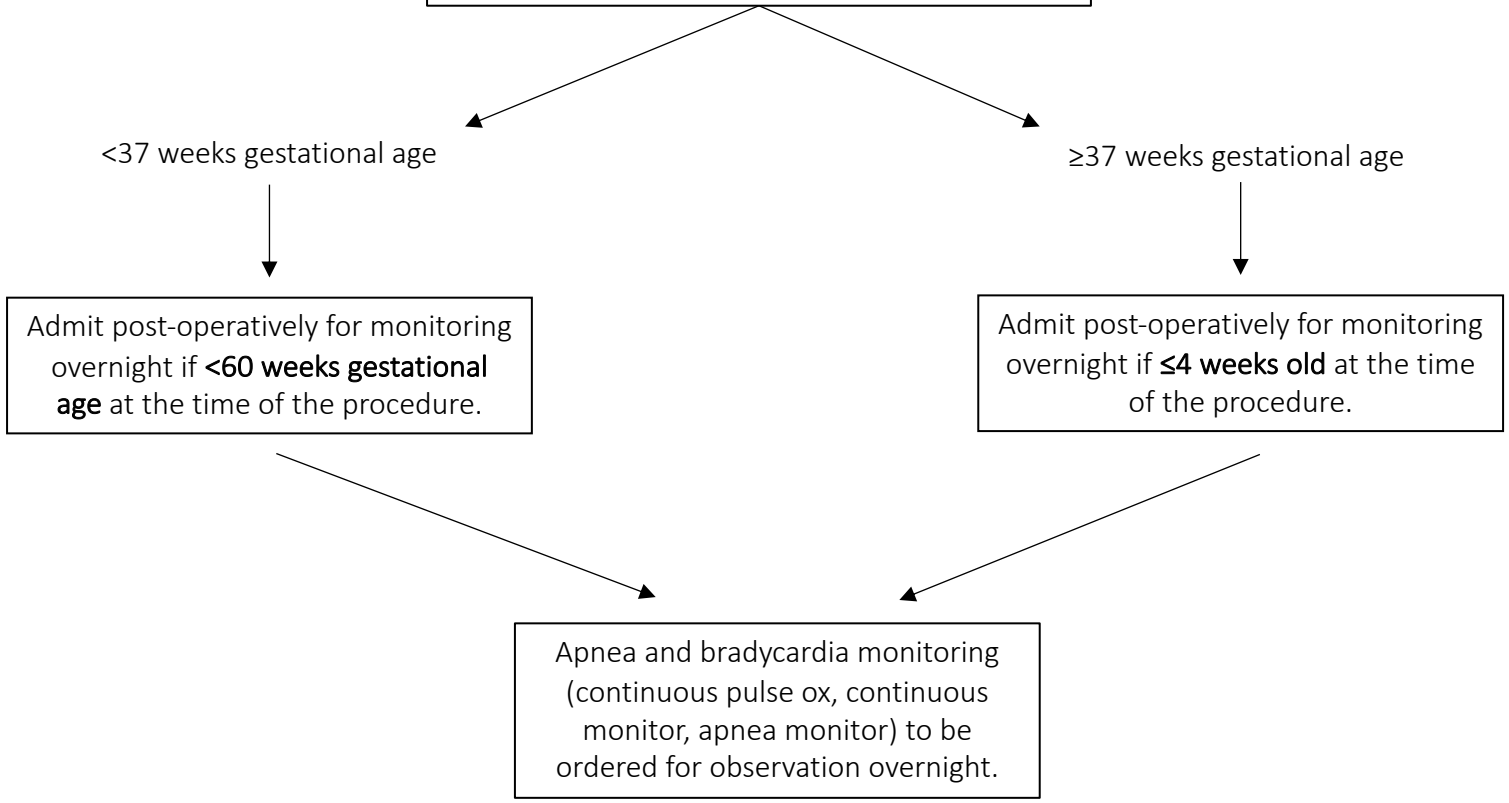


Updated 2/2019



Updated 2/2019

Post-Operative Monitoring Guidelines for Infants Undergoing Procedures



Source:

- Pang L, et al. Anesthesia for ex-premature infants and children. UpToDate. Literature review current through November 2018.

Updated 3/2019

TEF Post-Op Guideline (MWPSC Protocol)

- No trans-anastomotic tube prior to completion of post-op esophagram
- No prosthetic interposition material between esophageal and tracheal suture lines
- Discontinue antibiotics used for SSI prophylaxis within 24 hour
- Obtain esophagram on POD5 (or next business day if weekend/holiday)

Source:

- Lal DR, et al. Challenging surgical dogma in the management of proximal esophageal atresia with distal tracheoesophageal fistula: Outcomes from the Midwest Pediatric Surgery Consortium. *J Pediatr Surg* 2018;53: 1267-1272.

Updated 1/2019

Asplenia Guidelines

- *Vaccinations* (>2 weeks pre-op, or post-op if emergent): Haemophilus influenzae type b (Hib), Meningococcal, Pneumococcal
  - See next slide for specific vaccine recommendations
- *Prophylaxis*:
  - Daily antibiotic prophylaxis to age 5 or for 1 year following splenectomy if > 4 years old
  - Lifelong antibiotic prophylaxis if patient is immunocompromised
  - Initiation of prophlyaxis by 2 months old if congenitally asplenic
- *Antibiotic Dosing:*
  - Amoxicillin: 20 mg/kg BID (max 250 mg/dose) OR
  - Pen V K: <3 yo 125 mg BID, ≥3 yo 250 mg BID

Source:
- American Academy of Pediatrics, Committee on Infectious Diseases. Policy statement: recommendations for the prevention of pneumococcal infections, including the use of pneumococcal conjugate vaccine (Prevnar), pneumococcal polysaccride vaccine, and antibiotic prophylaxis. *Pediatrics* 2000;106:362-6.

Updated 3/2019 v3

Detailed Asplenia Vaccination Recommendations

Initiate vaccination at least 2 weeks prior to splenectomy. If emergent splenectomy, start antibiotic prophylaxis immediately and initiate vaccination post-operatively (typically ≥14 days).

Haemophilus Influenza B (HIB)

- Anatomic or functional asplenia (including sickle cell disease)
  - 12-59 months:
    - If unvaccinated or only 1 dose before 12 months: give 2 doses, 8 weeks apart
    - 2 or more doses before 12 months: give 1 dose, at least 8 weeks after previous dose.
  - Unimmunized* persons 5 years or older:
    - Give 1 dose
- Elective splenectomy
  - Unimmunized* persons 5 years or older:
    - Give 1 dose (preferably ≥14 days before procedure)

**unimmunized = less than routine series (through 14 months) OR no doses (14 months or older)*

Pneumococcus

- Pneumococcal conjugate vaccine (PCV13 or Prevnar 13®) if not previously received
  - Teens vaccinated before 2010 will need the booster
  - Complete Prevnar13 at least 4 weeks prior to Meningococcal (Menactra) as Prevnar13 decrease immunogenicity of Menactra
- Pneumococcal polysaccharide vaccine (PPSV23 or Pneumovax®) (minimum age 2 years)
  - At least 8 weeks after Prevnar13
  - Can be given with Meningococcal (Menactra) without any interactions
  - Pneumovax/PPSV23 boosters suggested every 5 years

Pneumococcal Vaccination Schedule

Previous Dose	Recommendations[25]	
2-5 Years Old: Unvaccinated or any incomplete schedule (< 3 doses)	2 doses PCV13	First dose ≥ 8 weeks after most recent dose Second dose ≥ 8 weeks later
2-5 Years Old: Any incomplete schedule of 3 doses	1 dose of PCV13	≥ 8 weeks after most recent dose
6+ Years Old: No history of PCV13 (*PCV13 available only after 2010*)	1 dose of PCV13	≥ 8 weeks after most recent dose

*Once PCV13 administration is completed, PPSV23 should be administered beginning 8 weeks after the final dose of PCV13. A second PPSV23 should be administered 5 years later .

Meningococcus

- Meningococcal ACYW: Meningococcal conjugate vaccines (Menactra®, Menveo®)
  - Guidelines for patients 24 months and older (patients <24 months of age: refer to the CDC immunization schedule; Menveo recommended <24 months as not affected by PCV13)
  - Everyone receives 2 doses 8-12 weeks apart
  - Boosters:
    - If primary series <7 years of age: first booster after 3 years, then every 5 years
    - If primary series ≥7 years of age: booster every 5 years
  - Can be given with Pneumovax®
- Meningococcal B: Meningococcal B sesies (MenB; Trumenba or Bexsero)
  - The CDC/ACIP currently recommends MenB for patients 10 years of age or older with anatomic or functional asplenia.
  - ID recommends MenB vaccination to individuals that will likely undergo surgery within 12 months of evaluation.
  - Trumenba – 3 vaccine series (0.1-2, and 6 months); Bexsero – 2 vaccine series (0 and ≥1 month). Bexsero and Trumenba are not interchangeable, therefore it is preferable to receive the vaccine from same provider/location.
  - Trumenba on formulary at CCHMC

Updated 3/2019 v3

Risk Assessment for Thrombosis for Non-Bariatric Surgical Patients 10-17 years old

*Patients ≥ 18 are eligible for adult guideline

RN or MD/APN to Complete:

Risk factors?	History □ Personal history of blood clot □ Family history of clotting disorder or clots High-risk Medical conditions □ Known clotting disorder □ Blood stream infection (currently on antibiotics for positive blood culture) □ Cancer □ Chronic inflammatory condition (i.e. Crohn's, Ulcerative Colitis, Lupus) □ Nephrotic syndrome □ Trauma patient if > 1 lower extremity (LE) fracture, pelvic fracture, or spinal cord injury Medications □ Estrogen (i.e. birth control) in past 2 months Physical Exam □ Obesity (BMI > 95th percentile, see growth chart in Epic) □ PICC or central line	Total number of risk factors: _____
Contraindications to SCD (sequential compression device)?	□ Current DVT □ Fracture of lower extremity (LE) □ Skin conditions affecting LE (burn, dermatitis, wound, epidermolysis bullosa)	□ Yes (if any checked) □ No
Contraindications to Lovenox?	□ Active bleeding □ Known bleeding disorder □ Epidural or lumbar puncture in the last 12 hours □ Platelets <50,000/mm or heparin-induced thrombocytopenia □ Brain tumor □ Pelvic fracture in last 48 hours □ Recent or scheduled neurosurgical procedure within 48 hours □ Uncontrolled hypertension	□ Yes (if any checked) □ No

For MD/APN to complete:

