APPROPRIATE SURGICAL EDUCATION FOR COUNTRIES WITH LIMITED RESOURCES

Cognitive Apprenticeship
The Why, When and How of Surgical Practice

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Abstract

Appropriate surgical education for countries with limited resources
Cognitive apprenticeship: The why, when and how of surgical practice

by
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Master of Science in Experimental Surgery – Surgical Education

The role of surgical education in the prevention and management of surgical disorders continues to be an important topic of study, as in developing countries we struggle to meet the growing demands, in the absence of sufficient resources, for the provision of adequate surgical services.

People living in remote areas that are also underdeveloped and lacking modern medical facilities are at risk of significant disruption and increased morbidity and mortality.

The correction of this problem requires the identification and implementation of educational programs and curricula that provide training and experience that can be provided in communities that are located in remote locations and have limited resources.

This title, "Appropriate Surgical Training for Resource-limited Countries," reflects the need to identify, retain, and develop methods of surgical practice and education that will provide acceptable care to surgical patients living in remote communities or to resources, who do not have access to current standards of care.

The main objectives of this thesis are to share information and document educational activities that will have a significant impact on the global burden of surgical disease, as well as to promote a surgical care approach that is affordable and can be applied in different ways to obtain good results, depending on local circumstances.

"Prevention and Management of Surgical Disorders", will be the theme of this review of current surgical educational practices and management options.

The final chapter of this thesis begins with a list of questions for surgeons practicing in remote communities, with limited resources and limited access to current standards of care established in university teaching centers.

I then review the published descriptions of programs and recommendations for improving surgical services in developing countries.

The chapter concludes with a self-assessment model of surgeons who wish to provide evidence of proficiency in the provision of essential surgical services in resource-limited communities, and the rationale for continued forensic insurance coverage for their surgical services.

It also serves as a guide for the content of the training and revalidation programs required for these surgeons.

With this thesis, I verify and illustrate the importance of surgical training programs based on cognitive learning, in accordance with applied clinical surgery courses, skill-based training programs of animal testing laboratories, assessments health technologies and validation protocols advocated in this thesis.

Résumé

Formation chirurgicale appropriée pour les pays ayant des ressources limitées - Apprentissage cognitif - Le pourquoi, le quand et le comment de la pratique chirurgicale
par
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Le rôle de l'éducation chirurgicale dans la prévention et la gestion des troubles chirurgicaux continue d'être un sujet d'étude important, car dans les pays en développement nous luttons pour répondre aux demandes croissantes, en l'absence de ressources suffisantes, pour la prestation de services chirurgicaux adéquats.

Les personnes vivant dans des zones reculées qui sont également sous-développées et dépourvues d'installations médicales modernes risquent de subir des perturbations importantes et d'accroître la morbidité et la mortalité.

La correction de ce problème nécessite l'identification et la mise en œuvre de programmes éducatifs et de programmes d'études qui fournissent une formation et une expérience pouvant être dispensées dans des communautés qui sont situées dans des endroits éloignés et qui disposent de ressources limitées.

Ce titre "Formation chirurgicale appropriée pour les pays à ressources limitées" reflète la nécessité d'identifier, de retenir et de développer des méthodes de pratique et d'éducation chirurgicale qui assureront des soins acceptables aux patients chirurgicales vivant dans des communautés éloignées ou aux ressources limitées, qui n'ont pas accès aux normes de soins actuelles.

Les principaux objectifs de cette thèse sont de partager des informations et de documenter les activités éducatives qui auront un impact significatif sur le fardeau mondial de la maladie chirurgicale, ainsi que de promouvoir une approche des soins chirurgicaux, abordable et pouvant être appliquée de différentes manières pour obtenir de bons résultats, selon les circonstances locales.

"Prévention et gestion des troubles chirurgicaux", sera le thème de cette revue des pratiques éducatives chirurgicales actuelles et des options de prise en charge.

Le dernier chapitre de cette thèse commence par une liste de questions pour les chirurgiens pratiquant dans les communautés éloignées, avec des ressources limitées et un accès restreint aux normes de soins actuelles établies dans les centres d'enseignement universitaire.

Je passe ensuite en revue les descriptions publiées de programmes et de recommandations pour améliorer les services chirurgicaux dans les pays en dévelopement.

Le chapitre se termine par un modèle d'auto-évaluation des chirurgiens qui souhaitent fournir une preuve de compétence dans la prestation de services chirurgicaux essentiels dans les communautés de ressources limitées, et la justification de la poursuite de la couverture d'assurance médico-légale pour leurs services chirurgicaux.

Il sert également de guide pour le contenu des programmes de formation et de revalidation requis pour ces chirurgiens.

Avec cette thèse, je vérifie et illustre l'importance des programmes de formation chirurgicale fondés sur l'apprentissage cognitif, en accord avec les cours de chirurgie clinique appliquée, les programmes de formation basés sur les compétences des laboratoires d'expérimentation animale, les évaluations des technologies de la santé et les protocoles de validation préconisés dans cette thèse.

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Contributions to thesis

Team presentations and discussions by classmates in

- EPIB – Special topics on Prostate-Specific Antigen Based Population Screening for Prostate Cancer (Chapter 5). Joint presentations included segments by classmates, Mabel and Sahir.

The entire text of materials presented in the thesis obtained from the following team presentations was produced by me.

- EXSU 605 – Biomedical Research Innovation Stem Cell Research Projects
- EDPE 637 – Issues in Health Professions Education
- EDPH 689 – Teaching and Learning in Higher Education
- EDPH 664 – Expertise Reasoning and Problem-solving

There were no co-authors for any other parts of the thesis.

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(published separately)

Chapter 1

Cognitive Apprenticeship Surgical Education for reducing the global surgical burden

The role of surgical education in the prevention and management of surgical disorders continues to be an important subject for study, as we struggle in developing countries, to meet the growing demands, in the absence of sufficient resources, for the provision of adequate surgical services.

Persons living in remote areas which are also undeveloped and without modern medical facilities are at risk of significant disruption of their lives and increased morbidity and mortality.

Correction of this problem requires the identification and implementation of educational programs and curricula which provide training and experience which can be delivered in communities which are at remote locations and have limited resources.

The initial title of my Hypothesis was "The health status of communities and the delivery of affordable surgical services would benefit from an epidemiological and participatory educational approach to surgical education, which includes the merging of old and new theories, methods and skills of surgical education, research and practice." (Appendix I)

This title is simplified to "Appropriate surgical education for countries with limited resources", a title that reflects the need for the identification, retention and development of methods of surgical practice and education, that will ensure acceptable levels of care for surgical patients living in remote communities or communities with limited resources, who have no access to current gold standards of care.

The main objectives of this thesis are to share information and document educational activities that will have a significant impact on the global burden of surgical disease, and also to promote an approach to surgical care, which is affordable and can be applied in varying ways to achieve good outcomes, depending on local circumstances.

"Prevention and management of surgical disorders", will be the theme of this review of current surgical educational practices and the options for care.

An accurate prediction of the incidence and prevalence of surgical disorders and their complications not only determines the personnel, facilities and supplies required for appropriate services, but also guides the implementation of preventive measures which reduce demand.
Age specific rates for surgical disorders remain relatively constant.

Unpublished original research conducted in1984 for a report entitled -General Surgery workload in England and Wales in 1980 (Appendix Ia), produced age specific rates for common surgical conditions which included herniae, appendicitis, peptic ulcer, biliary calculi and benign prostatic disease.

The age specific rates for the entire fifty million population of the United Kingdom were used to calculate and predict the prevalence and burden for a variety of local communities.

Hospital mean duration of stay and bed occupancy provided comparative data which illustrate the impact of changing patterns of care. Tables 1, 2, & Formula 1 (Appendix I-Ap I)

Table 1

Table 1

GENERAL SURGERY IN ENGLAND AND WALES: 1980

Operation Rates per 100,000 Population **(OR)**, Death & Discharge Rate per 100,000 Population **(DDR)**, Mean Duration of Stay in Hospital (days) **(MDS)**, Beds per Day Occupied per 100,00 population **(BDO)**, Mortality per Million Population **(MM)**.

Population – England and Wales = **49.2 million**; Total Surgical Deaths and Discharges = **1,029,671**

Total Cases in Sample = **102,006**

	OR		**DDR**		**MDS**	**BDO**	**MM**
			All General Surgical Patients	2088.6	8	45.8	All Death = 11,792
1	Inguinal Herniae	144	Inguinal Herniae	160	6.9	2.3	
2	Other Abdominal Herniae	41	Other Abdominal Herniae	49		1.4	19.25
3	Appendicectomy	132	Appendicitis Abdo. Pain? Appendicitis	125 244	6.2 4.2	2 3	3.63
4	Operations for Peptic Ulcer	87	Peptic Ulcers Ca Stomach	73 29	12.0	2.2 1.3	80 221
5	Mastectomy	82	Ca Breast	87	13.2	3.1	247
6	Other Breast Operations	32			6.3	1.4	
7	Cholecystectomy	81	Biliary Calculi	111	11.1 13.5 ops	3.4 (2.2) 3.0.	9.6
8	Operation on Varicose Veins	72	Varicose Veins	79	8.3 4.9 ops.	1.8	2.4
9	Prostatectomy	70	Benign Prostatic Hypertrophy Ca Prostate	75 31	12.6	2.6 1.3	14.6 210
10	Cystoscopy	168	Ca Bladder	88	7.3	1.8	86.5
11	Other Urology Operations	72					
12	Ops for Superficial Lesions	69					
13	Circumcision	45	Redundant Foreskin	42	2.1 ops.	0.26	
14	Operations for Skin Lesions	34	Ca Skin	27	5.8	0.8	16.5
15	Amputations	31	Peripheral Ischaemia	71		4.7	
16	Arterial Operations	28					
17	All Operations on Rectum Excision of Rectum	30 15	Ca Rectum	36		2.2	126.5
18	Operations on Colon	26	Ca Colon Diverticulosis	41 32	23 ops.	2.3 1.2	209.5 26.4
19	Haemorrhoidectomy	28	Haemorrhoids	43	5.8	0.7	0.12
20	Other Operations on Anus	58				0.9	
21	Orchidopexy	28	Undescended Testes	27	3.5 ops	0.27	
22	Operation on Testes	23					
23	Operation for Hydroceles	13	Hydroceles	15	4.6	0.2	
24	Operation for Wounds	26					
25	Toenail Operations	21			2.6	0.15	
26	Incision – Drainage	12	Abscesses	30	8.6	0.8	

Table 2

AGE DISTRIBUTION (%)
General Surgery in England and Wales – 1980
(Total Population = 49.2 million)

Age Range	Population (%)	Herniae (%)	Appendicitis (%)	Peptic Ulcers (%)	Gall Stones (%)	Benign Prostatic Hypertrophy (%)
0 – 4	6	10	1	-	-	-
5 – 14	16	5	31	-	-	-
15 – 44	40	17	54	25	29	-
45 – 64	20	35	9	34	38	25
65 – 74	12	19	3	20	21	44
75+	6	14	2	21	12	30
Discharge Rate/100,000		**209**	**125**	**73**	**111**	**75**

Formula 1

Local Predicted Rate per 100,000 Population
=

$$\sum_{\text{(of all age groups)}} \text{FOR EACH AGE GROUP}\ \Big[\text{(Proportion of National Population)} / \text{(Proportion of local population)} \star \text{(Proportion of Patients with Disease)} \star \text{(National Frequency of Disease)}\Big] / 100{,}000$$

The WHO reported for 2010, an estimated Global burden of 321.5 million inpatient surgical procedures or 4664 per 100,000 population. 15.8 million of these were in North America where 63.4 million, 4 times the estimated number, were performed, whereas, in Sub-Saharan Africa, of the estimated needed 21.9 million procedures, only 4.3 million, or 20%, were performed.

This disparity illustrates the situation throughout the world. 12 of the 22 regions of the world performing less than their estimated minimum need and the total unmet need estimated at 143.1 million operations, or 45% throughout the world. (1,2,3)

These statistics demand the attention of surgical educators, who must first understand the underlying intellectual, cognitive and procedural processes utilized by surgeons.

Strategies include, firstly, the development of, and training in methods of surgical education that boost the cognitive and creative skills of surgical trainees, so that they can with confidence, safely perform life saving procedures.

Secondly, the teaching of medical and surgical sciences in school curricula, has the potential to enhance the prevention of health disorders and also absorb some of the time required, for surgical trainees to reach expert status.

There is no reason why every Secondary School 5th Form graduate should not acquire Basic Life Saving certification before leaving school and the tasks performed in laboratories for sixth form science subjects, clearly indicate that the basic surgical skills of history taking, clinical examination, intravenous cannulation, catheterizations, incision, dissection and suturing, are not beyond the grasp of sixth form students.

It is therefore my opinion that an important factor in bringing about a significant reduction in the unmet global surgical burden, is the introduction of some aspects of surgical education into the curricular of schools and colleges.

Most of us remember with fondness the time spent as children with our parents, older siblings, relatives and friends, being shown how to do things, being helped, until the skills being taught, were mastered. Skills nurtured by practice under supervision, until we were declared competent to do them on our own. Apprenticeship, in its truest form.

But surgical practice, especially in countries with limited resources, require additional elements of knowing and perceiving, not just the physical features and nature of the subject at hand, but how they change, and what makes them change. Skills which utilize the mental processes of perception, memory, judgement and reasoning, usually without emotional or volitional processes. A pedagogical approach defined as Cognitive Apprenticeship Education.

With this Thesis, I propose to confirm that the theories of Collins and Kapur, (4) which describe the features of Cognitive Apprenticeship Education, have proven this approach to be the best, if not the only pedagogic approach to education, that has the potential of improving and maintaining the provision of essential surgical services to communities which are remote or have limited resources.

I am guided by forty years of practice as a general surgeon in small communities in the Caribbean, combined with periods of intensive exposure and practice at educational institutions in the United Kingdom, with numerous opportunities for learning from, and teaching colleagues with this approach.