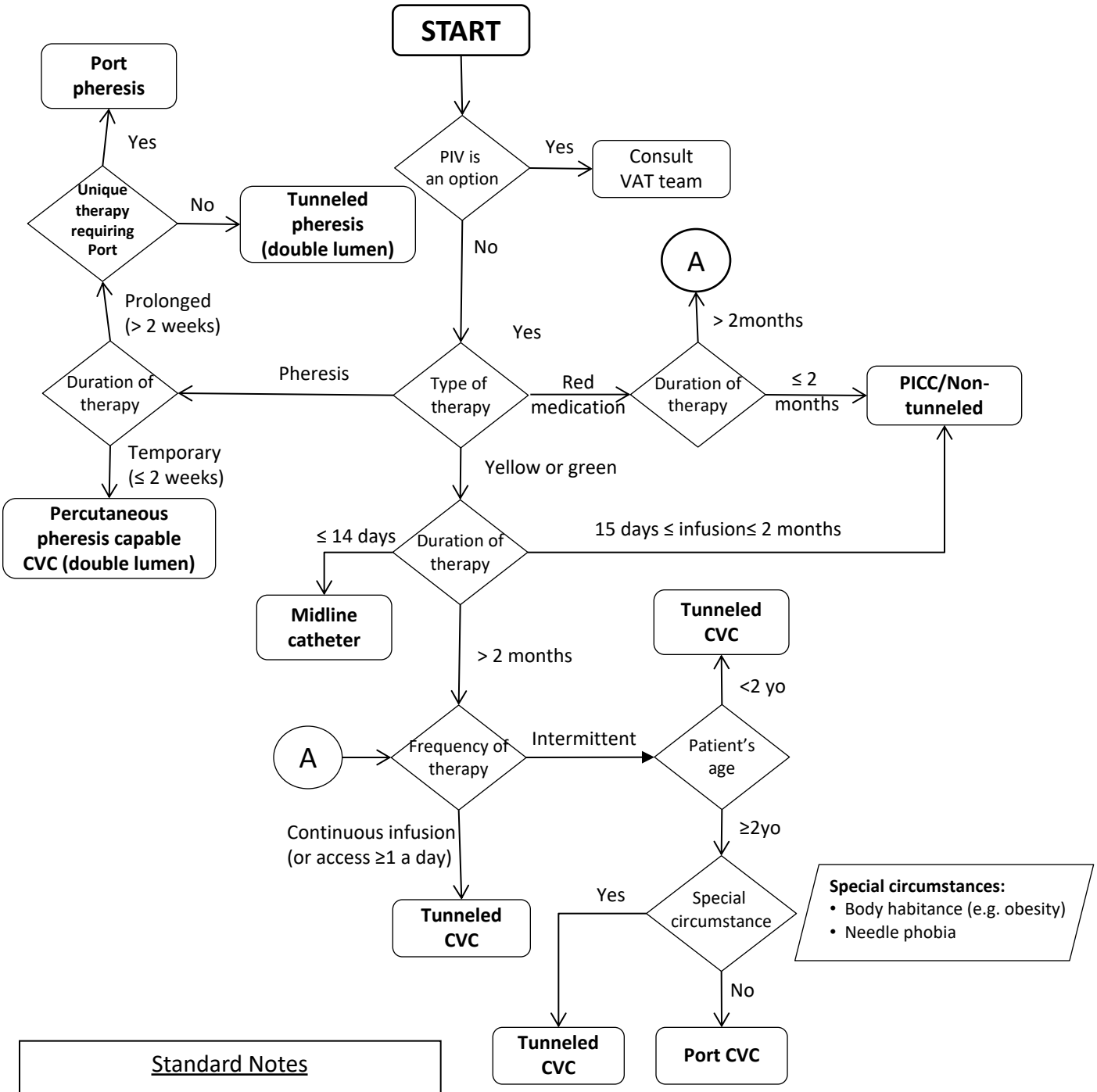
≥2 Risk Factors	Anticipated altered mobility > 48 hours? □ Bedrest or significant activity restriction □ Any line or tube that restricts mobility (i.e. epidural, foley, NG to continuous suction, chest tube, EVD, mechanical ventilation)	□ Yes = **High** Risk □ No = **Moderate** Risk
0-1 Risk Factor	Anticipated altered mobility > 48 hours? □ Bedrest or significant activity restriction □ Any line or tube that restricts mobility (i.e. epidural, foley, NG to continuous suction, chest tube, EVD, mechanical ventilation)	□ Yes = **Moderate** Risk □ No = **Low** Risk

If NO contraindications (see page 1), the following interventions (and orders) are indicated:

Pre-op Orders	
	Recommended Intervention/Order
ALL patients with surgery scheduled for > 60 minutes	□ Intra-op SCD (sequential compression device) – apply in pre-op/holding area

Post-op or Admission Orders	
Risk Category	**Recommended Interventions/Orders**
Low Risk	None – encourage early ambulation
Moderate Risk	□ SCD (sequential compression device), aim at 18 hours of use
High Risk	□ SCD (sequential compression device), aim at 18 hours of use **AND** □ Lovenox * (first dose 12 hours after surgery and hold 12h prior to surgical procedure) ○ < 50 kg = 0.5 mg/kg/dose subQ BID ○ 50-125 kg = 30 mg subQ BID or 40mg subQ daily ○ > 125 kg = 40 mg subQ BID * If renal dysfunction, consider decreasing dose and checking LMWH level 4 hours after 2nd or 3rd dose (goal 0.1-0.3 unit/mL, see BESt statement for management of LMWH for more details) ** If considering other options, consult hematology.

Line Selection Guide for Appropriate CVC Type

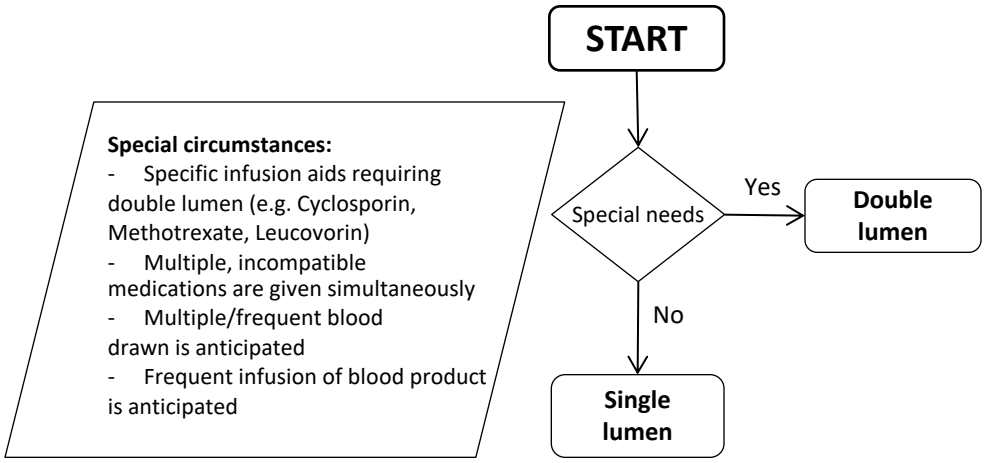


Standard Notes

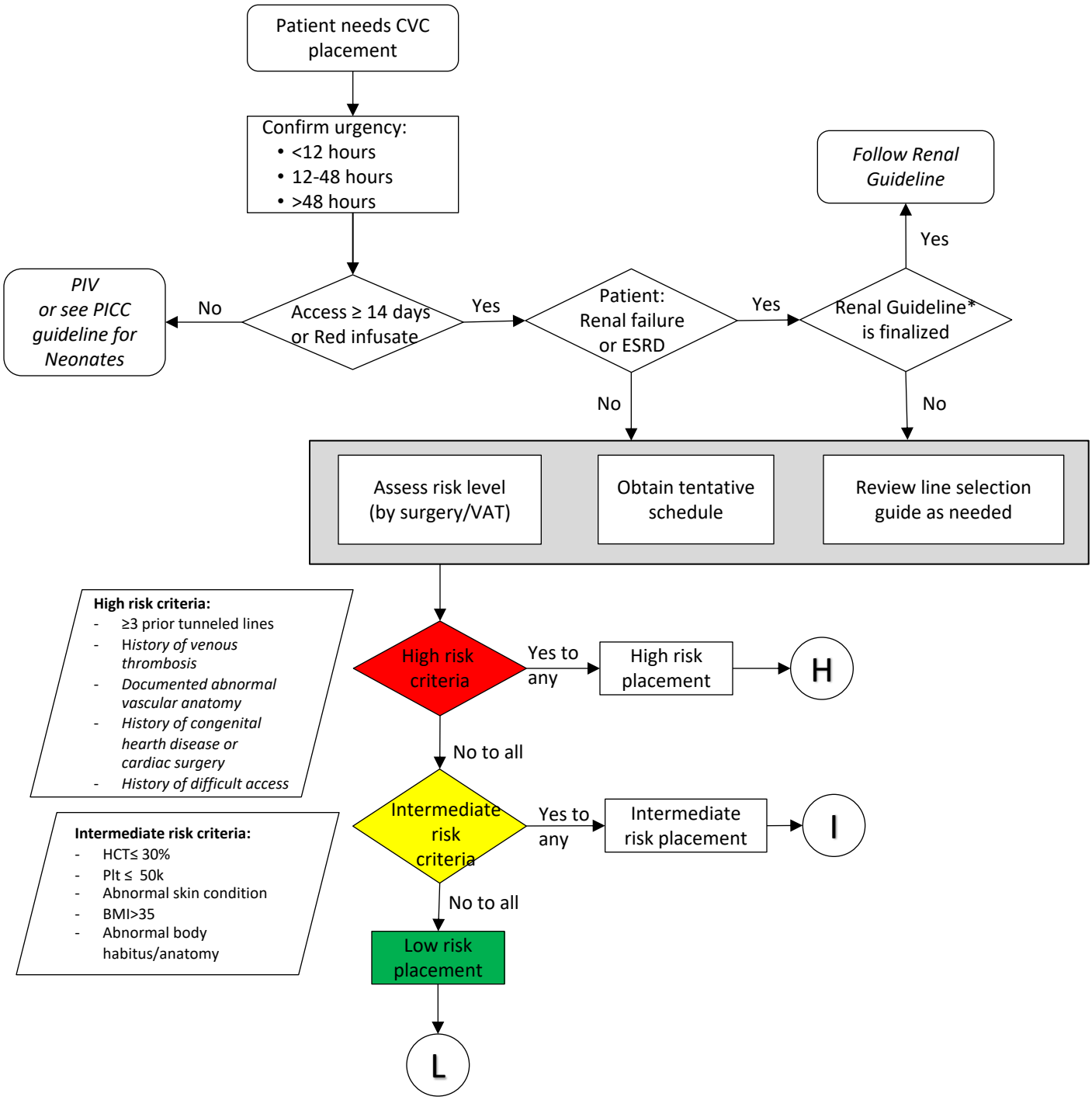
- Type "ip standard" into text box that reads "Insert SmartText".
- Choose appropriate note (tunneled CVC vs mediport)

Updated 1/2019

Selection Guide for Single vs. Double Lumen



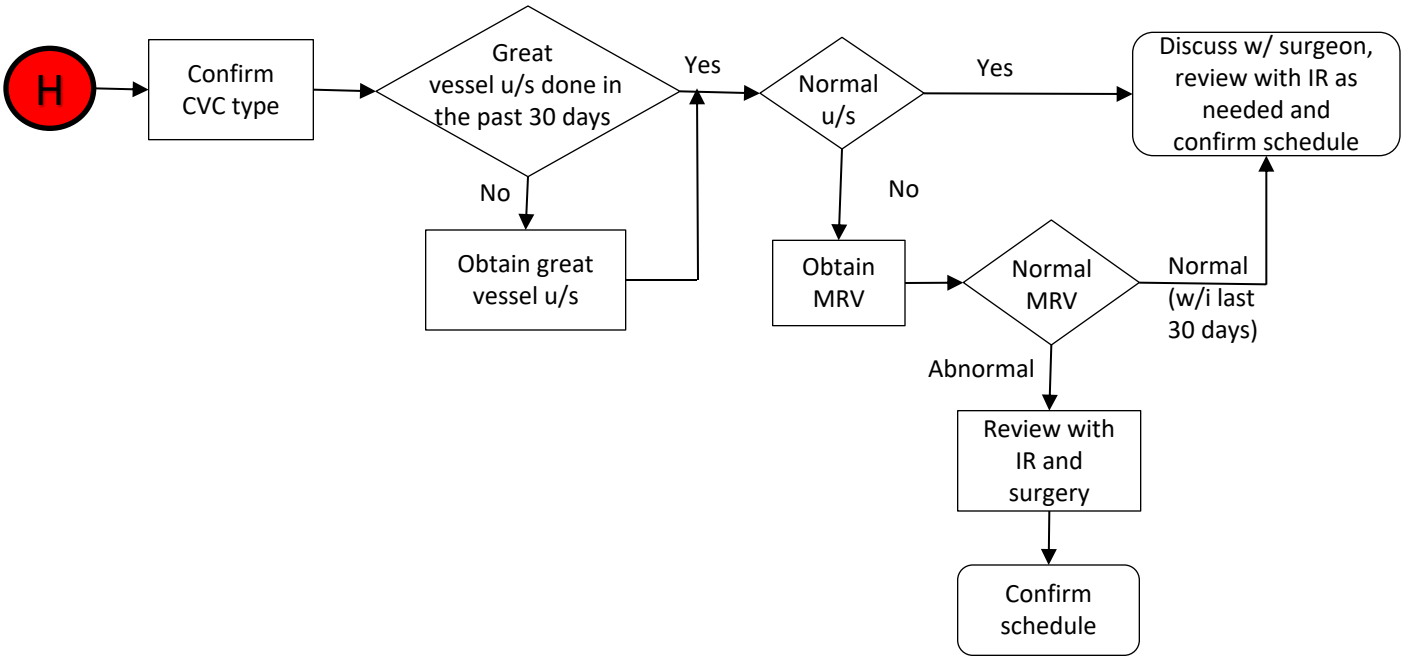
Care Algorithm for Evaluation of CVCs for Inpatients

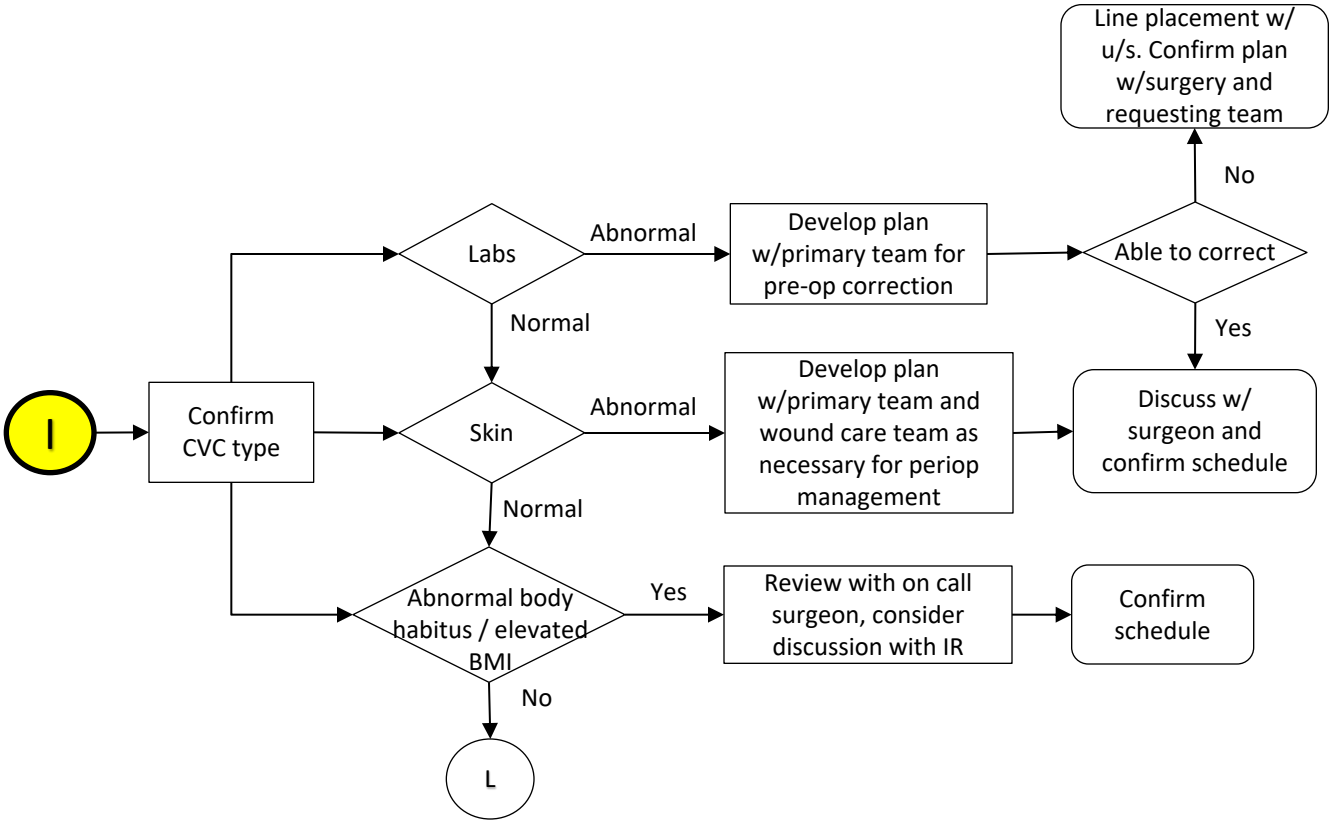


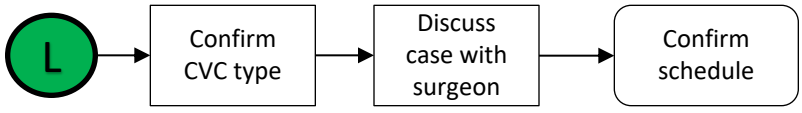
* We are expected to utilize Renal Guideline for renal failure or ESRD patients once it is developed.