The intensive 2 years of undergraduate immersion in the basic sciences of anatomy, biochemistry and physiology was further enhanced by 6 months of repetitive work, preparing cadaver pro-sections for anatomy students, and again by the post-mortem examinations and morbidity and mortality conferences during clinical clerkships.

In Chapter 2, I present the subject of curriculum development for surgical training, including templates for the cognitive frame work of the teaching sessions, prepared to guide the students who are expected to complete their training at a distance, without regular or close contact with teachers.

Throughout the cognitive apprenticeship format of medical and surgical training, the apprenticeship model of being helped to perform tasks, gives way to independent practice which builds the professional competence for trainees to successfully attempt procedures without supervision.

An illustration of this model is presented in Chapter 7, which describes the procedures for teaching and performing the life saving procedure of autologous transfusion of haemo-thorax blood, to patients who would otherwise die, in the absence of blood transfusion services.

In recognition of the importance of practice as a key part of the cognitive apprenticeship model of education, and the need for Competency Based Medical Education and Certification, I discuss in Chapter 8, a research project, which seeks to validate an affordable and ethically acceptable approach to the provision of animal laboratory facilities, for the teaching of life saving surgical skills, which are rarely required, but are critical to the survival of surgical patients in remote areas. Procedures such as laparotomy, thoracotomy and craniotomy which can be safely taught in animal facilities.

Chapter 9 discusses the role of digital technology in the performance and teaching of surgical procedures.

“The essential principle of adult education is recognition that the average adult is self-motivated and seeks to fulfill their own full human potential. There is no need to control, direct, coerce or manipulate the adult to learn. Their education is not by indoctrination, but by the internalizing of concepts and the achievement of their full potential. These are features well illustrated in all the stages of medical education.”(5)

This was the statement made at the end of my original paper, “Adult learning principles in the education of medical undergraduates and post graduate students” , written and published in the 1999 Bulletin 147, of The Barbados Association of Medical Practitioners.(Appendix VII)

Many of the issues presented in this Thesis reflect the views expressed in that paper, which I attach as Appendix VII of this Thesis.

This concludes the introductory chapter of my Thesis, which proposes that the Cognitive Apprenticeship pedagogic model of Surgical Education, is the approach most likely to reduce the unmet surgical needs and burdens of communities which are remote and have limited resources.

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4 Allan Collins and Manu Kapur. The Cambridge Handbook of the Learning Sciences Ed RK Sawyer Chapter 6 p 109 – 127 Cambridge Books Online http://eboks.cambridge.org/

5 Lewis L Adult learning principles in the education of medical undergraduates and post graduate students" Bulletin 147/1999, of The Barbados Association of Medical Practitioners. (Appendix VII)

Chapter 2

Surgical Education – Curriculum Development EXSU 690

This aspect of surgical education defines what is appropriate and is illustrated by the following pilot course in Applied Clinical surgery, which is the principal research output of this MSc program, which I intend to implement and evaluate when resources are available.

Applied Clinical Surgery - Curriculum
Applied Clinical Surgery

A cognitive apprenticeship surgical training program with a focus on preparation of trainees for surgical services in remote or resource limited communities.

This course is one day a week, 16 week course for Medical undergraduates, Surgical House officers and residents, Surgical nurse practitioners, Registered medical practitioners, and undergraduate or postgraduate students associated with the research, development and delivery of surgical services.

It is designed to be a module based, spiral curriculum, based on the provision of appropriate learning experiences, that are appropriate for a distance education program.

What 'philosophy' undergirds this curriculum?

"Cognitive apprenticeship" emphasizes generalizing knowledge. Instruction, tasks and problems are chosen to illustrate the power of certain techniques, to give students practice in applying these methods in diverse settings.

Who are the anticipated learners, clients or beneficiaries of this new curriculum?

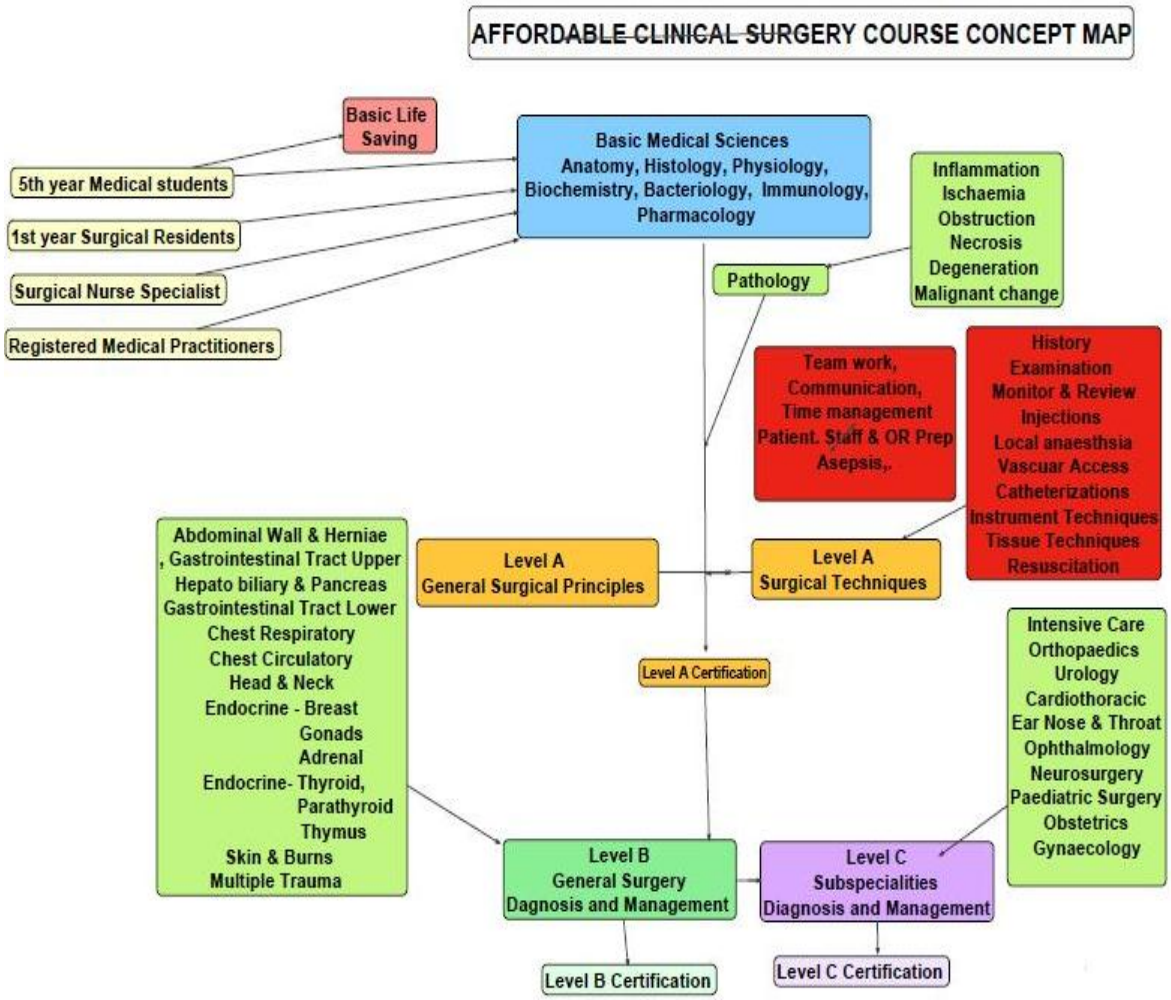
Student surgical clerkships, Surgical interns, First year surgical residents, Specialist Nurse Practitioners, and Registered Family Practitioners who wish to provide locum cover to District Polyclinics, Emergency Departments and inpatient surgical units of local hospitals .

What specific needs will be addressed?

Participants will update their knowledge and skills of surgical practice, learn the epidemiological features and management of surgical disorders, and be introduced to surgical practice that is consistent with the highest standards, but includes exposure to affordable surgical techniques required for services in resource limited communities.

Graduates will receive a comprehensive introduction and revision of the basic surgical sciences, surgical principles, clinical and surgical techniques in Level A, learn the diagnosis and management of general surgical conditions in Level B and learn the diagnosis and management of patients requiring specialist surgical services in Level C.

What content areas will be focus of the curriculum? *Concept Map*



What content areas and activities will be the focus of the curriculum?

- To learn the Diagnosis and management of disease processes that affect each system Listed in Course Syllabus
- Establish Prior knowledge with Pretest
- Summarize Epidemiology and Prevention Review
- Classify Differential Diagnosis
- Define Clinical Features – History
- Define Clinical Features – Examination
- Explain Investigations
- Describe Management
- Describe or perform Practical
- Describe Post-operative care and Follow up
- Analyze competence MCQ Post Test

Course Syllabus

Course materials will be delivered in the following order of Levels and Subjects.

Subsections	Level A		
		2.1	Introduction to surgery
		2.1.1	Course introduction, History of Surgery
		2.1.2	Surgical Anatomy, Histology
		2.1.3	Physiology, biochemistry, immunology, microbiology and pharmacology
		2.1.4	Surgical Pathology
		2.1.5	General Principles
		2.1.6	Surgical Techniques ;- History and Examination Monitor and Review. Injections & Anaesthesia Vascular access Catheterizations Instrument techniques Tissue techniques Resuscitation General surgical conditions
	Level B	2.2.	Abdominal Wall & Hernia
		2.2.1	
		2.2.2	Gastrointestinal Tract
		2.2.3	Liver, Gall Bladder, Pancreas & Spleen
		2.2.4	Circulatory System
		2.2.5	Urogenital Systems
		2.2.6	Head and Neck
		2.2.7	Multiple trauma and Surgical intensive care
		2.2.8	Endocrine- Breast, Adrenals, Gonads, Saliva, Thyroid, Parathyroid, Thymus
		2.2.9	Skin, Burns
	Level C	2.3	Surgical subspecialties
		2.3.1	Orthopaedics
		2.3.2	Urology
		2.3.3	Cardiothoracic
		2.3.4	Ear, Nose, Throat and Eyes
		2.3.5	Neurosurgery
		2.3.6	Paediatric Surgery
		2.3.7	Obstetrics & Gynaecology

LEARNING OUTCOMES

Students will become aware of their existing level of knowledge and skills related to the practice of surgery.

Participation in all the activities of the course will increase their factual knowledge of all subject areas listed.

Students will learn and recognize the linkages and inter-relationships of the different subject areas and related disciplines.

Students will learn indications for, and the impact of a selection of surgical interventions.

The acquisition of basic skills is an important feature of the course. This is covered in the Units of Level A, Sections 2.1.5 and 2.1.6,which must be completed for progress to Levels B and C.

Completion of Level A will indicate that students have acquired a preliminary working knowledge of anatomy, histology, physiology, biochemistry, immunology, microbiology, pharmacology and surgical pathology.

In addition they should have learned and have some experience in the surgical skills of history taking, physical examination, patient review, injections, vascular access, catheterizations, use of local anaesthesia, basic instrument and tissue techniques for incision, excision and suturing, and resuscitation.

Level C graduates of the course should have a working knowledge of the causes, presentation and management of surgical disorders and understand the indications and applications for their new knowledge and skills.

Different outcomes are expected for fully registered medical practitioners and surgical trainees, whose prior training and experiences, should enable them to demonstrate analytic and creative approaches in the completion of their modular assignments and assessments.

What teaching method(s) and/or learning activities are planned?

Unit Plan	Instructional Strategy
Level A: Sections 2 2.1.1 to 2.1.6	Formal transfer of information
• Lecture presentations	
• Video presentations	
• Classroom seminars	Group discussions, jig saw readings, mini-lectures, in-class activities, learning cells, think-share pairs, match games, quiz, peer critique, self-assessment
• Out-of-class activities	Readings, prepare summaries, plan classroom activities
• Assessment MCQ for each week's module	
Levels B and C: Sections 2.2 – 2.3	
1. Introduction: Overview of subject	Lecture presentation
2. Pre-test MCQ	
3. The subject	Reading list, out of class assignment
a. Epidemiology review	Classroom seminars
b. Differential diagnosis	Mini-lecture, Video Presentations, in-class activities
4. Clinical applications	
• History, physical examination	Classroom seminars, outpatient clinic sessions
• Investigations, management	Ward round sessions, simulations sessions
• Practical procedures sessions	Operating theatre sessions and simulation
5. Summary of unit activities	Classroom seminars, assessment module return

Which strategies for giving feedback on learning and/or for assessing learner performance will be used?

Table 3 Unit Assessment Rubric Levels B & C

GRADE:
Excellent A 80+ Good B 60+ Pass C 50+ Poor/ Fail 50 - Repeat Course 30-

Evaluation activities
- Pretest,
- MCQ
- Association Test
- Procedures Perform/Describe Report
- MCQ

Table 4 Total Course Assessment Rubric

Course Evaluation:
1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

- I learned a great deal from this course ____
- The instructors were excellent ____
- Explanations were clear and understandable ____
- Students were encouraged to actively participate ____
- There was good feedback and guidance with out of class assignments ____
- The general climate for the course was good for learning ____
- The course respected diverse ways of learning - ____
- The evaluation methods used were fair and appropriate ____
- The topics stimulated interest and attention ____

What resources do you anticipate requiring for the development and delivery?

- An existing University Department of Surgery, or a Department of Continuing Medical Education at General Hospitals with facilities for General and Emergency Surgical Services, participating patients and staff.
- Assignment of responsibilities for Training and Research to an appropriately qualified member of staff, who would serve as coordinator of the course and session Instructor, assisted by an administrative assistant and a technical assistant.
- Additional session instructors will require honoraria..
- Budget of the Hospital and supporting services for the provision of General and Emergency Services.
- Surgical Services, where out of class activities can take place.
- Seminar Classroom for 10 students with access to facilities for distance education, and clinical activity simulations and out of class clinical activities.

What will be your main strategy in evaluating the program's effectiveness?