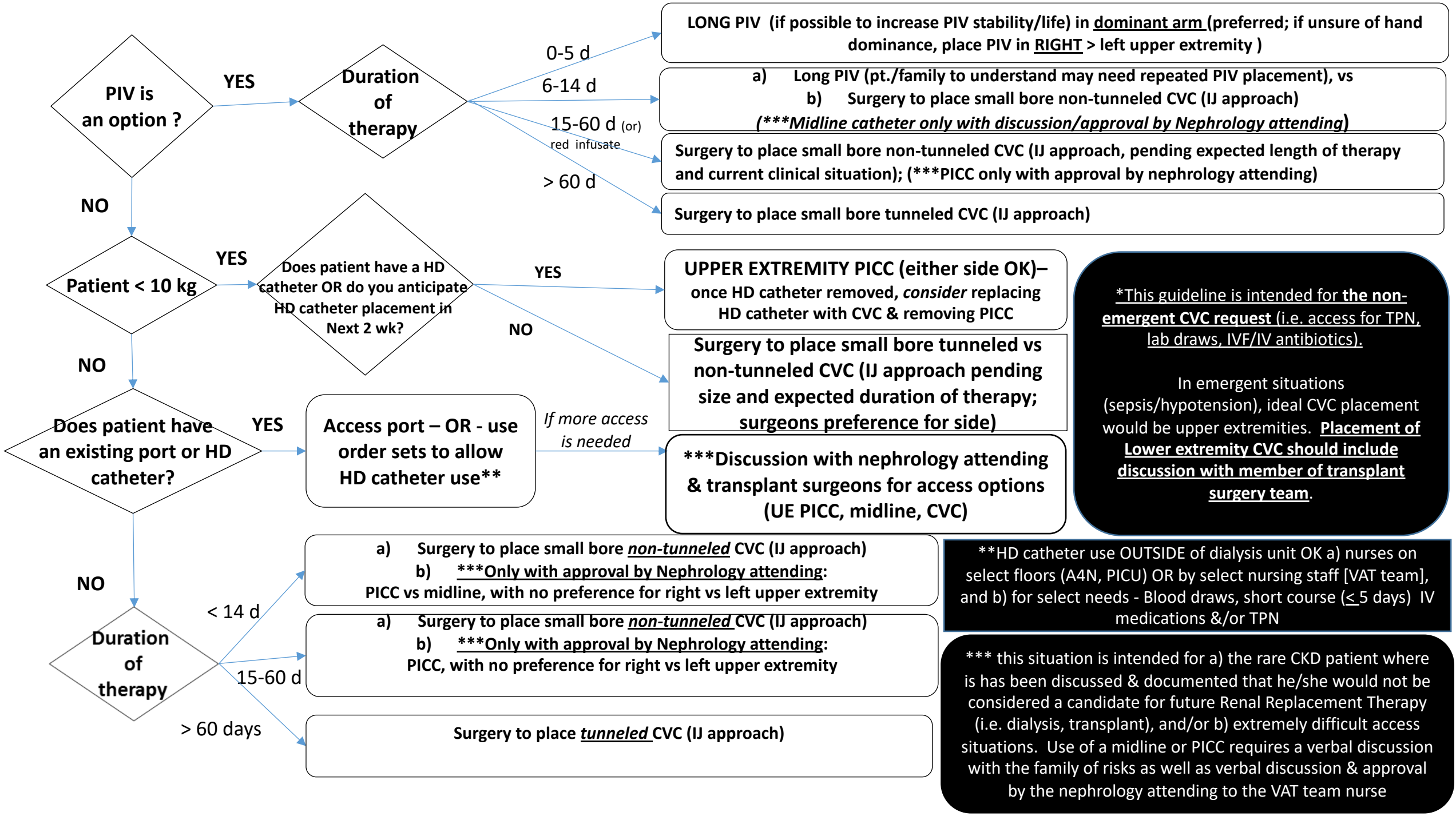
v. 2017 .424

Care Algorithm for Pre-op Evaluation








PIV is an option ?
YES
Duration of therapy
0-5 d
6-14 d
15-60 d (or) red infusate
> 60 d
LONG PIV (if possible to increase PIV stability/life) in dominant arm (preferred; if unsure of hand dominance, place PIV in RIGHT > left upper extremity)
a) Long PIV (pt./family to understand may need repeated PIV placement), vs
b) Surgery to place small bore non-tunneled CVC (IJ approach)
(***Midline catheter only with discussion/approval by Nephrology attending)
Surgery to place small bore non-tunneled CVC (IJ approach, pending expected length of therapy and current clinical situation); (***PICC only with approval by nephrology attending)
Surgery to place small bore tunneled CVC (IJ approach)
NO
Patient < 10 kg
YES
Does patient have a HD catheter OR do you anticipate HD catheter placement in Next 2 wk?
YES
NO
UPPER EXTREMITY PICC (either side OK)– once HD catheter removed, consider replacing HD catheter with CVC & removing PICC
Surgery to place small bore tunneled vs non-tunneled CVC (IJ approach pending size and expected duration of therapy; surgeons preference for side)
NO
Does patient have an existing port or HD catheter?
YES
Access port – OR - use order sets to allow HD catheter use**
If more access is needed
***Discussion with nephrology attending & transplant surgeons for access options (UE PICC, midline, CVC)
*This guideline is intended for the non-emergent CVC request (i.e. access for TPN, lab draws, IVF/IV antibiotics).
In emergent situations (sepsis/hypotension), ideal CVC placement would be upper extremities. Placement of Lower extremity CVC should include discussion with member of transplant surgery team.
NO
Duration of therapy
< 14 d
15-60 d
> 60 days
a) Surgery to place small bore non-tunneled CVC (IJ approach)
b) ***Only with approval by Nephrology attending:
PICC vs midline, with no preference for right vs left upper extremity
a) Surgery to place small bore non-tunneled CVC (IJ approach)
b) ***Only with approval by Nephrology attending:
PICC, with no preference for right vs left upper extremity
Surgery to place tunneled CVC (IJ approach)
**HD catheter use OUTSIDE of dialysis unit OK a) nurses on select floors (A4N, PICU) OR by select nursing staff [VAT team], and b) for select needs - Blood draws, short course (≤ 5 days) IV medications &/or TPN
*** this situation is intended for a) the rare CKD patient where is has been discussed & documented that he/she would not be considered a candidate for future Renal Replacement Therapy (i.e. dialysis, transplant), and/or b) extremely difficult access situations. Use of a midline or PICC requires a verbal discussion with the family of risks as well as verbal discussion & approval by the nephrology attending to the VAT team nurse

Line Selection Table – RENAL (Nephrology) CKD/ESRD patients

v. 2016 1007

Type of Med	0-5 days	6-14 days	15 days-2 month	>2 months
Green	PIV	PIV Non-tunneled CVC (Midline***)	Non-tunneled CVC (PICC***)	Tunneled CVC Port
Yellow	PIV	PIV Non-tunneled CVC (Midline ***)	Non tunneled CVC (PICC ***)	Tunneled CVC Port
Red	Non-tunneled CVC (PICC***)	Non-tunneled CVC (PICC***)	Non-tunneled CVC (PICC ***)	Tunneled CVC Port

*** this situation is intended for a) the rare CKD patient where is has been discussed & documented that he/she would not be considered a candidate for future Renal Replacement Therapy (i.e. dialysis, transplant), and/or b) extremely difficult access situations. Use of a midline or PICC in a pt with documented CKD stages 2-5 OR ESRD (KTX, HD, PD pt) requires a verbal discussion with the family of risks as well as verbal discussion & approval by the nephrology attending to the VAT team nurse

Venous Infusion Extravasation Risk

This is an estimate of risk for phlebitis or local tissue injury due to extravasation from any intravenous infusion device.

Risk derived from available evidence, CCHMC data and CCHMC expert opinion, subject to review and change as further evidence becomes available.

For Treatment of Extravasation, Refer to CCHMC Policy P&T II-112

This does not apply in situations of emergency medical treatment.

If a medication is not on this list, please refer to the CCHMC formulary or contact pharmacy (6-4291) for information

Red

Higher Risk

Acyclovir
Amiodarone
Caffeine Citrate
Calcium *(all salt forms)*
Dextrose > 12.5%
Doxycycline
Esmolol
Mannitol 20% & 25%
Promethazine
Potassium >60 mEq/L
Sodium bicarbonate ≥ 3%
Sodium chloride ≥ 3%
TPN > 950 mOsm/L
Vasopressors such as Dopamine

Chemotherapy Drugs
Extravasation treatment:
Refer to policy P&T II-113

Yellow

Intermediate Risk

Acetazolamide
Allopurinol
Amikacin
Amphotericin B (conventional)
Arginine
Ciprofloxacin
Dextrose 10% to ≤12.5%
Diazepam
Erythromycin
Ganciclovir
Lorazepam
Midazolam
Morphine
Ondansetron
Nafcillin
Non-Ionic Radiology Contrast
Phenobarbital
Phenytoin
Potassium ≤ 60 mEq/L
TPN ≤950 mOsm/L
Vancomycin

Green

+ Lower Risk

Aminophylline
Amphotericin B Liposomal
Ampicillin
Ampicillin/Sulbactam
Cefazolin
Cefotaxime
Ceftazidime
Ceftriaxone
Cefuroxime
Clindamycin
D5LR
Dextrose < 10%
Fentanyl
Fosphenytoin
Furosemide
Gentamicin
Heparin
Imipenem
IVIG
Lactated Ringers
Lipids
Magnesium sulfate (bolus)
Meropenem
Methylprednisolone
Normal saline
Pentamidine
Piperacillin
Piperacillin/tazobactam
Ticarcilllin
Ticarcillin/clavulanate
Tobramycin

+ NOTE:

No intravenous infusate is “safe”.

Gross extravasation, even of normal saline, may result in serious harm including compartment syndrome, causing ischemia and loss of tissue or permanent loss of limb function.

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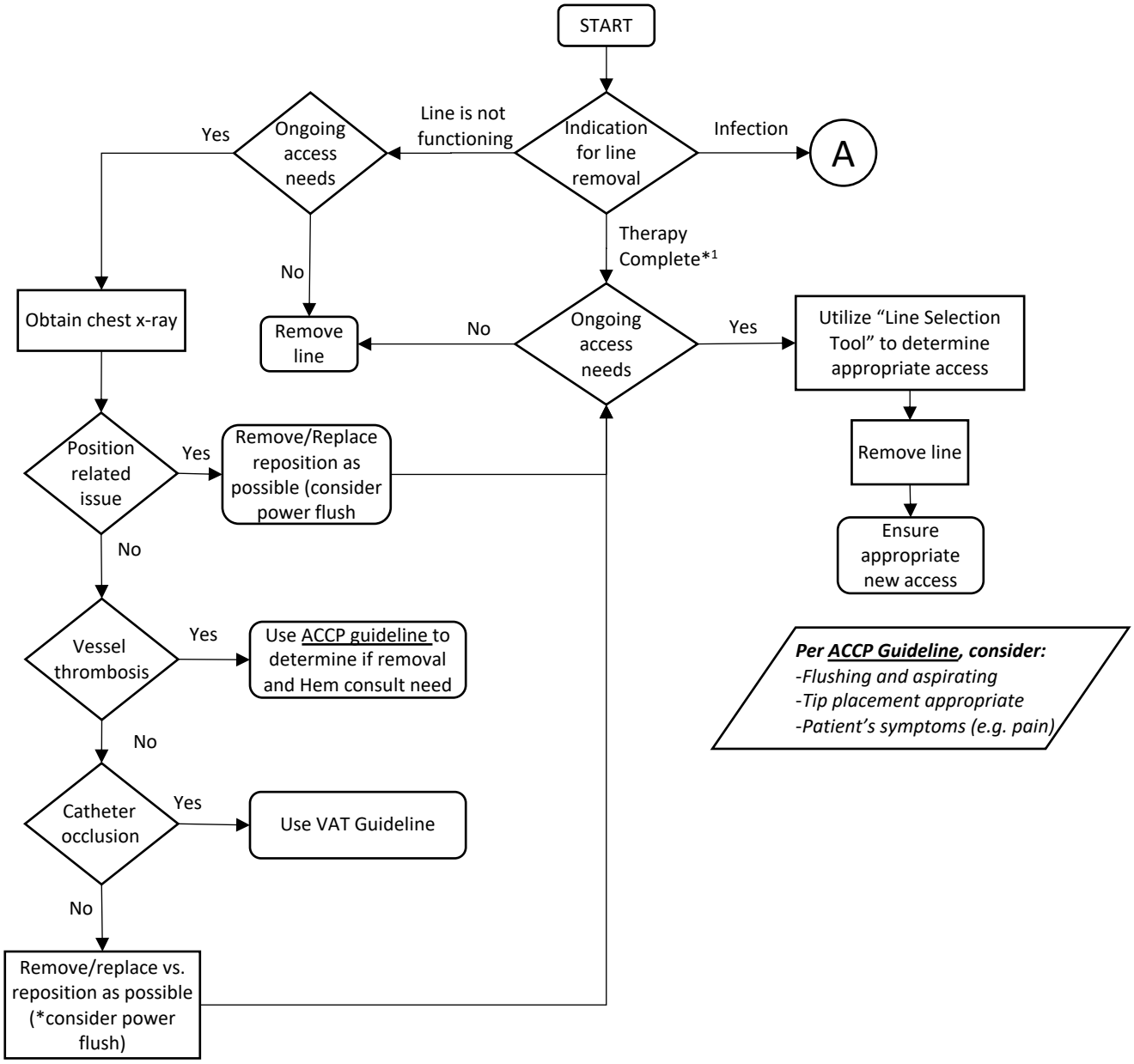
Reviewed: January 30, 2017

Care Algorithm for Determining Line Removal

DRAFT
v.2017 0424



*1. Consider removing line if ≥48h w/o use for NICU and ICU.