- A pilot project consisting of 2 days of the course will be conducted and evaluated by a review of assessment performances of the trainees.

- This evaluation will guide modifications of the substantive course, prior to its implementation.

- Subsequent evaluation will be done in the same way, and an objective measure of output after 1 year, provided by the number of graduates of the program, and total number of Continuing Medical Education Credits awarded to participants who complete the full course or sections of the course.

What is the "So –What" of this new curriculum or program.

- This course is designed to support a training program for Surgical House Officers, who on successful completion of the course, will be recognized with an allocation of CME credits which contribute to their requirements for renewal of license to practice, and qualify for promotion to Senior House Officer posts within the department of surgery.

- Access to the program for other medical and nursing practitioners, is expected to improve the level of performance in their professional areas, and provide a reservoir of appropriately trained professionals, capable of providing surgical support services, at times of natural disaster and mass casualty events.

Certificate of Completion
This document certifies that ***Lowell Lewis***
has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue **3 July, 2016**

Chapter 3

Draft Submission for Research Ethics Board Approval and sample courses – EXSU 690

Subject: Applied Clinical Surgery Course - Cognitive Apprenticeship Surgical Training for resource limited countries

Background

Developing countries and communities with limited resources, are becoming subject to the high cost of medical supplies and new technologies, as a result of the dominance of standards of care taught at universities, and expected by post graduate licensing institutions.

These factors which are mainly external, justify a need for change. A change to accessible distance Continuing Medical Education programs, that include both old and new methods of surgical practice, that produce equivalent, but affordable outcomes.

Research is required to provide evidence for policy makers, and agencies engaged in disaster management and search and rescue training programs, to consider adoption of affordable approaches to surgical education, consistent with the desire for improved diagnostic and therapeutic services at district clinics and the offices of private sector medical practitioners.

This course seeks to promote the retention, adjustment, discovery and validation of alternative affordable methods of practice and the creation of a pool of medical practitioners, who are able to provide effective support to surgical services, in situations of limited resources and at times of natural disasters.

Hypothesis

The acquisition of surgical skills and evaluation performance by surgical trainees is improved by out of class preliminary Cognitive exercises which are completed prior to formal teaching and assessment activities.

Summary of research plan

Participants will be given Unit Module Assignments and a research group, given an additional Preparation Manual with cognitive exercises, prior to the activities of the second day.

Evaluation and assessment of the Pilot Project will be derived from a review of the course assessment performances of participants and their personal evaluation of the course.

The Board is asked to approve a 2 Day Pilot Project that delivers the Sections on Basic Surgical skills, Trauma Surgery and Surgical Intensive Care services.

Supporting documents for this proposal include:- Course Outline, Consent Form , Cognitive framework of out of class exercise, Supporting Letter from Supervisor.

Cognitive Frame work for Applied Clinical Surgery Course Notes 1a

Learn Remember Understand Apply Create

Cognitive Apprenticeship

Cognition = Knowledge and understanding
Thoughts cause behavior - Not things. People, situations or events
We Think and learn, Not just Listen and Do
All thoughts subject to change regardless of situations
Studies show behavior therapy much quicker than psychoanalysis etc

Features of Cognitive Apprenticeship

Highly instructive
Dependent on homework assignments (independent)
Defined end points
Learn how to think differently and act on learning
Develop rational self counseling skills
Collaborative effort between teacher and student.

Learn how to **remain calm** when confronted with challenges /Undesirable situations (Getting upset is another problem to solve) Unlearn unwanted reactions
Use intelligence, knowledge, energy and resources to resolve problems (Must know you have)

The Socratic method - Understand from questions.. Focus on goal
Teach = How to do and why. Not just what to do. Nurture Cognition - a Professional not a Slave
Teach = Think with, not just talk with or down to.
Rational Thinking = based on fact.

Wrong facts lead to wrong actions. New facts require new actions
e.g. Observation charts and laboratory results

Home work essential
Repeat +++ = Practice promotes “Learning and Expertise” Ref **(nacbt.org)**

Clinical Framework - Key activities and factors

Patient Assessment and Diagnosis identifies Indicated Surgery

Situation awareness, Decision planning, Leadership, Communication, Team work

Preop and peri-operative Planning and Preparation

Patient Condition					
Preparation					
Transportation					
Procedure Name					
Position					
Supporting systems					
Critical Tasks	1				
	2				
	3				
Avoidable errors	1				
	2				
	3				
Post op care Critical tasks	1				
	2				
	3				
Potential Complications	1				
	2				
	3				
Follow up Critical tasks	1				
	2				
Outcome rating (Audit)	1	2	3	4	5
	Excellent	Good	Satisfactory	Poor	Disastrous

Applied Clinical Surgery Course. Trauma Surgery

General Principles, Basic Surgical Skills and Management of Surgical Intensive Care Patients.

This 2 day pilot project is an excerpt from a course in Applied Clinical Surgery(2)
.
The content of the course will be consistent with the highest standards expected, but special attention will be given to the inclusion of affordable surgical techniques, required for the provision of essential surgical services in resource limited countries and remote communities

The sessions chosen for this course are:-

Day 1 Module 4 Level A Sections 1.3 General Principles and 1.6 Basic Surgical Skills
Appendix IIIc WHO GIEESC Basic Surgical Skills Tool Kit

Day 2 Module 10, Level B Section 2.7 Multiple Trauma and Surgical Intensive Care.

The 2 days of the course are separated by a one week period, to facilitate the out of class activity, feedback and assessment activities which are key elements of the course.

Participants will be given Unit Module Assignments and a research group, given an additional Preparation Manual with cognitive exercises, prior to the activities of the second day.

Evaluation and assessment of the Pilot Project will be derived from a review of the course assessment performances of participants and their personal evaluation of the course.

Day 1

Module 4 Level A Sections 1.5 General Principles 1.6 Basic Surgical Skills

Pre course Module Appendix IIIc WHO GIEESC Basic Surgical Skills Tool Kit

8.00	Registration and Pretest Registration Form Assessment Activity 1 Pretest MCQ 10 minutes	
8.15	General Principles of Surgical Practice	Seminar Discussion
9.00	Basic Surgical Skills History, Physical Examination, Case documentation Monitor and Review, Asepsis	Class room activities
11.30	Assessment Activity 2 Cognitive Test	
12.00	Lunch	
13.00	Surgical Procedures	Table Stations 30 mins each

1. Incision, excision, Suturing and Knot tying
   Instruments:- Knife, Forceps, Scissors, Ring Handles
   Ratchets, Needles, Sutures, Staples, Drains
2. ascular access
3. Catheterizations - Nasogastric, urethral, rectal
4. Injections
5. Local Anaesthesia - Intra dermal, subcutaneous, intramuscular, thigh, buttock, shoulder, abdomen
6. Regional, Epidural, Spinal

15.00	Assessment Activity 3	
15.30	ACLS Resuscitation and intubation	
17.30	Assessment Activity 4 Post Test MCQ	30 mins
18.00	Adjournment	

Day 2

Module 10 Level B Section 2.7 Multiple Trauma and Surgical Intensive Care.

8.00	Return of Out of Class Preparation Modules	
8.30	Assessment Activity 1 Pretest MCQ	
9.00	Epidemiology Review	Class room Seminar
	Differential Diagnoses Investigations and Trauma Score	Mini- Lecture Pairs exercise
10.00	CLINICAL APPLICATIONS History Physical examination Management Simulation	Pairs stations
11.30	Assessment Activity 2 Cognitive Test	
12.00	Lunch	
13.00	Practical Procedures	Table stations 30 mins each

1. Ambulance Transportation and reception at Emergency Department
2. Chest Injuries
3. Trauma laparotomy
4. Head and Spinal Injuries
5. Orthopaedic injuries
6. Surgical Intensive Care

16.00	Assessment Activity 3 Practical Procedures	
16.30	Assessment Activity 4 Post test MCQ Assessment 30 mins	Classroom
19.00	End of course dinner and certification.	Restaurant

ASSESSMENT PLAN

Assessment Activity 1 Pretest MCQ 10

True or False questions x 10

1.
2.
3.
4.

Assessment Activity 2 Cognitive Test 20

Match the following features X 10

1 A
2 B
3 C
4 D
5 E
6 F
7 G
8 H
9 I
10 J

Assessment Activity 3

Practical Procedures

1 Describe or Perform Practical or Oral Exam 20

2 Report on Description or Performance 20

Assessment Activity 4

Post test MCQ 30

Which of the following statements are true? x30

ANSWER SHEET
For all correct statements, put a mark in the 0 below the letters

Activity 1	Maximum mark
A B C D	
0 0 0 0 x10	10

Activity 2 Place matching letter next to appropriate number
1 ___ 2____3 ____4____5____6____7____8____9____10___ 20

Activity 3

Mark given by examiner	a b c d e	
1 Describe or perform	0 0 0 0 0	
2 Report	0 0 0 0 0	
Final Grade	0 0 0 0 0	40

Activity 4
MCQ For all correct statements, Put a mark in the 0 below the letters

1 a b c d	x 30	30

Assessment Rubric

GRADE Activity	Excellent A 80+	Good B 60+	Acceptabl C Pass 50+	Poor D Fail 50 -	Repeat Course 30-	Total Mark 100
1. Pretest	10	8+	5+	4-	3-	10
2 Cogn test	18+	15+	10+	9-	6-	20
3						
Procedures	**35+**	30+	20+	18-	12-	40
Perform	**18+**	15+	10+	9-	6-	20
Report	**18+**	15+	10+	9-	6-	20
Details below*						
4. Post MCQ	25+	20+	15+	14-	10-	30

Activity 3 Task *					
Describe or Perform	Accurate, presentation or completion of task, with expected outcomes, and demonstration of all factors to ensure success.	Good presentation, or completion of task with demonstration of critical factors for success	Satisfactory presentation or completion of task	Incomplete presentation or performance of the task with missing critical steps of the procedure	Incorrect procedures and un-satisfactory presentation or performance of task
Report	Clear and correct summary of indications, critical steps taken & results.	Good summary of critical steps taken and results achieved or expected	Acceptable summary of critical steps taken and outcome of task	Incomplete summary of performance, but mentions critical steps for task.	Little effort, Poor compre-hension. Inaccurate, Unsafe Unacceptable

Applied Clinical Surgery Course

General Principles, Basic Surgical Skills and Management of Pediatric Surgical Conditions

This 2 day pilot project is an excerpt from a course in Applied Clinical Surgery(2)
.
The content of the course will be consistent with the highest standards expected, but special attention will be given to the inclusion of affordable surgical techniques, required for the provision of essential surgical services in resource limited countries and remote communities

The sessions chosen for this course are:-

Day 1 Module 4 Level A Sections 1.5 General Principles and 1.6 Basic Surgical Skills

Day 2 Module 10, Level C Section 3.6 Paediatric Surgical Conditions

The 2 days of the course are separated by a one week period, to facilitate the out of class activity, feedback and assessment activities which are key elements of the course.

Participants will be given Unit Module Assignments and a research group, given an additional Preparation Manual with cognitive exercises, prior to the activities of the second day.

Evaluation and assessment of the Pilot Project will be derived from a review of the course assessment performances of participants and their personal evaluation of the course.

Day 1

Module 4 Level A Sections 1.5 General Principles 1.6 Basic Surgical Skills
Pre course Module Appendix IIIc WHO GIEESC Basic Surgical Skills Tool Kit

8.00 Registration and Pretest Registration Form
Assessment Activity 1 Pretest MCQ 10 minutes

8.15 General Principles of Surgical Practice Seminar Discussion

9.00 Basic Surgical Skills Class room activities
History,
Physical Examination, Case documentation
Monitor and Review,
Asepsis

11.30 Assessment Activity 2 Cognitive Test

12.00 Lunch

13.00 Surgical Procedures Table Stations 30 mins each

1. Incision, excision, Suturing and Knot tying
   Instruments:- Knife, Forceps, Scissors, Ring Handles
   Ratchets, Needles, Sutures, Staples, Drains
2. Vascular access
3. Catheterizations - Nasogastric, urethral, rectal
4. Injections and Local Anaesthesia
   Intra dermal, Subcutaneous, Intramuscular, Thigh, Buttock, Shoulder,
   Abdomen, Regional, Epidural, Spinal

15.00 Assessment Activity 3

15.30 ACLS Resuscitation and intubation

17.30 Assessment Activity 4 Post Test MCQ 30 mins

18.00 Adjournment

Day 2

Module 10 Level C Section 3.6 Pediatric Surgical Conditions

8.00	Return of Out of Class Preparation Modules	
8.30	Pretest MCQ	
9.00	Epidemiology Review Differential Diagnoses Investigations	Class room Seminar Mini- Lecture
10.00	CLINICAL APPLICATIONS History Physical examination Management Simulations Assessment Activity 2 Cognitive Test	Pairs stations
12.00	Lunch	
13.00	Practical Procedures 1. Ambulance Transportation and reception at Emergency Department 2. Pediatric Triage, Vascular access and Resuscitation 3. Gastrointestinal and abdominal surgical conditions 4. Head and Spinal Injuries 5. Orthopaedic injuries 6. Pediatric Surgical Intensive Care Assessment Activity 3 30 mins	Table stations 30 mins each
16.30	Assessment Activity 4 Post test MCQ 30 mins	Classroom
19.00	End of course dinner and certification.	Restaurant

Assessment Plan, Answer Sheet and Rubric as on Page 20.

Illustration of implementation of the Applied Clinical Surgery Courses

Title: **SEARCH AND RESCUE AND CLINICAL SKILLS TRAINING COURSE**

A 2-day weekend course. Place: Montserrat, West Indies

Objectives

To improve the emergency response medical skills of staff of the health department, emergency services and members of the general public I order to prevent injuries and the complications of minor illnesses that arise from delayed interventions.

To enable certification of participants with recognized Basic Life Saving (BLS), Clinical Skills and Search and Rescue Certificates.

To develop and incorporate in training programs, outdoor practical exercises for search and rescue and Basic Clinical Skills.