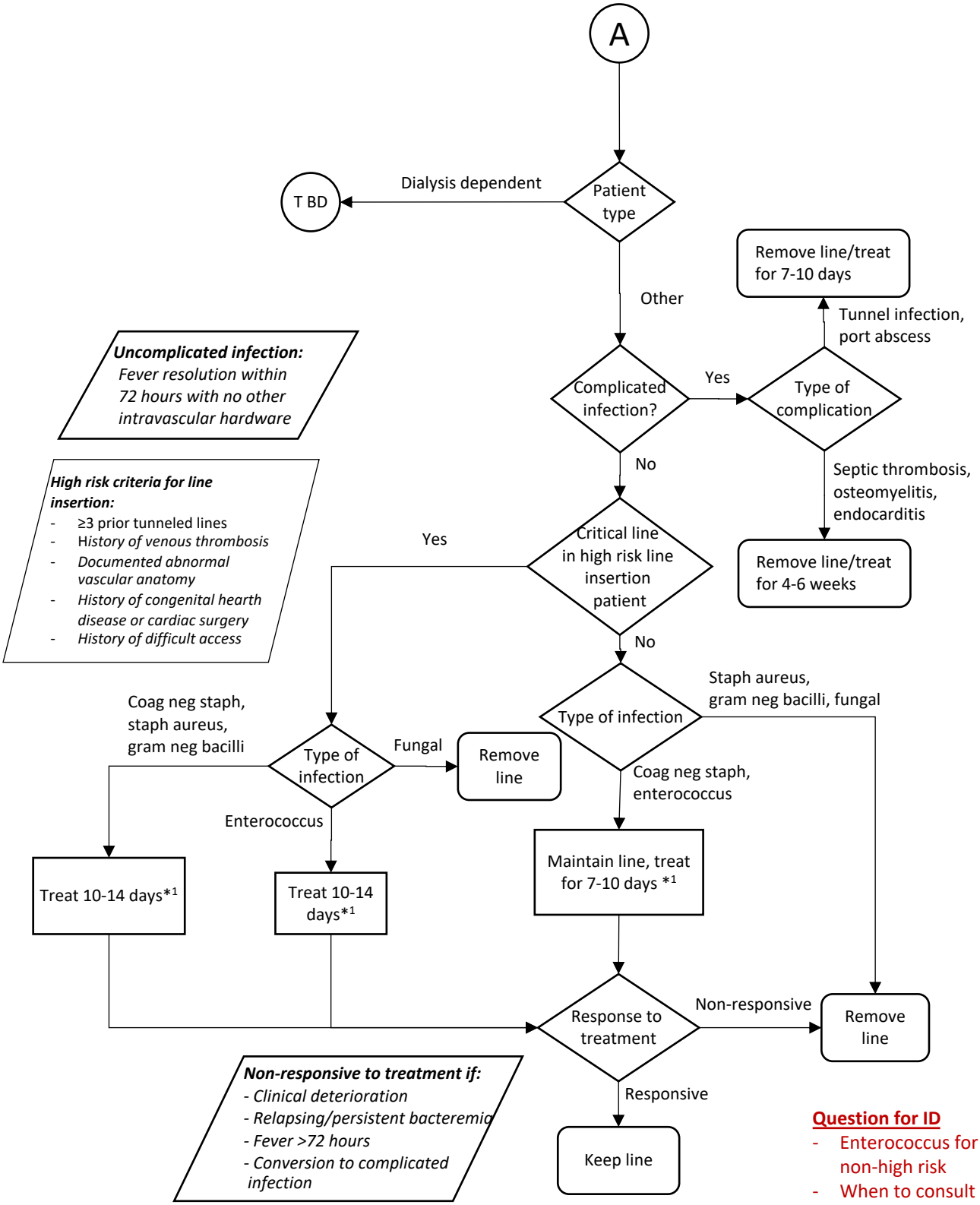
Prior to Removal:

Always consider ongoing access needs and if patient meets high risk criteria for access

If Patient in need of new access, utilize line stratification tool

Care Algorithm for Determining Line Removal

DRAFT
v.2017 0424



*1- Consider antibiotic/ethanol lock
Complete treatment or at least negative cultures for 48h.
If patient to receive high dose immunosuppression (i.e. BMT), consider replacing line even if cultures become negative

Updated 1/2019

Gastroschisis Feeding Protocol

For infants with uncomplicated gastroschisis and birthweight ≥ 1500 grams and ≥ 34 weeks

Replogle Output ≤ 20 mL/kg/day

- Discontinue Replogle
- Start glycerin suppository 1-2x daily

Intolerance of Discontinued N/OGT
Replace N/OGT to LCWS
Continue glycerin suppository

Intolerance
-Retching
-Ill appearing
-Forceful expulsion
-Concerning abdominal exam (tenderness, change from prior)
NOT Small Spit Ups!

****Notify surgical fellow if Intolerance develops**

Tolerance of Discontinued Replogle x 24 hours

Feeding day 1: start 20 ml/kg breast milk PO/NG
-Initiate feeds q 3 hours
-Encourage parents feeding 1st bottle
-Continue *nonnutritive* breast feeding

Feeding day 2: Increase by 20 ml/kg/day PO/NG

Feeding day 3: Continue advancing 20 ml/kg/day
-Begin *nutritive* breast feeding, using sliding scale

Feeding day 4: Increase by 20 ml/kg/day PO/NG

Feeding day 5: Fortify feeds to 22 calories
-Use Human Milk Fortifier if taking breast milk
-Concentrate formula if taking formula

Continue advancement per protocol (20 ml/kg/day) until full feeds achieved

Consider removing NG and allowing infant to PO ad lib when taking at least 80% of goal enteral feeds

If Mother's breast milk not available, use donor breast milk + liquid protein

If no MBM available and DBM refused, use Elecare

When tolerating full feeds and transitioning off DBM, first try Similac Total Comfort (non-WIC) or Goodstart Gentle (WIC). If not tolerated, use Elecare

If intolerance develops on feeding day 1, replace Replogle and re-try when output returns to < 20 ml/kg/day

If develops on feeding day 2+:
-Decrease feed by 20 ml/kg
-Continue glycerin suppository
-Re-attempt advancement in 12-24 hours

If unable to advance feeds x 3 attempts due to emesis, consider continuous feeds initiated at 20ml/kg/d

Nonnutritive Breast Feeding
-Mom pumps < 30 minutes prior to putting infant to breast
-Limit time at breast to ≤ 30 minutes
-Can initiate when replogle is still in place

Breast Feeding Sliding Scale
BF will be observed by LC on a regular basis to inform the amount of supplementation required.

Discharge
-When taking oral feeds + weight gain x 48 hours

-If >38 weeks CGA and not increasing PO by 10% per week, follow G-Tube algorithm regarding discharge with tube feeds

Cincinnati Children's
changing the outcome together

Pathway for Gastric Sleeve or Bypass (see gastric bypass orderset)

Pre-Operatively

- Compression Stockings
- SCDs
- Type and Screen
- Lovenox 40 mg subq x 1 dose
- Cefoxitin prior to incision
- Scopolamine patch

POD 0

- Continuous pulse oximetry
- Bariatric stage I diet (sugar free clear liquids)
- Ambulate TID
- Incentive spirometry 10x/hour
- D5 ½ NS + 20 meq KCL @ 75 cc/hr
- Compression Stockings
- SCDs
- Scopolamine patch
- Cefoxitin x 3 doses
- Zofran Q8H standing

POD 1

Initiate POD1

- Check CBC
- Start lovenox 40 mg Q24H if CBC okay
- Multivitamin Qday (2 chewable tablets)
- Thiamine Q24H

Continue from POD0

- Bariatric stage I diet
- Ambulate TID
- Incentive spirometry 10x/hour
- D5 ½ NS + 20 meq KCL @ 75 cc/hr
- Compression Stockings
- SCDs
- Scopolamine patch
- Zofran Q8H standing

POD 2

Initiate POD2

- Stop IVF

Continue from POD0/1

- Bariatric stage I diet
- Ambulate TID
- Incentive spirometry 10x/hour
- Compression Stockings
- SCDs
- Scopolamine patch
- Zofran Q8H standing

Discharge home if adequate PO (stop lovenox on DC)

Updated 1/2019

Pathway for Gastric Sleeve or Bypass
(see gastric bypass orderset)
Type II Diabetes
(*differences in protocol for type II DM noted in red*)

Pre-Operatively

- Compression Stockings
- SCDs
- Type and Screen
- Lovenox 40 mg subq x 1 dose
- Cefoxitin prior to incision
- Scopolamine patch
- Follow endocrine recommendations from pre-operative consult

POD 0

- Continuous pulse oximetry
- Bariatric stage I diet (sugar free clear liquids)
- Ambulate TID
- Incentive spirometry 10x/hour
- D5 ½ NS + 20 meq KCL @ 75 cc/hr
- Compression Stockings
- SCDs
- Scopolamine patch
- Cefoxitin x 3 doses
- Zofran Q8H standing
- Endocrine consult

POD 1

Initiate POD1

- Check CBC
- Start lovenox 40 mg Q24H if CBC okay
- Multivitamin Qday (2 chewable tablets)
- Thiamine Q24H

Continue from POD0

- Bariatric stage I diet
- Ambulate TID
- Incentive spirometry 10x/hour
- D5 ½ NS + 20 meq KCL @ 75 cc/hr
- Compression Stockings
- SCDs
- Scopolamine patch
- Zofran Q8H standing

POD 2

Initiate POD2

- Stop IVF

Continue from POD0/1

- Begin bariatric stage II diet
- Monitor blood glucose per endocrine
- Ambulate TID
- Incentive spirometry 10x/hour
- Compression Stockings
- SCDs
- Scopolamine patch
- Zofran Q8H standing

Discharge home on POD 3 if adequate PO and adequate blood glucose control
(stop lovenox on DC)

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Updated 1/2019

Pathway for Pectus Excavatum Repair (see pectus excavatum orderset)

Pre-Operatively

- SCDs
- Type and Screen
- Ancef or Vanc (*+ORSA*) prior to incision
- Pre-op wash (Dynahex of HIbiclens) in SDS

POD 0

- Continuous pulse oximetry
- Clears, advance as tolerated
- OOB to chair and then ambulate (if first case of the day)
- Incentive spirometry 10x/hour
- mIVF D5 ½ NS + 20 meq KCL @ maintenance
- SCDs
- Ancef x 3 doses (Clinda if *+ORSA*)
- *Pain management per pain team*: Epidural, valium, robaxin, toradol, IV Tylenol, methadone x1, scheduled Zofran
- Chewing gum 5 separate times for 20 min (if fully awake post-op)
- Senna/miralax BID and Movantik
- Foley catheter

POD 1

Initiate POD1

- OOB (up to chair and ambulate) TID
- Remove foley catheter
- *Pain management per pain team*: Continue Epidural, valium, robaxin, toradol, IV Tylenol, start oxycodone

Continue from POD0

- Regular diet
- Incentive spirometry 10x/hour
- mIVF until drinking well and urinates after foley removal
- SCDs
- Chewing gum 5 separate times for 20 min
- Zofran Q8H (changes to prn)
- Senna/miralax BID and Movatik

POD 2

Initiate POD2

- Stop IVF (if still running)
- Stop epidural at 0600
- Epidural removed when pain team rounds
- Transition to all PO pain medication: oxycodone, valium, robaxin, motrin, Tylenol
- 2V CXR to evaluate bar location(s) and for pleural effusion/pneumothorax
- Remove dressings and wash chest daily

Continue from POD0/1

- Regular diet
- Ambulate TID
- Incentive spirometry 10x/hour
- SCDs
- Chewing gum 5 separate times for 20 min
- Zofran Q8H prn
- Senna/miralax BID and Movantik

POD 3

Initiate POD3

- PT/OT will sign off on walking stairs
- Prescriptions filled and medication schedule given

Continue from POD0/1/2

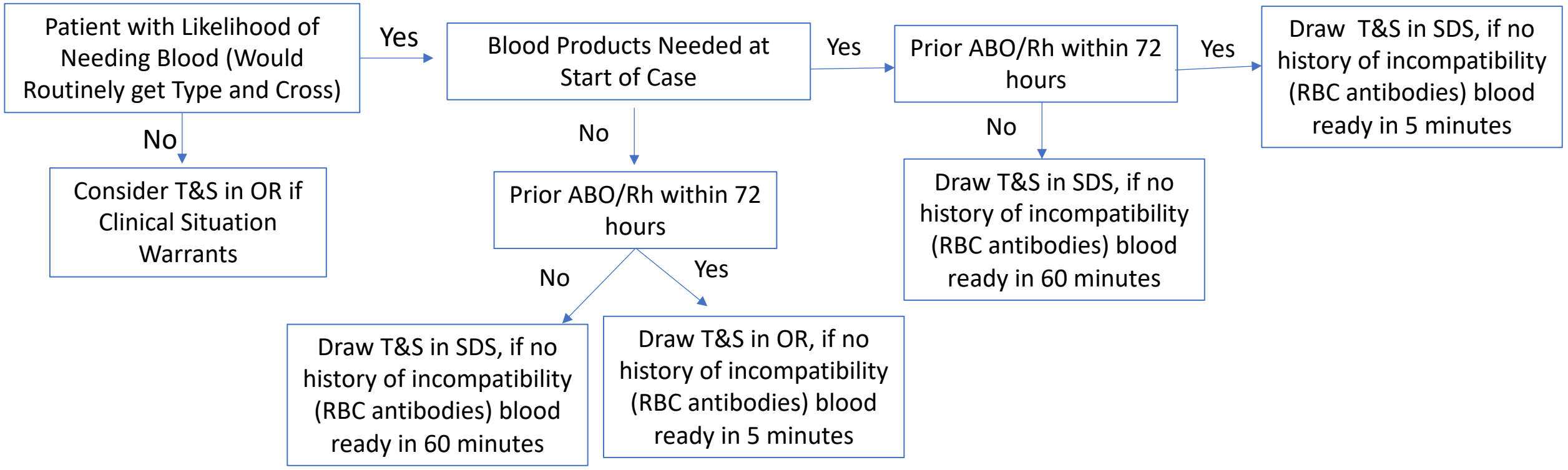
- Regular diet
- Ambulate TID
- Incentive spirometry 10x/hour
- SCDs
- Chewing gum 5 separate times for 20 min
- Wash chest daily
- PO pain medication
- Senna/miralax BID

Discharge home if pain well controlled, tolerating PO intake

Updated 1/2019

Updated 1/2019

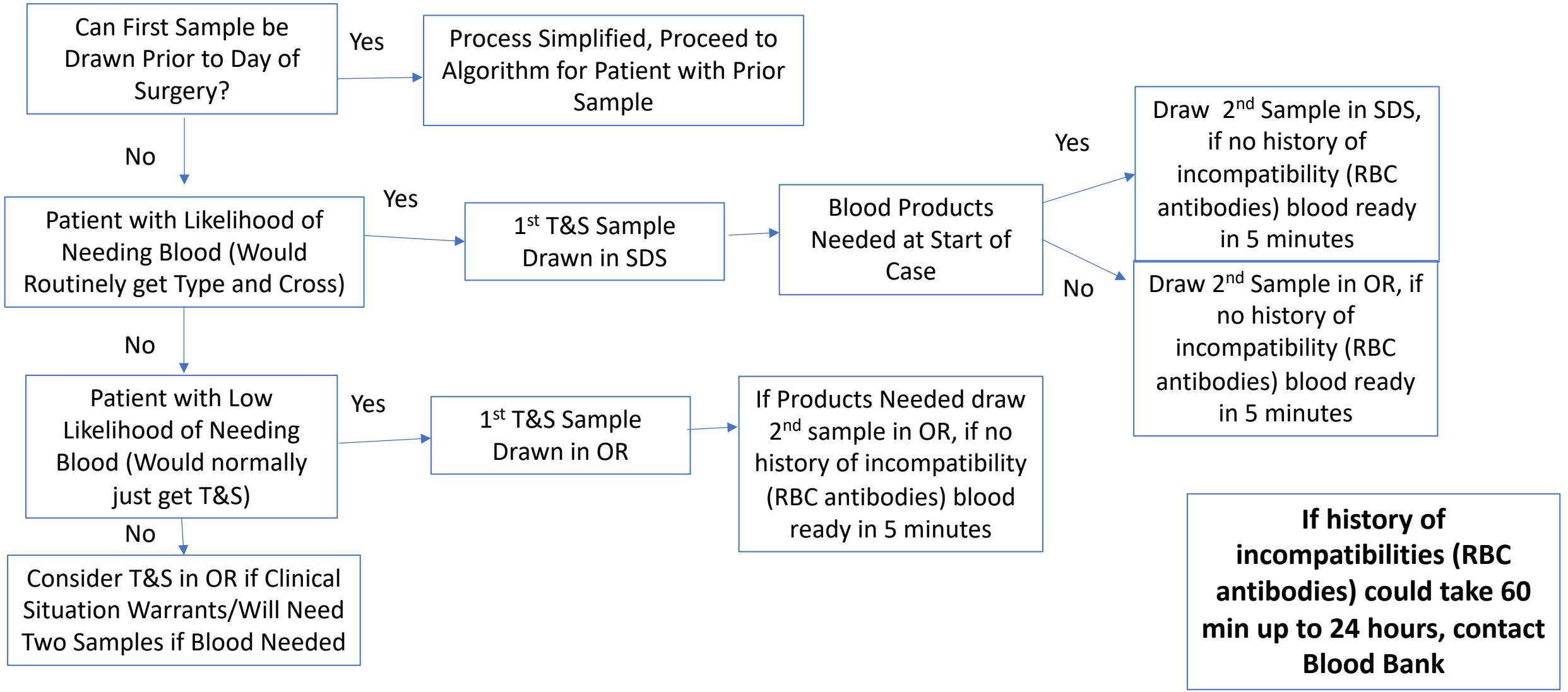
Patient has Prior ABO/Rh Type at CCHMC (Ever)



If history of incompatibilities (RBC antibodies) could take 60 min up to 24 hours, contact Blood Bank

Updated 1/2019

Patient has NEVER had ABO/Rh at CCHMC (Will Need Two Samples)



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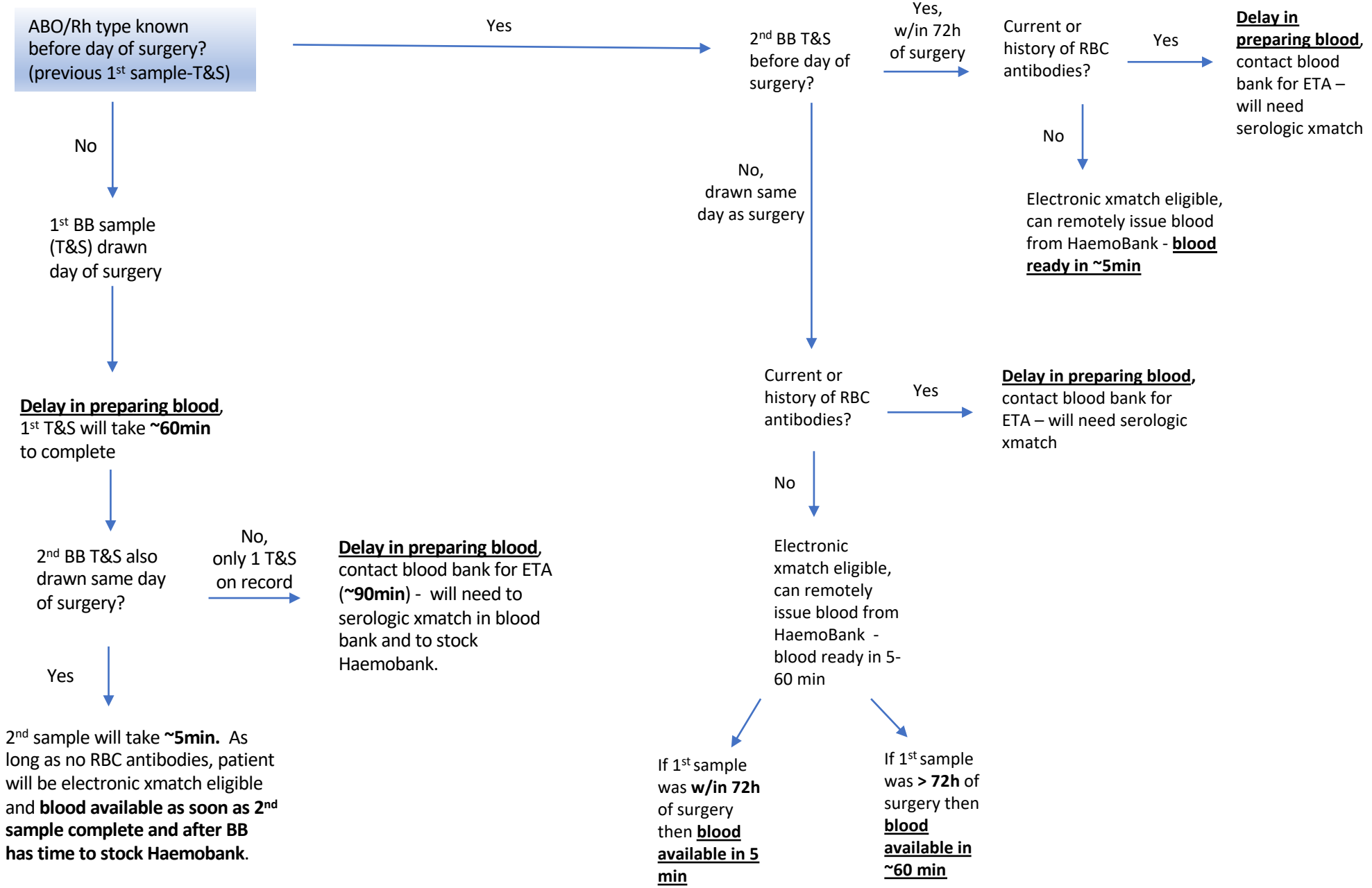
Updated 1/2019