To provide each certified participant with Continuing Education Credits and a personal take away Basic Life Saving Kit.

To identify persons capable of being competent trainers for future courses.

Start Date: 5/2017 End Date 7/2017

Proposed date for Courses

Course 1 May 26 to 28 BLS, CS and S&R Training Certificate

Course 2 June 2 to 4 BLS, CS and S&R Training Certificate

Counterpart Name: Permanent Secretary, Ag

Counterpart's responsible contact: Chief Medical Officer

Collaborating officials

Director Disaster Management Agency

Nursing Tutor, Health Promotion Officer, Manager Emergency Department Glendon Hospital.

Phone Number: Cell Phone Number: Email

Expected number of participants (Attach List):20 10 in each course

1. **REQUIRED DOCUMENTATION (To be completed by Technical Department or PAHO/WHO Country Office/Center, see CO Operations Manual for guidelines)**

Prior to the Activity	Budget 12,500	☒	Agenda	☒	Attendees/Registered Nurses Police Officers, Firemen and First aid workers	☒	Request Letter from Institution	☒
After the Activity	Technical Report (if required)	☐	Financial Report (See Below)	☐	Other	☐		☐

3. ACTIVITY REQUIREMENTS: (Attach Terms of Reference)		**3.1 PROJECTED BUDGET & EXPENDITURES** Please attach additional documentation as may be necessary		**3.2 ACTUAL EXPENDITURES**
		Local Currency Amount	**US$ Amount**	
Per Diem Local Trainers	☐	1600.00		
Transportation :	☐	500.00		
Venue / Facility Rental	☐			
Breakfast	☐			
Lunch	☒	**2000.00**		
Class room Sessions	☐			
Field Exercises	☐	**2000.00**		
Office Supplies (Add a List)	☒	**500.00**		
Honoraria for local Trainers	☐	**2000**		
Fees , travel and accommodation costs for certified instructors	☐	**4000**		
Registration (Third party registration fees only)	☐			
Translation Services	☐			
Service Contract (please specify)	☐			
Other Expenses (Please Specify):	☐			
TOTAL		**12,600**		

_____ Date: ___/___/____

Applied Clinical Surgery Course - Pilot
Basic Surgical Skills and Management of Trauma and Surgical Intensive Care Patients.

This 2 day pilot project is an excerpt from a course in Applied Clinical Surgery(1).
The content of the course will be consistent with the highest standards expected, but special attention will be given to the inclusion of affordable surgical techniques, required for the provision of essential surgical services in resource limited countries and remote communities

The sessions chosen for the pilot course are:-
Day 1 Module 4, Level A Section 1.5, 1.6 Principles of Surgery and Basic Surgical Skills
Day 2 Module 10, Level B Section 2.7 Multiple Trauma and Surgical Intensive Care.

The 2 days of the course are separated by a one week period, to facilitate the out of class activity, and the feedback and assessment activities which are key elements of the course.

Summary of research plan.

All participants will be given Unit Module Sessions and Assignments and a research group, given an additional Preparation Manual with cognitive exercises, prior to the activities of the second day.

Evaluation and assessment of the Pilot Project will be derived from a review of the course assessment performances of participants and the participant's personal evaluation of the course.

The Board is asked to approve this 2 Day Pilot Project that delivers the Sections on Principles of surgery and Basic Surgical skills, Trauma Surgery and Surgical Intensive Care services.

Supporting documents for this proposal include:-
Pilot Course Program, Consent Form , Cognitive framework of out of class exercises,
Applied Clinical Surgery Course Outline
Supporting Letter from Supervisor.
Proposed Faculty Principal Researcher and Certified Instructors
Proposed participants: 20 Medical Practitioners. Members of Antigua Medical Association
Proposed venue: Seminar Room and Emergency Department MSJMC or
Simulation Center of American University of the Caribbean Medical School
Budget to be confirmed; estimate: US$5,000

Chapter 4

Competency Based Medical Education (CBME)

An essential strategy for the improvement of surgical services in resource limited countries.

Introduction

Competency based medical education, assessment and selection is a desirable strategy for meeting the manpower needs of the medical and surgical services. Aspiring physicians and surgeons study, serve as apprentices, and are examined by their peers and mentors, who are responsible for ensuring that their trainees proceed to independent practice, only when they have proven themselves to be worthy of such progression.

The Royal Colleges, in collaboration with the regulatory and licensing institutions such as the General Medical Councils of the United Kingdom and Canada, the Medical Boards of The United States of America and the Government Ministries and Departments of Health, rely on CBME to fulfil their mandate to ensure the delivery of safe, reliable and affordable health care to their communities.

CBME Charter

Carraccio C et al., (1) in their paper on Advancing Competency Based Medical Education present a Charter for Clinician-Educators, which states: –

> Competency-based education (CBE) is an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It de-emphasizes time-based training and promises greater accountability, flexibility, and learner-centeredness."

They then discuss the fundamental principles in which they state that – "Education must be based on the health needs of the populations served." (1)

This is relevant in relation to the concern that there is a growing proportion of unmet surgical needs worldwide, as a result of the inadequate numbers of skilled professionals being trained, and a perceived fall in the productivity of surgeons.

The introduction of new technologies, more rigid and expensive systems of certification and revalidation, and the restriction of hours per week at work for trainees has created manpower crisis situations.

These measures have all been justified in the interest of patient safety, but unless new methods of training are introduced to either, increase the number of graduates, or reduce the time required to achieve competence, the burden of surgical disorders will continue to rise.

Evidence of need

Recent studies on graduates from residency programs in the USA indicate that 40% lack confidence in their surgical skills, that over 80% require or seek a further 1 or 2 years of subspecialty fellowship training and that there is an increasing rate of failure in the oral examinations. (2)

Bacchus Barua and his team at the Fraser Institute, in 2014, reported that over a 16 year period , increases in wait times in Canada for medically necessary elective treatment may have been associated with 2.5 % (44,273) of total female deaths and 1.2% of total mortality (male and female). (3)

Training programs for residents should prepare them being able to make reliable diagnoses and therapeutic interventions without sophisticated imaging studies. They must be able to manage patients by proven traditional methods, when modern facilities and supplies such as endoscopic and laparoscopic equipment are not available.

Most papers and discussions on competence based medical education, devote significant attention to the process of Entrustment, recognised as a fundamental feature of the Health Professions. Patients trust their care provider, the consultants trust his trainees, to whom they delegate duties, and the trainees trust their supervisors, not to permit them to harm patients. (4)

Progressive autonomy through close supervision leading to professional activity without supervision, is the goal of every trainee and the objective of all competency-based training programs for services, in what is recognised as a high stakes environment.

Despite these efforts, complication and mortality rates and the medico-legal costs of professional blunders remain significant, indicating that the existing system of competency based training, requires review and further improvement.

Possible solutions

A possible solution to this dilemma is the exposure to the scientific basis and use of medical and surgical skills at an earlier stage in the life of aspiring surgeons, and a focus on the cognitive aspects of clinical practice, at an earlier stage of general education.

This is pre-requisite for the acquisition of relevant knowledge and understanding of the basic sciences, which are critical for the development of competence.

This concept has been incorporated in the design of my pilot research project, which seeks to demonstrate that the cognitive apprenticeship models of surgical training which took place in the past, when combined with modern technology, can in fact enhance the impact of competence based medical education.

Allan Collins and Manu Kapur, in Chapter 6 of The Cambridge Handbook of the Learning Sciences Edited by R Keith Sawyer(3), illustrate how their framework of Cognitive Apprenticeship Training, extends practice to diverse settings and articulates common principles, so that students learn how to apply their skills in varied contexts.(5)

Their methods of achieving competence are listed as Modeling, Coaching, Scaffolding, Articulation, Reflection and Exploration. They illustrate how the sequencing of the programs are guided by the principles of - Increasing complexity, Increasing diversity and the mastery of global before local skills.

The authors illustrate the value of situated learning, in which the students are educated in the environment which they are expected to work, and the enhancement of this approach by video and computer technology, in the creation of simulated environments for learning skills in context.

In Surgical training, certification is very dependent on the scaffolding concept discussed in this paper, which includes the practice of providing students with an overall structure of a complex task, so that they are guided to individual components of the task at the appropriate moment. Learners are expected to subsequently accomplish the tasks on their own.

The paper also discusses the role of Articulation and Reflection in the training and learning process, the practice of students learning to compare their performance with that of others.

The paper concludes that extensive research over the past 25 years, has led to the incorporation of the principles of Cognitive Apprenticeship in the design of learning environments, and that as computer based learning environments become more pervasive, that there is likely to be continued development of new ways to embody these principles in these designs.

Evaluation of CBME courses

Carlos Gomez Gabriello and Linda Snell, in their guidelines for Competency Based Medical Education curriculum design and assessment, present a summary of principles which serve, not only as a guide for the development of such programs, but also as a template for an evaluation instrument of such courses. (6)

I have given scores to the listed items, which add up to a total of 100, and applied this Instrument to my draft 2 Day Research Pilot Cognitive Apprenticeship Surgical Training Course, that features the inclusion of surgical procedures required for surgical services in resource limited communities. This pilot course proposes to determine whether or not, out of class cognitive exercises, can significantly reduce the time for training and improve the performance of trainees.

This evaluation exercise, which is provided as an attachment of this paper, gives the course a score of 59, indicating that there is much room for improvement, which may or may not be confirmed by the results of the pilot project. (7)

There is a growing demand from not only trainees, but also members of the public, for a further reduction in the rates of complications and the time for training, by greater access to simulated operating procedures in animal laboratories.

We are at risk of a new cohort and generation of surgeons, who as a result of rapid transfer to Level 1 trauma centres, massive transfusion protocols and angiographic interventional radiologist services, witness the superior outcomes, but are deprived of opportunities for achieving competence in the traditional management of these cases.

How can a supervisor be expected to assist a trainee who encounters a problem that he himself has never faced before? Very few general surgeons have had to repair a common bile duct or hepatic artery injury that occurs during a laparoscopic cholecystectomy or control torrential bleeding from a variety of locations, such as pelvic vessels during a low anterior-resection of colorectal carcinoma, vena cava during a radical nephrectomy, or portal vein during a gastrectomy. Every trainee surgeon still needs to know how to proceed to open chest cardiac massage for a cardiac arrest during an abdominal operation, or proceed with repair of an iatrogenic ureteric injury, or hand sewn bowel anastomoses when staples are not available.

These examples of required competences are mentioned in support of recommendations for affordable systems of simulated competency based training in animal laboratories, particularly for the benefit of trainees expected to work in developing countries, where there is no access to the new technologies, and available standards of care are no longer taught at North American and European Surgical Education Units.

This is an ethical dilemma which must be overcome by resolving the moral inconsistency which exists in countries that slaughter millions of animals for food, and engage in therapeutic experimentation and trials, in the search for effective treatment of malignant diseases and degenerative diseases of brain, bones and other tissues, whilst neglecting the need for competency based surgical training.

The role of centres of excellence such as McGill Universities in advancing this approach is critical, in that such activities already take place, but in a very expensive way that is not transferable to limited resource areas.

The opportunity exists for scientific study of alternative protocols for producing conclusions that are as reliable as those from randomized control studies, whose results can be predicted by other forms of credible evidence.

Holmboe et al. confirms this with their final practice point of their paper - The role of assessment in competency –based medical education. - “New assessment tools and approaches will need to be developed for new competences such as team work, systems, and quality improvement, among others, to fully realize the promise of CBME. (8)

For example, the practice of insulin infusion induced hypoglycaemic coma for the delivery of electro convulsive therapy (ECT) to psychiatric patients in the past, a practice now rightfully abandoned and recognized to be unacceptable, may be justifiably be considered for the provision of anaesthesia in an alternative affordable humane method for simulated animal laboratory, competency based surgical training.

Conclusion

I end this paper with a quotation from Helen Chapman's paper: "Some important limitations of competency based education with respect to nurse education: an Australian perspective." (9)

She concludes that "The curriculum of nurse training programs, should ensure a balance between vocational and educational aspects, and not just be focused on outcomes and technical procedures. In so doing, competency achieved will be determined by the four patterns of nursing knowledge, the science, art, personal and moral components of their profession."

This view is supported by the views of Norman et al (10), who describe Outcome Based Education as a"sophisticated strategy for curriculum planning that offers a number of advantages. It is an intuitive approach that engages the range of stakeholders, it encourages a student centered approach and at the same time supports the trend for greater accountability and quality assurance. It highlights areas in the curriculum which may be neglected, such as ethics and attitudes."

Helen Chapman's paper also reminds us of the economic cost of professional incompetence.

How do we improve the performance of a surgeon that takes an average of 4 hours to perform a modified radical mastectomy, which makes it necessary for the patient to have an indwelling urinary catheter and be more at risk from venous thrombosis and pulmonary embolus?

How do we improve the performance of a surgeon whose average time for an inguinal hernia repair is over 2 hours, making in unlikely for the patient to be offered that procedure under local anaesthesia?

How do we ensure that a gynaecologist who cuts a ureter during a hysterectomy can complete an effective corrective repair in the absence of a general surgeon, urologist or ureteric stent?

Not with-standing the message of these questions in relation to the expectations of competency based medical educational programs, her paper rightly points out that education cannot and should not be reduced to outcome oriented technical procedures, and that medical education curricula, must continue to reflect the educational aspects of University programs.

References

1 Carraccio C et al , Advancing Competency Based Medical Education: A Charter for Clinician-Educators. Academic Medicine, Vol 91, No 5: 645-48, May 2016

2 Minter R Visiting Professor Lecture McGill University Dept Surgery May 19 2016

3 Bacchus Barua et al The effect of Wait Times on Mortality in Canada Fraser Institute Publication May 2014 Summary pg v

4 Olle ten Cate, et al Entrustment decision –making in clinical training Academic Medicine 92(2) : 191-198, 2015

5 Allan Collins, Manu Kapur, Cognitive Apprenticeship.
Ch6 The Cambridge Handbook of the Learning Sciences Edited by R Keith Sawyer.