CCHMC SSI Protocol

- A basic set of interventions to prevent SSIs among Class I and Class II surgical procedures
    - Included: All surgical procedures involving a skin incision

Proposed measures:

Intervention	Definition
Pre-op	
Bathing	1 Soap & Water, 1 CHG bath both occurring within 24 hours of procedure
Linen Change	Clean bed linens and gown/pajamas changed night prior to procedure
S aureus Screening*	2-site screening within 2-6 weeks of procedure
Decolonization*	Decolonization protocol if positive including additional CHG bathing and mupirocin
Intra-op	
Skin prep	Alcohol-containing product, CHG preferred
Antibiotic timing*	Complete within 60min p/t incision
pCO2	ETCO2 ≥40 during procedure unless contraindicated
Normothermia*	Core temp at incision closure ≥36.0
Post-op	
Wound Care Plan	Documented plan in an Epic order

*For sub-set of procedures

- S aureus screening and decolonization – Class I/II procedures with sterile implant, excludes ports and CVCs
- Antibiotic timing – Class I/II procedures for which antibiotics are recommended
- Normothermia – All patients ≤5kg

Cincinnati Children's

Wound Class Definitions

Class I: Clean

- No breaks in sterile technique
- No inflammation is encountered
- An uninfected operative wound in which respiratory, alimentary, genital or uninfected urinary tract is not entered

Examples: Spinal fusion, thyroidectomy, ganglion incision, hernia repair

Class II: Clean Contaminated

- No breaks in sterile technique
- No inflammation is encountered
- An operative wound in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination

Examples: Cholecystectomy, colon resection, tracheostomy, Malone/mitrofanoff, appendectomy (incidental, not inflamed)

Class III: Contaminated

- Major break in sterile technique
- Incisions with acute, non-purulent inflammation
- Open, fresh, or accidental wounds less than four hours old
- Gross spillage from gastrointestinal tract

Examples: Non-perforated appendicitis, inflamed gallbladder (bile spillage), open fracture (fresh, no gross contamination), penetrating wound (fresh)

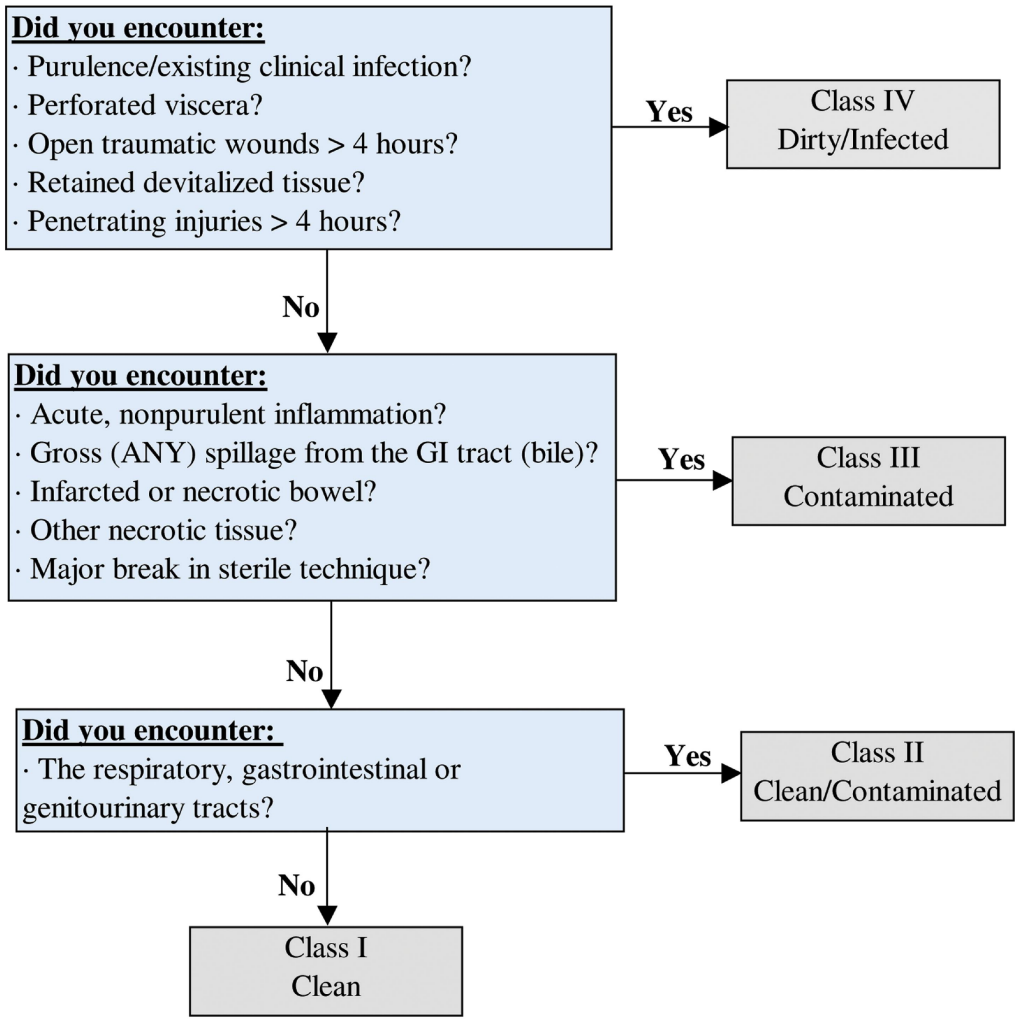
Class IV: Dirty

- Old traumatic wounds over four hours
- Trauma from a contaminated source or gross spillage of infected source
- Organisms causing post-operative infection were present in the operative field before the operation

Examples: Perforated appendicitis, open fracture (old, contaminated trauma), drainage of intra-abdominal abscess

Updated 3/2019

Wound Class Definitions



NOTE:
- Chronic inflammation only does not change the classification.
- Gross spillage is any spillage you can see with the naked eye.

Source: Zinn JL. Surgical Wound Classification: Communication is Needed for Accuracy. *AORN Journal.* 2012;95(2): 274-278

Updated 3/2019

Suspected Hirschsprung's Associated Enterocolitis (HAEC) Treatment Guidelines

Scenario: Patient with known/suspected Hirschsprung's Disease (HD) presents to the ED with GI complaints* and/or fever.

Treatment Principles for Suspected HAEC

1). A surgical fellow or attending should personally **see and evaluate** all patients with suspected HAEC at the earliest possible opportunity (*within 1 hour*) and document exam and treatment plan.

2). A **rectal exam** should be performed as part of initial exam. If patient is <4 weeks from surgery, rectal exam or dilations should be discussed with the Attending Surgeon prior to performing exam.

3). **Rectal irrigations** should be initiated at earliest opportunity (*within 1 hour*) of arrival. Do not delay irrigations to wait for initial abdominal x-ray. Rectal irrigations should be performed by the person most versed in the process; A4S nurses are available to provide support and assistance. Irrigations should be Q8H at minimum (consider more frequent – Q6H or PRN – if severe enterocolitis).

4). **Abdominal x-ray** should be obtained on arrival and repeated after the initial irrigation and thereafter as needed to demonstrate adequate decompression.

5). Patient should be NPO and started on IVF. If significant abdominal distention, consider replogle.

6). **Antibiotics: Any vomiting patients should be on IV antibiotics.**

Outpatient:
PO metronidazole is sufficient for low suspicion or mild cases

Inpatient:
- *WITH systemic signs***: IV broad-spectrum antibiotics, including metronidazole
- *WITHOUT systemic signs***: PO or IV metronidazole (low suspicion or mild cases may be managed with PO)

7). **Laboratory tests** that should be considered include: CBC, renal panel, and a venous blood gas (for any patient with systemic signs).

8). **Disposition**:
- *Patients without systemic signs***: Admit to the surgical floor.
- *Patient with systemic signs***: Should be evaluated for potential ICU admission.

9). All HAEC patients on the surgical floor should have **vitals** with blood pressure measurement every 4 hours.

GI complaints may include:
Abdominal distention, vomiting, no/minimal stooling, foul-smelling stool, and/or explosive diarrhea

****Systemic signs include:***
Fever, age-adjusted tachycardia, hypotension, tachypnea, oliguria

Rectal Irrigation Supplies:
- Silicone foley catheter (16 fr for children ≤1 year; 24 fr for children >1 year)
- 60 cc catheter tip syringe
- Lubricant (water soluble)
- Saline solution
- 2 non-sterile basins (e.g. emesis basin)

Rectal Irrigation Orderset:
Use "Hirschsprung Disease Rectal Irrigation" orderset to order subsequent irrigations.

Rectal Irrigation Video:
https://cchmcstream.cchmc.org/MediasiteEX/Play/545154a603a844e8988ef74cd5b4c1c11d

v2 Updated 4/2019

GUIDELINES
FOR COLONIC IRRIGATIONS

RATIONALE: Patients with Hirschsprung's Disease may suffer from enterocolitis, either before or after corrective surgery. They have an underlying dysmotility of the colon which leads to stasis of their stool, subsequent bacterial overgrowth, diarrhea, and dehydration.

The rationale of rectal irrigations is to clean the colon of stool and to prevent "stasis" (failure of stool to empty from the colon). The child should be irrigated with normal saline solution beginning with 10-20ml at a time for a total of 20ml/kg. If the saline is returned during the irrigation process, then this volume can be repeated.

Supplies needed:

- Silicone foley catheter:
  - *16fr for children under one year of age
  - *24fr for children over one year of age
  - *Catheter size is based on child size. Parents may have to purchase sizes between 16fr and 24fr based on anus size and integrity of the rectum. **The lumen size of these catheters are larger to allow passing of thick stool through the catheter.)
- 60ml catheter tip syringe
- Lubricant (Water soluble), such as Surgi-lube or KY jelly (nothing petroleum based)
- Saline solution
- 2 non-sterile basins such as emesis basins

To begin:

1. Pour normal saline solution into a basin

2. Using a 60 ml catheter tip syringe, draw up 20 ml of normal saline solution

3. Gently insert appropriately-size lubricated silicone catheter into the rectum, approximately six (6) inches

4. Allow any stool or gas to run out into the basin. Advance the catheter to allow any other "pockets" of stool/gas to empty

5. Place the catheter tip syringe into the end of the silicone catheter and inject 20 ml of normal saline solution into the rectum. Hold catheter in place at the level of the anus so it does not fall out.

6. Disconnect syringe from the end of the catheter; allow the normal saline solution to drip into an empty emesis basin which will be used for your discarded solution

7. Repeat this process until the fluid draining from the catheter is clear. With each irrigation, advance the catheter a few inches further and repeat the irrigations until the returning fluid is clear. Do not force or advance the catheter further than the y-divider ports of the catheter. If gently pushed the catheter should follow the curve of the colon.

   ***NOTE:** It will be important between instillations of the 20 ml of normal saline solution to allow the solution to drain from the catheter into the emesis basin with the discarded solution. For example, if you are giving 100 ml of normal saline, you should have the same amount of solution in the basin in addition to any stool.

   If the amount of return is not equal to, or more than the volume of the fluid for the irrigation, reinsert the catheter and gently draw back on the syringe. The catheter may be held in place high in the colon for a few minutes to help expel any gas that is not relieved with the irrigations.

   In acute episodes of enterocolitis irrigations should be done three (3) times a day and can be performed as often as hourly to get clear results.

   If there are symptoms of enterocolitis: fever, abdominal distention, not stooling, foul smelling stool, stooling very frequently; you should irrigate first, then seek medical attention immediately.

Date of procedure:
Patient name and MRN (or sticker):

Colorectal Surgery SSI Protocol Checklist

Pre-Hospital:

- ☐ Patient education
- ☐ Shower/bath on evening prior (antibiotic or regular soap)
- ☐ Chlorhexidine wipes on morning of (in Same Day Surgery or on the wards if admitted)

Pre-Incision

- ☐ Hair removal (if applicable) with clippers
- ☐ Surgical field prep with Chloraprep (if contra-indication to Chloraprep then use betadine *AND* alcohol). Allow adequate drying time for prep (per current OR standards).
- ☐ Appropriate antibiotics within 30 min prior to incision (with re-dosing intraoperatively)

Intra-Operative

- ☐ Routine use of fascial wound protector (ALEXIS) for both open and laparoscopic extraction sites. (If already being utilized, GelPort counts as wound protector).
- ☐ Ioban allowed, but not required.
- ☐ Gown and glove change by surgeons and scrub prior to fascial closure
- ☐ Place clean towels around wound prior to fascia/skin closure. If drapes are grossly contaminated or soaked through with fluids, new laparotomy drape to be placed.
- ☐ Use dedicated wound closure tray for fascia and skin. Replace bovie and suction tip/tubing.
- ☐ Irrigation of wound once fascia is closed (using normal saline; antibiotic solution not necessary).
- ☐ Approximate tissue layers and skin with interrupted deep dermal sutures to allow for free drainage (okay to leave wound open). Avoid water tight subcuticular closures. No dermabond on incision of a bowel extraction site. (Can use dermabond at other clean incisions).
- ☐ Ensure proper wound classification at end of case and announce during final time out.

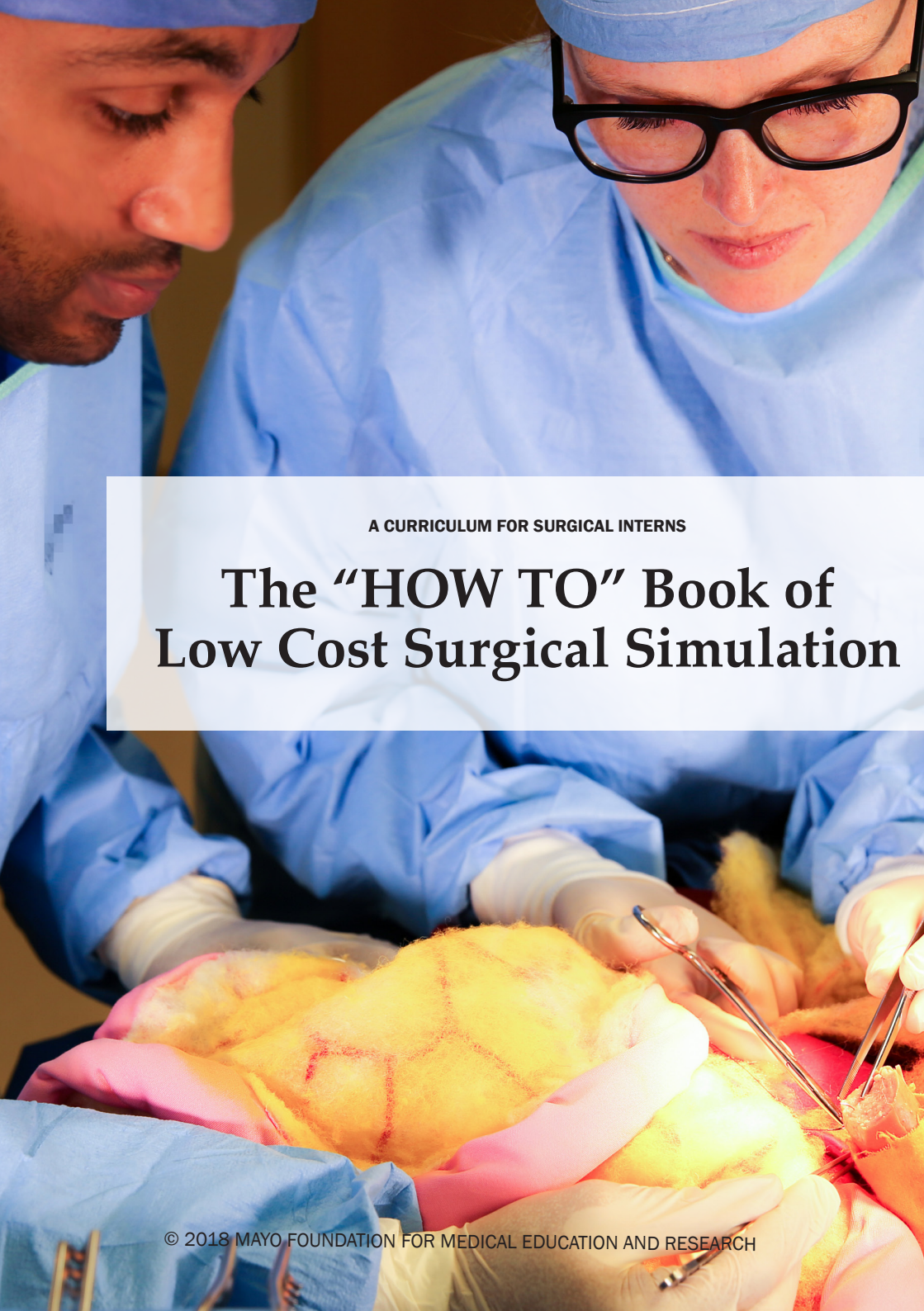
Post-Operative

- ☐ Standard use of post-operative antibiotics: no post-operative antibiotics for Class I/II wounds; limit prophylactic post-operative antibiotics to 24 hours for all other wound classes. Continuation of antibiotics beyond 24 hours only if treating active infection.
- ☐ Normothermia, euglycemia, and 40% FiO2 by facemask in PACU.
- ☐ Dressing removed within 48 hours (if applicable) and daily inspection of wound

Surgeon name and signature: _____

OR nurse name and signature: _____

***Cases to be used for**: Creation/closure of ileostomy/colostomy, bowel resection, PSARP or PSARVUP with laparotomy, staged Hirschprung's pullthrough with laparotomy, creation of Malone, vaginal reconstruction/replacement using bowel, bowel tapering procedures. Can consider for ex lap for perforated viscus (excluding appendicitis).*



A CURRICULUM FOR SURGICAL INTERNS

The "HOW TO" Book of Low Cost Surgical Simulation

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Authors

Mohamed S. Baloul, M.B.B.S.
Moustafa M. ElKhatib, M.B.,B.Ch.
EeeLN H. Buckarma, M.D.
Jad M. Abdelsattar, M.D.
David R. Farley, M.D.

Contributors

Fareeda H. Mukhtar, M.B.B.S.
Nicholas J. Prabhakar, B.A.
Yazan N. AlJamal, M.B.B.S.
Eduardo F. Abbott, M.D.
T.K. Pandian, M.D.
Muhammad H. Zeb, M.B.B.S.
Abhishek Chandra, B.A.
Humza Y. Saleem, M.D.
Apram Jyot, M.B.B.S.
Miguel A. Gomez Ibarra, M.D.
Monali Mohan, M.B.B.S.
Rachel Cadeliña, M.D.
Alina Seletska, C.S.A.
Vicky Yeh, Ph.D.
Raaj K. Ruparel, M.D.
Nimesh D. Naik, M.D.
Phillip G. Rowse, M.D.
Francisco Cardenas-Lara, M.D.
Courtney M. Backstrom, B.S.
Becca L. Gas
Jorge Cabrera, B.S.
Jacob R. Billings
Nicholas L. Fuqua
Nicole M. Philipps
Suzanne E. Strubel

Photography

Sam J. Allen

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Introduction

Although academic institutions have trained surgical residents using cadavers, animals, and mock oral exams for decades, the majority of clinical training has always been on human beings (real, live patients). Surgeons have long respected the sanctity of operating on another human being, said best by *Dr. Alec Walt*,

"The concept that one citizen will lay himself horizontal and permit another to plunge a knife into him, take blood, give blood, rearrange internal structures at will, determine ultimate function, indeed, sometimes life itself — that responsibility is awesome both in the true and in the currently debased meaning of the word."

Indeed, *Dr. Will Mayo* in 1923 stated,
"There is no longer the need to practice on real patients."

It is from the shoulders of these revered and humble giants as well as the innovators in aviation, computers, robotics, anesthesiology, and adult learning theorists that modern surgical educators now gravitate towards the benefits of simulation. The Mayo Clinic Multidisciplinary Simulation Center opened its doors in October of 2005 and allowed our General Surgery training program to begin formally using a simulation curriculum to teach, train, assess and remediate our surgical learners.

While we are proud of our efforts in surgical simulation, this book represents an imperfect effort to turn novice surgical trainees into insightful and competent surgeons. Our curriculum remains a work in progress and we appreciate the feedback from readers of this text on how to continue to improve and advance surgical simulation to the betterment of all trainees. This compilation records the current low fidelity, low cost, high repetition surgical simulation curriculum for our interns in 2018-2019.

Selfishly, this book was created for two reasons: 1) to offer our cookbook of simulation recipes for other educators that have asked for it, and 2) to better record what we do to allow our own simulation staff and educators better preparation to guide and improve upon the sessions we run. I thank you for your interest in our work, and we hope you find the "HOW TO" Book of Low Cost Surgical Simulation engaging, cost effective, time-saving, and beneficial to you and your program.

David Farley, M.D.

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