6 Carlos Gomez Garibello Competence Based Medical Education Course Design and Assessment Guide. EDP 637 May 4 2016

7 Lewis L unpublished Cognitive Apprenticeship Surgical Training Pilot Course.

8 Holmboe E S et al The role of assessment in competency –based medical education Medical Teacher 3, 2 (8): 676-682 2010

9 Helen Chapman Nurse education Today 1999 19 129- 135 Some important limitations of competency –based education with respect to nurse education: An Australian perspective.

10 Norman G et al. Competency-Based Education: Milestones or Millstones? Journal of Graduate Medical Education, March 2014: 1-6

Chapter 5

Experimental Surgery – Health Technology Assessment

Epidemiological studies remain the basis of policies which determine the approved standards of care for surgical disorders.

Collecting information for the review of surgical practice in the United Kingdom for the period 1900 to 1980, required many hours of sitting in a library in London, at the Office of Population Census and Surveys in 1983, tediously turning though fading pages of books, now no longer available or necessary as a result of transfer to the electronic media.

Similarly, no longer do trainee surgeons spend many hours making dissected pro-sections from donor cadavers for the teaching of anatomy to MB BS students.

This was and still could be an activity that guarantees the unforgetable familiarity with human anatomy which is essential for the expert surgeon.

Experimental surgery remains a desirable discipline within surgical education and practice, which ensures that surgeons remain active in research and innovation, as they practice their trade.

For this thesis, I will illustrate the potential impact of epidemiological studies, by presentation of a proposal for "New strategies for the management of malignant diseases, in relation to the global variations in patterns of care for patients with prostatic carcinoma.

I will also illustrate the educational value of scientific experimental investigations which permit the validation and revalidation of older methods of surgical education and practice which remain indispensable for countries with limited resources.

Methods of practice no longer being used in developed countries, remain indispensable elsewhere and must therefore be subject to the same rigorous monitor and evaluation applied to new surgical technologies.

The outcomes of such an approach to health technology assessment is illustrated by the following discussions which arose following a review of personal experiences with the management in the Caribbean, of patients with a variety of malignant diseases.

The implications and recommendations may be controversial, but are options which must be considered for populations with no access to the current standards of care being established in North America and Europe.

New strategies for the identification and management of malignant disease

Lowell Lewis MSc Student Experimental Surgery McGill University

Over ninety percent of mortality from carcinoma is related to the physiology and genetics of organs of the reproductive, gastrointestinal, endocrine and haematopoietic systems.

This suggests that alternative strategies for the prevention, control, and cure of carcinoma of these tissues, are yet to be explored.

The major determinant of neoplastic disease, is the very process of life. The formation, regeneration, and survival of cells, through the replication of both predetermined and random linkages and disruptions, between protons, neutrons, atoms, molecules, elements and the environments in which they exist..

New strategies for the prediction, prevention, control and elimination of malignant disease, must therefore focus on identification and prevention of the factors that predispose to the undesirable linkages and disruptions that cause malignant disease.

The indisputable acknowledgement that removing the molecules of tobacco derived nicotine from the environment of living cells, and the successful exclusion of carcinogenic viral antigens by the production of vaccine generated antibodies, confirm a point of focus for early detection, prevention and treatment of malignant disease.

New strategies should start with the identification of persons at risk, by diagnostic tests directed at the secretions and excretions of specific organs, which contain biologic materials associated with malignant transformation.

It would be interesting to know whether age specific screening of cutaneous, urine, semen, vaginal, breast, gastrointestinal and respiratory secretions or excretions, would identify those at significant risk and therefore likely to benefit from active exclusion of carcinogenic exposures, and interval screenings to permit early diagnosis and treatment.

Immunological Eliza strip screening of organ secretions and excretions may have a significant role in such a program.

The feasibility of such an approach requires biomedical investigations and epidemiological studies to determine the presence of oncogenic precursor proteins in the glandular secretions of carcinoma patient populations.

It is already known that these appear after the invasive diagnostic techniques which disrupt the basement membrane of the duct systems of endocrine organs and may be associated with metastatic disease and reduced survival of patients.

HEALTH TECHNOLOGY ASSESSMENT

The importance of the application of Health Technology Assessment in the framing of national policies regarding appropriate surgical education and practice is illustrated by the ongoing debate, on how best to manage male patients with the most common malignant disease in countries of limited resources, **prostate cancer.**

In my experience of managing patients with prostate cancer in the Caribbean, where the principal cause of death was very rarely their prostate cancer, many men over the age of 70, after 2 doses of the expensive androgen suppressant Zoladex subcutaneous injections, readily agree that since the injections render them impotent, that they would prefer, as their compatriots did before the arrival of androgen axis suppressants, to remove the source of their testosterone, by the operation of subcapsular orchidectomy under local anaesthesia, which leaves them with a palpable mass in the scrotum, whilst achieving the same level of androgen suppression and reduced PSA levels, achieved by Zoladex.

Most also agree that if they have no access to, or cannot afford radical prostatectomy or radiotherapy, that they would accept a diagnosis based on clinical examination and a continuously rising PSA level, decline prostatic biopsy to avoid metastatic dissemination, and proceed to subcapsular orchidectomy under local anaesthesia.

Statements such as the above provide a compelling argument for the principles of Health Technology Assessment to be included in surgical education of medical practitioners in resource limited locations, who are then able to make decisions, which are contrary to the standards of care in affluent countries.

I have chosen to present in this thesis the text of a power point presentation on the subject. The power point slides are also attached as Appendix IV.

Such a Health Technology Assessment is considered supporting evidence for the opinions presented in the call for "New strategies for the detection and management of malignant disease", presented on page 36.

This is consistent with reported developments of possible non-invasive strategies to distinguish between low-high grade cancers as a way to decrease the risks associated with biopsy:

> "Illustrated by the proposals for application of CDK 4/6 Biomarkers in which attempts are being made to improve physician's understanding regarding the development of and use of prognostic biomarkers for patient selection and response to cyclin-dependent kinase (CDK)4/6 inhibitors in HR-positive breast cancer patients."

Prostate-Specific Antigen (PSA)–Based Population Screening for Prostate Cancer: OHTAC Recommendation
HTA Review and presentation McGill University Course EPIB 670 HTA June 10 2016

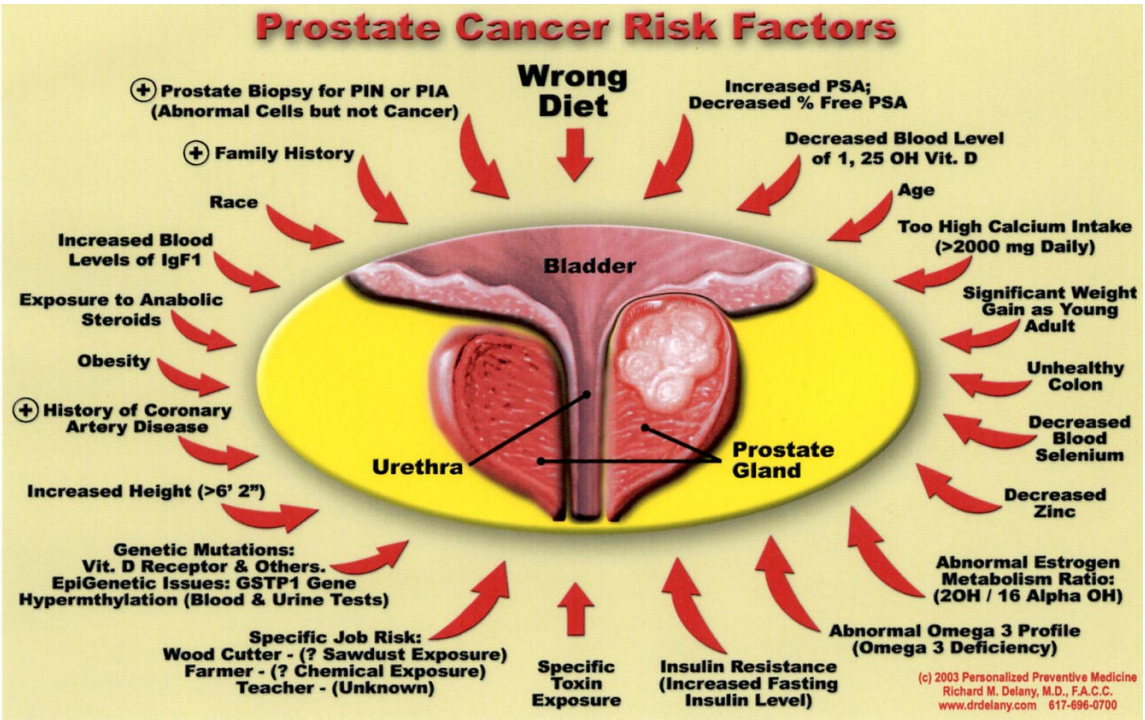
Lowell, Sahir, Mabel Slides of presentation in Appendix IV

The preparation of this presentation was guided by an expert statistician, whose profession is similar to that of a physician, in that Health Technology Assessments and statistical evaluations lead to decisions that can save lives and change budgets. As we do in medicine, very good history taking and accurate recording of information is the first step.

I begin by reminding you of what the prostate gland is. It is the gland at the bottom of the bladder, between the bladder and urethra which leads down to the penis. It is the equivalent of the uterus in the female, because it lies in a similar position and is traversed by the products and agents of reproduction .

The only difference is that, instead of the ovaries being up in the belly, they've come down into the scrotum because the testicles which is the male equivalent of the ovaries, need to be at a cooler temperature, to function properly. Figure 1 illustrates all the relevant features and and factors associated with prostate cancer.

Fig 1



The cancer in the prostate usually arises in the area where the seminal vesicles come into the urethra. The mutated abnormal malignant cells increase in numbers causing the prostate gland to grow irregularly in size.

Eventually, the cells break through the basement membrane, enter into the blood stream and lymphatics, and then move to other parts of the body such as the skeleton, liver and lungs. The detection of persons who are likely to be at risk of metastatic disease is a priority for the prevention and cure of metastatic prostate cancer disease.

Current recommendations do not include this strategy. How do we change this?
Let us look at the data:

Rates of death. There are four thousand (4000) deaths a year and twenty-four thousand (24,000) cases diagnosed in Canada in 2015.

It appears that there is a rising incidence. In 1970, 53 per 100,000; in 2007, 124 per 100,000. It could be that we observe increased diagnosis rather than increased prevalence.

The important finding is that the survival after 10 years is 95%. This indicates the intervals appropriate for repeat screening or whether further action is required for each person.

In the Caribbean now, life expectancy with good health care is about 85, and many 70 year old men expect to reach the age of 90. Interventions are therefore required to prevent deaths for prostate cancer.

There are two types of cancer of the prostate. The low-risk, with low Gleason scores, and the high-risk which is fatal, and requires early detection and treatment.

Deaths-per-thousand of Low Grade patients is much lower than the high-grade: 6 to 121.
11 years after, 8.3% of low risk patients had cancer, 9.1% in the medium risk group and 25.6% in the high risk group.

How can these patients be diagnosed in a non-invasive way?

At what age should screening start and what should be the interval between repeat screens.
Studies report increases with age, every 10 years by about 10% from the age of 50, at which 10% of men have cancer of the prostate; to age 80 at which the prevalence rate is 40%.

An interesting finding in post mortem studies, was that there was a seven per cent (7%) incidence of pre-cancerous tissue in persons ages 20 to 29. This is justification for early screening of men with a family history of prostate cancer and a policy for repeat screening of persons considered at risk.

Over diagnosis can be a problem. At present confirmation of the grade of a cancer requires prostate biopsy. Similarly, malignant breast lumps, require biopsy for diagnosis.

Putting a needle into tissue breaks the basement membrane. This action, mobilizes cells and exposes the blood and lymphatic circulations to tumour cells. White blood cells migrate to

the prostate as part of the inflammatory response to the biopsy, and migrate to other parts of the body.

We now know that metastasis is directly related to white cell transmission of the prostate cells. A major complication associated with a diagnostic procedure.

A PSA test result of four is considered the level at which further testing will be required.
If the patient has a positive rectal examination, with palpation of an abnormally enlarged or hard and deformed prostate, whether the PSA is low or not, current standard of practice is biopsy for confirmation of the diagnosis.

A follow up study of PSA screened men reported after seven years, 15% cancer in all the patients, 6%, if PSA was under 3, 26.9% if PSA between three (3) and four (4), and 60% for PSA over 4.

The aim of the screening is to reduce specific mortality, so that patients die from something else, and also, by early detection, to reduce morbidity associated with treatment.

Our review examined six databases for studies published between January 2008 and September 2013 and the included RCTs, systematic reviews, and meta-analyses.

The outcomes of interest were: prostate cancer mortality, and prostate cancer detection rates.

These were recorded on a flow chart.

Five systematic reviews and six RCTs for a total of 11 studies.
The individual trials included in those systematic review provided some information.
The rows have the five different studies and the columns are the RCTs that were included in those systematic trials.

Our teams conclusion was that further studies are required to establish more appropriate guidelines for screening of men for prostate cancer, and provide statistical evidence of the benefits and disadvantages of invasive methods of diagnosis confirmation and curative or palliative treatment.

References: See Appendix IV

Chapter 6

Validation protocols EXSU 691

A thesis on appropriate surgical education for countries with limited resources is incomplete without a discussion on the validation of alternative surgical treatments and approaches, not currently approved for use in North America, Europe or more developed countries.

I therefor present examples of alternative surgical treatments and the process required for their validation.

I have chosen items from the list of procedures currently being investigated by the Institute of Surgical Research and Education in Montserrat, West Indies, which I have established for this purpose**.**

These procedures include a number which have not been assigned official Validation Grades, but have been have performed successfully for many years by the author and colleagues.

Institute of Surgical Research and Education (InSRE)

Medical research requires a rigid framework of regulation and supervision to ensure compliance with all the legal obligations and approvals stipulated by law.

Students and staff of McGill University are required to complete the online Ethics course and receive the approval of the Review Ethics Board for research projects.

To ensure compliance with the local laws of Montserrat, where most of my research projects will be conducted, the Institute of Surgical Research and Education (InSRE) is registered a Limited Liability Company, through which all local permits, licenses and funding will be sought, processed and administered.

The company, "Institute of Surgical Research and Education (InSRE) will serve as the legal umbrella for all research and development activities in Montserrat and the Caribbean.

Institute of Surgical Research and Education
Brades Montserrat
P.O. Box 410 1 664 491 3685

Research Projects ongoing

1. Applied Clinical Surgery Course EXSU 690
   Design, evaluate, and implement a Distance Education Course in Applied Clinical Surgery.
   General Principles and Basic Surgical Skills
   Trauma and Surgical Intensive Care
   Pediatric Surgical Conditions
   Colorectal Surgery
   Breast Surgery
   Urology
   Gastro Intestinal surgery
2. Establish and evaluate a protocol for investigating the role of digital technology in surgical research, education and services. EXSU 692

3. New strategies for the identification and management of malignant disease.

4. Establish protocols for simulation, validation and teaching of alternative affordable surgical techniques. Validation of protocols for :-

   Emergency autologous blood transfusion by direct infusion through standard blood administration sets EXSU 691a Chapter 7

   Emergency peritoneal dialysis,

   Enteral and parenteral nutritional support for prolonged intestinal failure
   .
   Hand sewn bowel anastomosis.

   Supra pubic cystostomy under local anaesthesia..

   Sub-capsular orchidectomy under local anaesthesia,

   Percutaneous stenting of iatrogenic ureteral injury repairs.

   Wide local excision of breast lump and axillary node biopsy under local anaesthesia,

   Insulin induced Hypoglyaemia sedation of animals for surgical research and simulated training. EXSU 691b Chapter 8

   Brachio-Basilic Transposition Fistula. An alternative to Brachio axillary PTFE graft fistulae.

Wolf graft repairs under local anaesthesia for injuries of head and limb injuries.

Gastrostomy under local anaesthesia,

Gastro- enterostomy under local anaesthesia.

Sigmoid colectomy under local anaesthesia.

Chapter 7

Autologous Blood Transfusion EXSU 691a

Validation of protocols for emergency autologous blood transfusion by direct infusion through standard blood transfusion sets.

A pilot project for the development of protocols for simulation, validation and teaching of alternative affordable surgical procedures required for services in remote or austere communities.

Hypothesis

Emergency Autologous Blood Transfusion by direct infusion through standard blood administration sets is a safe and effective procedure worthy of approval:-

Level 3 and Validation Grade 1B
Strong recommendation : Benefits clearly outweigh the risks and burdens
Moderate-quality evidence: Very strong evidence of some form.

Current Grade 3D: Benefit unknown No evidence of benefit available

Objective of this research project is to provide evidence to support a recommendation for all hospital emergency departments and district clinic facilities required to resuscitate critically injured trauma patients, to include on the list of essential items, the equipment and supplies required of the performance of emergency autologous blood transfusions.

Background

Twenty five percent of trauma deaths are caused by chest injuries, most of which were associated with haemothorax, respiratory failure and exanguination .

The 300,000 per year patients with haemothorax in the USA require over 1 million units of blood and blood products. (1)

Countries with limited access to blood transfusion services or massive transfusion protocols, have high mortality rates for this condition, often linked to inappropriate protocols, in which large volumes of crystalloid intravenous fluid infusions render patients hypothermic and profoundly coagulopathic.

Current recommendations are that large-volume fluid therapy should be avoided prior to haemorrhage control, as fluid therapy prior to haemorrhage control worsens outcome in penetrating thoracic trauma (and perhaps all penetrating trauma patients. (2,3)

Emergency autologous blood transfusion using standard intravenous infusion sets can save the lives of these patients.

Emergency thoracostomy to relieve obstructive pneumothorax and haemothorax, saves many lives but the current ACLS protocols do not include acknowledged procedures for preparation

and reinfusion of shed blood from the pleura and other body cavities, at locations without access to cell saver or specially manufactured autologous blood transfusion systems, such as the Atrium Autologuous transfusion system, currently in use with FDA approval Level 3.

The published report of Rhee et al. 2015 J Trauma Acute Care Surg V7 N4, supports this grading. Their randomized control study concluded that "Early autologous fresh whole blood transfusion leads to less allogeneic transfusions and is safe."(4)

Their study of 272 matched patients with Haemothorax, compared 136 patients who received Blood bank cross matched blood and 136 who were given autologous transfusion of blood drained from chest tubes, anti-coagulated with Citrate Phosphate Dextrose.

The results described were:-
No difference in Complications, Acute Respiratory Distress Syndrome, Sepsis, Disseminated Intravascular Coagulation, Renal insufficiency, Transfusion related lung injury, Mortality, or INR at 24 hours.

The only significant difference was a lower Red Blood Cell and platelet transfusion requirement for patients having the autologous transfusions.

Their overall conclusion: Autologous transfusion with the Atrium system safe and without complications. (5)

The Atrium autologous transfusion protocol utilizes Citrate Dextrose Anticoagulation – Citrate binds Calcium, inhibits fibrinogen formation and inhibits Platelet linkages.

Blood Bank Citrate Phosphate Dextrose CPD 14 mls / 100 mls blood

Autologous Transfusion Atrium Protocols		Ratio
Citrate Dextrose ACD	40 mls + 300 mls blood	1:7
	40 mls + 400 mls	1.10
	40 mls + 500 mls	1:13
	40 mls + 600 mls	1:15
	40 mls + 800 mls	1:20

Whilst coagulation features are important, a critical factor in the evaluation of the effectiveness of the proposed procedures is the oxygen carrying capacity of blood returned to the patient's circulation, and the subsequent provision of oxygen to tissues.

For this reason protocols must include the monitoring of temperature, acidity (pH), and oxygen tension (p02), and PCV or Haemoglobin levels.

Arterial blood with 15 gm/dl Hb contains 19.8 ml O2/dl, venous blood (75 % saturated) contains 15.2 O2 ml/dl.

4,6 ml O2 is delivered to tissues from each 100 ml blood, 250 ml delivered to the tissues / min.

The amount of Oxygen delivered depends on Haemoglobin level and content of 2,3 diphosphoglycerate (2,3 DPG), formed from 3-phosphoglyceraldehyde a product of glycolysis.

This anion binds with Hb and releases Oxygen, with a half life of about 6 hours.

This release is influenced by factors which increase affinity: A shift to the left:
These are :-

1.Low temp.
2.High pH.
3.Decreased 2,3,diphosphoglycerate.
4.PO2 60 represents 89% saturation which falls steeply as PO2 falls.

This project seeks to provide further evidence for alternative methods of autologous blood transfusion, by confirming the observations made during the management of a number of patients, who received emergency autologous transfusions in limited resource settings.

Case reports provide guidance for the research questions which must be answered.
These include:-

1. What protocols for collection, preparation and infusion of autologous blood are safe and effective?
2. What Investigations are required to verify the safety of salvaged autologous blood, prior to its return to the patient?
3. What systems of anticoagulation are effective ?
4. hat are the Indications for Emergency Autologous Blood Transfusion?

Haemothorax Causes and Management(6) (www.Injury Information.com)

The most common cause of haemothorax is chest trauma.

It can also occur in patients who have: A defect of blood clotting, Blunt trauma to the chest, Death of lung tissue (pulmonary infarction), Lung or pleural cancer, Penetrating chest trauma (when a weapon such as a knife or bullet cuts the lung), Placement of a central venous catheter, Thoracic or heart surgery, Tuberculosis

The most common symptoms of a hemothorax are:
Anxiety, Chest pain, Rapid heart rate, Restlessness, Shortness of breath
Decreased or absent breath sounds on the affected side.

Signs of haemothorax may be seen on the following tests:
Chest x-ray, CT scan, Pleural fluid analysis, Thoracentesis

The goal of treatment is to stabilize the patient, stop the bleeding, and remove the blood and air in the pleural space.

A chest tube is inserted through the chest wall to drain the blood and air. It is left in place for several days to re-expand the lung.

When a haemothorax is severe and a chest tube alone does not control the bleeding, surgery (thoracotomy) may be needed to stop the bleeding.

The cause of the haemothorax should be also treated.

In trauma patients, depending on the severity of the injury, chest tube drainage is often all that is necessary. Surgery is often not required. The outcome depends on the cause of the haemothorax and how quickly treatment is given.

Possible complications of a haemothorax include:

Collapsed lung, leading to respiratory failure, Death, Fibrosis or scarring of the pleural membrane, Pneumothorax, Shock

Systems of anticoagulation

The preliminary activity of this research project will compare the laboratory investigation results of venous blood, taken from a volunteer, and prepared for autologous transfusion by 4 different systems of anticoagulation.

Subsequent samples for analysis will be collected from chest drains and suction drains, before and after passage through standard blood filter administration sets. All blood samples will then be discarded and no time will the prepared blood be given to any patient.

Anticoagulation systems to be:-

Citrate Dextrose 10 mls per 100 mls blood

Normal Saline 20 mls per 100 mls blood

Ringers Lactate 20 mls per 100 mls blood

Heparin 100 units per 100 mls blood with Protamine reversal immediately prior to infusion through filter.

Additions at intervals of 0, 5 and 20 minutes after collection

Laboratory Investigations to include:-
Hb, PCV, Platelets, ESR, INR, PT, PTT, Albumin, Prothrombin, Urea and Electrolytes, Lactate, Liver Function tests, Microbiological Culture and Cytokine immune-assay.

The indications for Autologous Blood Transfusion by this method, in the absence of available donor fresh whole blood or stored blood bank supplies are expected to be:-

Patients with active bleeding and in hypovolaemic shock.

Patient at risk of loosing more than 20% of blood volume from injury or surgical procedure.

Persistent hypovolaemia and risk of cardiac arrest during thoracotomy.

The trigger for this procedure would be the following situations:-
No access to blood supplies to control and reverse existing or imminent hemorrhagic shock.
Patient's blood available for collection and use rather than being discarded.

Procedure guidelines

Chest Drain Insertion

Preferable in operating theatre with facilities and staff for emergency thoracotomy.

Patient position
Emergency situation or unconscious – Supine or
Supine 30 degrees chest elevation

Fully conscious normal Blood pressure – Sitting upright Arms forward-

Insertion site

pneumothorax	Second intercostal space mid clavicular line
Other indications	Fifth intercostal space mid axillary line

Oxygen by mask or nasal canulae
IVI line X2 Administer IV antibiotics, hydrocortisone 100mg

Equipment and supplies

Sterile Preparation and Drapes
Local Anaesthesia
Scalpel 10 blade
Chest drain F18 to 36 or Foley catheter 18 to 24
Connecting tubes
Wall suction set
Under water drainage system
Water or Normal Saline for drainage bottle
ACD Acid Citrate Dextrose solution

Blood collection Sterile tray -
Blood IV administration sets and three way taps
Compression cuff for rapid infusion

Surgical procedure

Infiltrate local anesthesia over line of incision,
3cm lower part of 5th intercostal space, from mid axillary line forwards.
Extend incision down to superior border of 6th rib and open pleura under direct vision with blade.
Insert fingers to exclude adhesions
Insert clamped chest drain, upwards & anteriorly for pneumothorax, anterior and downwards for haemothorax.
Close wounds with interrupted sutures, secure drains and place untied purse-string 1 prolene sutures.

Blood collection
50 mls Na saline in sterile kidney dish.
Release clamp on drain and add 300 mls blood Add another 50 mls Saline
Mix for 10 seconds with 50 ml bladder syringe and then transfer to emptied Normal saline bag.
Connect blood administration set and infuse into patient, under pressure if patient is hypotensive.

Repeat above steps until drainage is less than 100 mls per minute, and then connect to under water chest drain unit primed with ACD Citrate Dextrose and with a Three way tap connection to permit further collections of blood for transfusion.

During procedure, continuous monitor of patients vital signs should take place and venous samples of blood (10 mls) taken at hourly intervals for laboratory HCT and coagulation investigations, until the autologous transfusion is complete.

Blood collected and transferred to Saline bags which are not infused within 30 minutes of collection, to have added ACD Citrate Dextrose, 10 mls per 100 mls blood, an antibiotic solution and be stored at 4 degrees centigrade for up to 6 hours.

Complications

Puncture or laceration of lung parenchyma
Intercostal vessel and nerve injury
Long thoracic nerve injury
Increased bleeding
Lung compression and hypoxia from obstructed drains

Management

Post op chest xray
Ensure under water seal with respiratory swing
Seal below patient and clamped for patient movement.
Suction for resistant pneumothorax and fluid collection
Remove drain after deep inspiration.

Other studies providing supporting information:-
Salhanick M et al Am J Surg 2012(6) 817-821 (7)

This team compared blood from the pleural cavity for periods ranging from 0 to 4 hrs with Venous blood in 22 patients.
They found that Coagulation factors were significantly depleted

	HCT	Hb	Platelets	INR	PTT	Fibrinogen	equiv vol
Pleural blood	26.4	9.3	53	>9	>180	<50	726 mls
Venous blood	33.9	11.8	174	1.1	28.5	288	500 "

Conclusion: Significantly decreased coagulation factors

Implications: No anticoagulant needed, Requires double filter to remove coagulated content.
Patients require Platelet and FFP supplements

Colli et Al J Cardiothoracic surgery 2012 7:55 (8)

The team compared investigations of samples from Hemobag transfusion with Cell Saver transfusions.

The results from the Hemobag transfusions was better quality, with global improvement of all the blood parameters analyzed in the transfusion.

Hematocrit Increased from 21% ± 2% to 51% ± 3% in the Group H
Increased 21% ± 3% to 35% ± 3% in Group CW ($p < 0.001$).

Platelet count Increase 105 ± 12 K/mm3 to 201 ± 22 K/mm3 in Group H
Decrease 102 ± 11 K/mm3 to 57 ± 11 K/mm3 ($p < 0.001$).

Protein conc Increased 3 ± 0.5 mg/dLto 9 ± 1 mg/dl in Group H
Dropped 3 ± 0.3 mg/dlto 0.4 ± 0.2 mg/dlin Group CW ($p< 0.001$).

Albumin Increased from 1.5 ± 0.3 mg/dLto 4.5 ± 0.3 mg/dLin Group H
Dropped 1.7 ± 0.3 mg/dl to 0.3 ± 0.1 mg/dl in Group CW ($p < 0.001$)

Fibrinogen Increased from 125 +-18 mg/dl to 342 +-39 mg/dl in Gp H
Decreased 122 +-18 mg/dl to 33 +-4 mg/dl in Gp CW ($p<0.001$)

Implication: Quality of Pleural blood would improve with Hemobag processing.

Woerds et al Netherlands Journal of Critical Care 2011 (9)
Case report.
3 way valve return of pericardial tamponade blood into femoral vein.

Venkatachalam et al 2009 Mayo Clinic.J of Cardiovascular Electrophysiology 20/3 (10)
Case reports.
Ablation procedure -pericardial effusion 9 patients.
Cell saver process before return to circulation.

Mean aspiration vol 1078 mls Mean AT Return 380 mls

Implication: Direct return from pericardial space through filter to circulation without anticoagulant possible.

Wang et al Exp and Clinical Cardiology 20(6) 145-147 (11)
Case report: Disseminated Intravascular coagulation IC after major AT for blunt cardiac and splenic rupture.

DIC corrected by platelet transfusion.

Brearton C et al 2012 Int Journal of Obstetric anaesthesia (12)
Cell salvage use for Obstetric Haemorrhage
587 collections 137 returns 47 Litres 189 units
Safe, No complications.
Not cheaper than Blood Bank transfusions

Implication: There is a place for alternative low cost suction and centrifuge systems to make the technique available to low resource areas.

Caliste et al European Journal (13)
Autologous transfusion in emergent operative trauma resuscitation
179 Patients 199 to 2008
Penetrating and blunt abdominal trauma
71 had Autologous transfusion 108 Blood Bank transfusion

Implication: Better to use Autologous Transfusion rather that allow death from haemorrhage.

Savas Oz, B, G Arslan et al 2013 Cardiovascular Journal of Africa 24(4) 121-123 (14)
Comparison of autologous versus homologous blood transfusion in open heart surgery.

Group 1
Preop iso-volumetric substitution Autologous Transfusion (IVSAT) of blood, returned through the Right Internal Jugular Vein in 163 patients, compared with

Group 2
Homologous Blood Bank transfusions in 160 patients.

Different outcomes
Group 1
Mean extubation time , ICU and Hospital stays shorter,
Post op drainage less,
Fewer postop pulmonary complications including pneumonia. Atrial fibrillation and renal disease
Reduced number with low cardiac output and need for postoperative ionotropic Support.

Conclusion IVSAT safe and effective.

Implications of IVSAT-

Justifies development of affordable systems and protocols for extra corporeal preservation of autologous whole blood for periods of up to 6 hours.

A system which would permit preservation and retention of pleural blood, for use in patients being observed, whose deteriorating clinical condition demands thoracotomy.

Blaylock, R. C., K. S. Carlson, et al. (1994). (15)
"In vitro analysis of shed blood from patients undergoing total knee replacement surgery." American Journal of Clinical Pathology 101(3): 365-369.

Wound drainage from total knee replacement was collected into a cardiotomy reservoir, without anticoagulation, for 4 hours after surgery.
Coagulation parameters were evaluated on the washed supernatant and unwashed supernatant.

The most significant findings were:
Modified prothrombin time:Unwashed (mean,108 seconds), washed (mean,>150 seconds,P=.01).

Euglobulinlysis times: plasmin activation (unwashed supernatant + normal plasma = 24 minutes; washed supernatant + normal plasma = 106 minutes; p = .03

Fibrin degradation products: Concentrations were significantly elevated in unwashed blood.

The authors conclude these substances which are activated components of the soluble coagulation and fibrinolytic systems, can be significantly reduced with washing.

Faris, P. M., M. A. Ritter, et al. (1991). (16)
"Unwashed filtered shed blood collected after knee and hip arthroplasties. A source of autologous red blood cells.[Erratum appears in J Bone Joint Surg Am 1991 Dec;73(10):1580]." Journal of Bone & Joint Surgery - American Volume 73(8): 1169-1178.

Evaluated the results of twelve hematological and plasma protein determinations in 450 to 500- milliliter volumes of shed blood that had been collected with or without acid-citrate-dextrose anticoagulant (National Institutes of Health Formula A) from knees and hips during the first twelve hours after arthroplasty.

Also evaluated the effects on the recipients when the blood was used for reinfusion.
The clinical response of the patient was assessed after the reinfusion of a total of 205 units of unwashed shed blood into 153 patients.

In addition, in 126 of the 153 patients, hematological and plasma-protein measurements were analyzed before the auto-transfusion and one and twenty-four hours afterward.

Filtered but not washed febrile reaction.
Collected under 6 hrs (2 per cent) of 99 patients
Over 6 hrs 22 percent of 54 patients

Implication: No significant difference if under 6 hours No need to wash?

Froessler, B., I. Weber, et al. (2015). (17)
"Dynamic changes in clot formation determined using thrombo-elastometry after reinfusion of unwashed anticoagulated cell-salvaged whole blood in total hip arthroplasty." Blood Transfusion 13(3): 448-454.

Designed to investigate the content of intra-operatively salvaged filtered blood and its impact after reinfusion on clot formation in patients undergoing primary hip arthroplasty.

MATERIALS AND METHODS: Twenty-five patients scheduled for primary total hip arthroplasty were enrolled in the study. Cell salvage was performed using a new intra-operative autotransfusion filter system.

Before surgery and within 1 hour of reinfusion of 300 mL or more of salvaged whole blood, blood samples were taken to assess clot formation by thromboelastometry and standard laboratorybased coagulation profiling.
Cytokine content of the salvaged blood was assessed by enzyme-linked immunosorbent assays.

RESULTS
Clotting time, clot formation time, maximum firmness and maximum lysis all remained within the normal range. Standard laboratory coagulation tests were also normal in all patients before surgery and after reinfusion.

Although monocyte chemo-attractant protein-1 levels were higher than normal, all other measured cytokines were either undetectable or within the normal range.

No adverse events were seen following cell salvage.

DISCUSSION:
Reinfusion of unwashed salvaged whole blood did not alter clot formation in our patients.

The results add to the knowledge about this approach and contribute to the growing body of evidence regarding the lack of adverse events when re-infusing unwashed shed blood in major orthopaedic procedures.

Helwig, U., S. Schaub, et al. (2006). (18)
"Coagulation parameters after retransfusion of unwashed blood." Journal of Arthroplasty 21(3): 385-391.

We measured the concentrations of coagulation parameters after autotransfusion of unwashed shed blood in 22 patients having elective joint arthroplasty and compared them with patients without retransfusion. Twenty-two patients with a total hip or knee arthroplasty received a mean of 611.4 mL unwashed but filtered shed blood.

No complications were observed during or after the reinfusion of salvaged blood.

Levels of D-dimer and fibrinogen increased significantly after retransfusion ($P < .0001$).

Comparison of the auto-transfused group with the 25 patients without re-infused shed blood showed no significant difference in fibrinogen concentration between the 2 groups in the postoperative course but a significant difference with increased D-dimer concentrations in the auto-transfused group ($P < .001$).

Horst, H. M., S. Dlugos, et al. (1992). (19)
"Coagulopathy and intraoperative blood salvage *(IBS)." Journal of Trauma-Injury Infection & Critical Care 32(5): 646-652; discussion 652*-643.

The use of potentially contaminated shed blood and the contribution of autotransfused blood to coagulopathy are controversial issues associated with intraoperative blood salvage (IBS) in trauma patients.

Intraoperative blood salvage was used in 154 trauma patients and resulted in reinfusion of 7.97 units per patient. Moderate to severe abnormalities of the prothrombin time (PT) and partial thromboplastin time (PTT) occurred in 39 patients (31%). Prolongation of the PT and PTT occurred with increasing transfusion.

Coagulopathy was seen in patients receiving greater than 15 IBS units and in patients receiving greater than 50 combined units of blood. Of the 66 patients with bowel injury, 58 patients received shed blood.

Patients with bowel injury showed no increase in infection but did develop prolongation of PT and PTT at lower levels of IBS transfusion. Based on the results of this study, patients receiving greater than 15 units of IBS transfusion require careful monitoring and factor replacement, and IBS transfusion should be limited to less than 10 units in patients with bowel injury.

Kongsgaard, U. E., S. Tollofsrud, et al. (1991). (20)
"Autotransfusion after open heart surgery: characteristics of shed mediastinal blood and its influence on the plasma proteases in circulating blood." ActaAnaesthesiologicaScandinavica 35(1): 71-76.

Fourteen patients undergoing open-heart surgery received intermittent or continuous postoperative autotransfusion of shed mediastinal blood (minimum 400 ml during 6 h after surgery) collected in the cardiotomy reservoir.

Hematologic variables and changes in the coagulation, fibrinolytic and plasma kallikrein-kinin systems were investigated in the reservoir blood at the beginning and after 6 h of autotransfusion, and in patient blood during and after surgery and before and after autotransfusion. Autotransfusion volume ranged from 400 to 1200 ml per patient (median 482 ml).

The reservoir blood had a median haemoglobin level of 93 and 74 g/l, a platelet count of 71 and 119 x 10(9)/l, and plasma haemoglobin level of 3110 and 4100 mg/l before and after 6 h of autotransfusion, respectively.

Further examination of the reservoir blood showed that it had undergone extensive coagulation and fibrinolysis as well as a moderate activation of the kallikrein-kinin system.

Despite these extensive alterations in the reservoir blood, no major change could be found in the circulating blood after autotransfusion, except for a moderate increase in plasma haemoglobin from 180 mg/l to 430 mg/l.

The clinical safety and simplicity of this technique were confirmed for autotransfusion of shed mediastinal blood up to 1200 ml.

Lu, S. Y., G. Konig, et al. (2014). (21)
"Stationary versus agitated storage of whole blood during acute normovolemic hemodilution." Anesthesia & Analgesia 118(2): 264-268.

BACKGROUND:
Acute normovolemic hemodilution is an intraoperative technique to reduce the number of red blood cells lost in shed blood during surgery. Standard guidelines for storage of platelets recommend constant gentle agitation to maintain gas exchange for the metabolically active platelets.

The collected whole blood (WB) for acute normo-volemic hemodilution remains stationary for as long as 8 hours before reinfusion. We hypothesized that gentle agitation of WB throughout storage would improve the coagulation properties of the WB at the time of reinfusion.

METHODS:
WB was collected from 10 volunteer donors and control samples taken. The units were split in 2 storage groups: agitated (rocked) and stationary (unrocked). Cell counts and fibrinogen levels, as well as thrombo elastography (TEG) measurements, including TEG Platelet Mapping assays, were done.

RESULTS:
Nine units WB from 9 different healthy volunteers were tested. There were no significant differences in hematocrit, hemoglobin, red blood cells counts, platelet counts, or fibrinogen levels between the control samples and the rocked and unrocked WB samples.

WB coagulation as measured by TEG was preserved during the 8-hour storage period in both the rocked and unrocked samples.

There were no significant differences between the control, rocked, and unrocked samples in time to initiate clotting, time of clot formation, rate of clot formation, or maximum strength of clot values.

There were also no significant differences in the fibrin contribution to clot strength between the control, rocked, and unrocked samples, and no significant difference between the platelet activation from adenosine diphosphate or arachidonic acid among any of the 3 groups.

CONCLUSIONS:
Given the small sample size, there is no statistical evidence on which to reject the null hypothesis of there being no difference in the changes from the baseline between coagulation function as measured by TEG between WB that is either agitated or kept stationary for 8 hours.
These findings need to be confirmed in a larger study.

Marberg, H., A. Jeppsson, et al. (2010). (22)
"Postoperative autotransfusion of mediastinal shed blood does not influence haemostasis after elective coronary artery bypass grafting." European Journal of Cardio-Thoracic Surgery 38(6): 767-772.

OBJECTIVES:
The rationale of using autotransfusion of mediastinal shed blood after cardiac surgery is to preserve haemoglobin levels and reduce the need for allogenic blood transfusions. However, the method is controversial and its clinical value has been questioned. We hypothesised that re-transfusion of mediastinal shed blood instead impairs haemostasis after routine coronary artery bypass grafting and thus increases postoperative bleeding.

METHODS:
Seventy-seven consecutive elective coronary artery bypass surgery patients (mean age 67+/-9 years, 77% men) were included in a prospective, randomized controlled study. The patients were randomized to postoperative re-transfusion of mediastinal shed blood (n=39) or to a group where mediastinal shed blood was discarded (n=38). Primary end point was bleeding during the first 12 postoperative hours. Secondary end points were postoperative transfusion requirements, haemoglobin levels, thrombo-elastometric variables and plasma concentrations of interleukin-6, thrombin-anti-thrombin complex and D-dimer.

RESULTS:
Mean re-transfused volume in the autotransfusion group was 282+/-210 ml. There was no difference in postoperative bleeding (median 394 ml (interquartile range 270-480) vs 385 (255-430) ml, p=0.69), proportion of patients receiving transfusions of blood products (11/39 vs 11/38, p=0.95), haemoglobin levels 24h after surgery (116+/-13 vs 116+/-14 g l(-1), p=0.87), thrombo-elastometric variables, interleukin-6 (219+/-144 vs 201+/-144 pg ml(-1), p=0.59), thrombin-anti-thrombin complex (11.0+/-9.1 vs 14.8+/-15, p=0.19) or D-dimer (0.56+/-0.49 vs 0.54+/-0.44, p=0.79) between the autotransfusion group and the no-autotransfusion group.

CONCLUSIONS:
Autotransfusion of small-to-moderate amounts of mediastinal shed blood does not influence haemostasis after elective coronary artery bypass grafting. 6

Page, P. (1991). (23)
"Perioperative autotransfusion and its correlation to hemostasis and coagulopathies." Journal of Extra-Corporeal Technology 23(1): 14-21.

The use of autologous blood techniques affords the reduction or elimination of homologous blood transfusions for most patients. In addition, for certain religious faiths such as Jehovah's Witnesses or those patients with rare blood types, intraoperative salvage and return of the patient's own blood is the only source of available blood.

Autologous blood salvage in the perioperative period includes: hemodilution; intraoperative salvage of lost blood; postoperative collection of shed blood.

Perioperatively, autologous blood is salvaged and returned and the volumes involved do not create any hematological problems for the patient. In those cases involving large volumes of blood being processed and returned to the patient, the autotransfusionist must be aware of the possible alterations that may occur in the patient's coagulation system.

The collection and reinfusion of wound drainage fluids from operative sites has the potential to cause severe bleeding problems.

This paper will present an overview of autologous blood salvage techniques in the perioperative period along with a review of the clinical effects of auto-transfusion on hemostasis.

Also discussed will be possible coagulopathies that can be caused by returning collected autologous blood.

Pedersen, M., M. Kremke, et al. (2015). (24)
"Autotransfusion of a restricted volume of shed mediastinal blood does not affect the haemostatic capacity in patients following cardiac surgery." Scandinavian Journal of Clinical & Laboratory Investigation 75(4): 314-318.

The aim was to investigate the haemostatic capacity after autotransfusion of shed mediastinal blood in patients following cardiac surgery.

Fifteen cardiac surgery patients with a chest tube drainage > 300 mL blood within the first 6 hours postoperatively were included. The haemostatic capacity was evaluated using whole blood thromboelastometry (ROTEM()), impedance aggregometry (Multiplate()) and conventional coagulation tests.

Measurements were carried out in (1) mediastinal blood, and in blood samples obtained, (2) before autotransfusion, and (3) after autotransfusion of mediastinal blood.

In shed mediastinal blood, ROTEM() analyses showed reduced clot firmness in the EXTEM ($p < 0.001$), INTEM ($p < 0.001$), and FIBTEM assay ($p = 0.002$). Platelet function and conventional coagulation parameters were significantly impaired ($p < 0.001$).

However, platelet function and conventional coagulation tests remained unchanged after auto-transfusion.

CONCLUSION:
Shed mediastinal blood has a substantially reduced haemostatic capacity, but auto-transfusion of an average of 350 mL did not affect the overall haemostatic capacity.

Salhanick, M. A., V. G. Sams, et al. (2016). (25)
"Shed Pleural Blood from Traumatic Hemothorax Contains Elevated Levels of Pro-Inflammatory Cytokines." Shock 7: 7.

PURPOSE:
The autotransfusion of unwashed (or unprocessed) shed hemothorax blood (USHB) in trauma patients is widely assumed to be beneficial; however, the inflammatory potential of shed pleural blood has not been thoroughly studied. Since previous studies have documented

marked changes in coagulation function of shed pleural blood, we hypothesized that its level of inflammatory cytokines would be elevated.

METHODS:
A prospective observational study of trauma patients in which cytokine levels from USHB were compared to venous samples from from healthy volunteers was conducted. Differences between the cytokine content of patient-derived samples were compared to those from healthy subjects.

RESULTS:
There was a statistically significant increase in pro-inflammatory cytokines (IL-6, IL-8, TNFalpha, GM-CSF), a pro-inflammatory Th-1 cytokine (IFNgamma) and anti-inflammatory Th-2 cytokines (IL-4 and IL-10) in shed pleural blood over four hours when compared to samples from healthy controls ($p < 0.05$). Cytokine levels in USHB are approximately 10- to 100-fold higher compared to healthy control venous samples.

CONCLUSIONS:
USHB, even collected within the accepted four-hour window, contains significantly elevated cytokine levels, suggesting the potential for deleterious effects from autotransfusion. Randomized trials are needed to determine the safety and efficacy of autotransfusion in trauma patients.

Sebastian, C., R. Romero, et al. (2000). (26)
"Postoperative blood salvage and reinfusion in spinal surgery: blood quality, effectiveness and impact on patient blood parameters." European Spine Journal 9(6): 458-465.

Although reinfusion of salvaged shed blood has become popular in major orthopaedic procedures, this blood saving technique is still controversial.

In an effort to assess the functional and metabolic status of shed blood erythrocytes and the impact of postoperative shed blood reinfusion on allogenic blood requirements and patient's blood parameters, analyses of perioperative blood samples were performed in 28 consecutive orthopaedic patients undergoing spinal fusion, in which postoperative shed blood was collected and reinfused with the ConstaVac CBC II device.

In comparison with a previous series of 31 patients, this procedure reduced allogenic blood requirements by almost 30% ($P < 0.05$), without any increase in postoperative complications.

Postoperative shed blood presented lower haematological values and higher plasma-free haemoglobin (PFHB) levels than preoperative blood, without any disturbance in morphology, median corpuscular fragility (MCF) or erythrocyte adenosine triphosphate (ATP) and diphosphoglycerate (DPG) content.

Serum concentrations of enzymes--glutamate-oxalacetate aminotransferase (GOT), glutamate-piruvate aminotransferase (GPT), creatine kinase (CK), lactate dehydrogenase (LDH)--and inflammatory cytokines (IL-1beta, IL-6) were elevated in shed blood. After reinfusion, there was no alteration in coagulation parameters or cytokine levels.

Serum levels of some enzymes increased at the end of surgery and remained elevated at postoperative day 2 (CK) or 7 (GOT, LDH), with a higher increase if postoperative autotransfusion was used as a blood saving method.

In conclusion, salvaged shed blood in orthopaedic procedures of the spine seems to be an excellent source of red cells which are not significantly damaged, keeping a normal functional and metabolic status, and reduces allogenic blood requirements without significant side effects.

Vertrees, R. A., V. R. Conti, et al. (1996). (27)
"Adverse effects of postoperative infusion of shed mediastinal blood." Annals of Thoracic Surgery 62(3): 717-723.

BACKGROUND: Postoperative infusion of shed mediastinal blood has been used in an effort to decrease blood usage after cardiac operations. Recent experience has suggested that this practice may actually lead to a delayed increase in bleeding.

METHODS:
In a prospective, randomized study, 40 patients undergoing coronary artery bypass grafting with shed mediastinal blood collected in a cardiotomy reservoir were divided into two equal groups and studied during their first 4 hours in the intensive care unit.

Shed mediastinal blood was directly infused in group I (n = 20), whereas in group II (n = 20), it was not. In group II, if a sufficient volume of red cells was present to allow processing (n = 5), washed red cells were infused.

Variables studied before and after infusion were the amount of blood lost and infused, homologous blood transfused, complete blood count and differential, serum fibrinogen, fibrin split products, D-dimers, clotting factors, prothrombin time, activated partial thromboplastin time, thromboelastograms, plasma-free hemoglobin, complement factors C3 and C4, creatine kinase and its MB isoenzyme, and body temperature.

RESULTS:
After infusion of shed mediastinal blood, elevated levels of fibrin split products and D-dimers were found in significantly more patients in group I. The thromboelastogram index was normal in 76% of patients in group II but in only 12.5% in group I.

Group I also had an increase in band neutrophils, a greater number of febrile patients, higher serum levels of creatine kinase, its MB isoenzyme, and plasma-free hemoglobin, and greater blood loss during hours 3, 4, and 5 in the intensive care unit.

The volume of red cells in shed mediastinal blood (hematocrit, 9% to 10%) was small, resulting in clinically insignificant autotransfusion when infused directly, and insufficient for cell processing in most patients.

CONCLUSIONS:
These data support those in previous studies that direct infusion of shed mediastinal blood does not save substantial amounts of autologous red cells and can cause a delayed coagulopathy and other adverse effects that may be harmful to patients postoperatively.

Wolzt, M., M. M. Samama, et al. (2011). (28)
"Effect of edoxaban on markers of coagulation in venous and shed blood compared with fondaparinux." Thrombosis &Haemostasis 105(6): 1080-1090.

Edoxaban, an oral direct factor Xa (FXa) inhibitor, is in phase III clinical development for stroke prevention in atrial fibrillation and treatment of venous thromboembolism.

The shed blood model allows for study of activated coagulation at a site of standardised tissue injury due to local release of tissue factor.

The objective of this study was to evaluate the effect of three doses of edoxaban on markers of coagulation in shed and venous blood versus placebo and a standard prophylactic dose of fondaparinux.

A total of 100 healthy male subjects were randomised to receive single doses of one of five treatments: subcutaneously administered fondaparinux 2.5 mg; orally administered edoxaban 30, 60, or 120 mg; or placebo.

The primary objective was measurement of blood coagulation markers prothrombin fragment 1+2 (F1+2) and thrombin-antithrombin (TAT) complex, and platelet activation marker beta-thromboglobulin (beta-TG), in venous and shed blood.

Secondary objectives included pharmacokinetics, shed blood volume, and safety of edoxaban.

Single doses of edoxaban caused rapid and significant decreases of F1+2, TAT, and beta-TG in the shed blood model, indicating inhibition of thrombin generation and platelet activation.

Inhibition was significantly less for fondaparinux versus edoxaban. Baseline-corrected F1+2, TAT, and beta-TG values demonstrated sustained inhibition up to 24 hours for shed blood in the edoxaban groups but no significant inhibition in venous blood.

Overall, edoxaban treatments were well tolerated.

In conclusion, single oral doses of edoxaban 30, 60, or 120 mg caused rapid and sustained inhibition of coagulation up to 24 hours in the shed blood model.

Questions

How to maintain quality of salvaged blood constituents and retain coagulation processes to control bleeding?

What systems of anticoagulation effective in emergency autologous transfusion of shed blood?
What type of filters in IVI Administration sets are most effective?

.What training programs are required for competent performance of the procedure by medical personnel?

What is the process for validation and FDA approval of such alternative affordable surgical procedures?

What are the significant differences between the results of laboratory investigations of samples of blood prepared for autologous transfusion by the following methods?
Cell saver systems, Hemobag concentration systems, Atrium self-filling bags, Direct transfer by syringe to filtered blood administration sets?

Research plan.

Draft REM approval submission
Establish sample collection Protocol
Compile list of personnel, equipment and supplies required
Identify funds for project.

Identify source of samples
Volunteers, patients with chest or haemovac drains, suction drains from operation fields or cell saver systems that are not required for patient care, laboratory or blood bank activities.

Key activity:

Prepare collected blood for simulated Autologous Transfusion and test samples before and after infusion though blood administration sets.

No samples to be taken directly from patients or subjects, but the project will require approval of access to the results of investigations done on samples of venous and arterial blood, and body fluids and tissues, taken from patients, during the course of their illness.

Chapter 8

Insulin induced Hypoglyaemia sedation of animals for simulated surgical training. EXSU 691b

Introduction

Surgical training and research programs utilizing anaesthetized pigs are established in many parts of the world, but are very expensive systems, which cannot be extended to countries of limited resources. (1)(2)

Affordable programs to provide similar opportunities in resource limited countries are required to reverse the deficiency of surgeons who are competent to perform certain lifesaving procedures. Such programs will not be approved or introduced unless evidence is provided to demonstrate compliance with the ethical standards expected for the use of living animals for medical research and skills training programs.

This discussion paper is presented as part of the response to the Hypothesis of a Masters Degree research program which states that:-

The health status of communities and the delivery of affordable surgical services would benefit from an epidemiological and participatory educational approach to surgical education, which includes the merging of old and new theories, methods and skills of surgical education, research and practice.

The following quotation from my reflective paper titled:-**Competency Based Medical Education (CBME) - An essential strategy for the improvement of surgical services in resource limited countries**, illustrates the motivation and justification for this discussion paper.

> There is a growing demand from not only trainees, but also members of the public, for a further reduction in the rates of complications and the time for training, by greater access to simulated operating procedures in animal laboratories.
>
> We are at risk of a new cohort and generation of surgeons, who as a result of rapid transfer to Level 1 trauma centers, massive transfusion protocols and operating theatre angiographic interventional radiology services, witness the superior outcomes, but are deprived of opportunities for achieving competence in the traditional management of these cases.

A hypothesis which promotes alternative affordable surgical methods, requires the validation of protocols for their performance and teaching. This discussion paper introduces an activity, which is not only an illustration of the subject, but may also facilitate the desired validation of a variety of alternative surgical practices.

My interest in this proposal arises from an introduction to pigs as an important resource in surgical training, during a 1992 to 1994 transplant surgery training program in Portsmouth United Kingdom.

Activities included visits to an abattoir in Petersborough for harvesting of kidneys, pancreas, blood vessels and other organs for hands on training programs directed by Mr Maurice Slapak.

A more disturbing experience was witnessing at the animal laboratory facility at Southampton University Hospital, the rage and rampage of a 80 Kg pig, in response to quiet whimpering noises from another pig in an adjacent room, who was being put to sleep by an injection of thiopentone into an auricular vein.

This event confirmed the importance of humane methods for such activities and the need for approved legal and ethical standards for the performance of laboratory animal research and training programs.

A pilot project to validate alternative low cost procedures is proposed, to document dosage requirements, procedures for monitoring and maintenance of vital signs and blood biochemistry, procedures for endotracheal intubation and manual ventilation without anaesthetic agents, during the performance of research and training activities.

The Scientific evidence

Animal studies have shown that hypoglycemia of sufficient severity causes cessation of spontaneous EEG activity, and that recovery to normal activity and function, takes place following a 30 minute period of such hypoglycemia.(3) Cerebral energy failure occurs when glucose level falls below 20 mg/dl, but other vital functions of cardiac, respiratory, visceral and musculo-skeletal activity remain intact for a period of time. (4)

This indicates that animals prepared in this way for simulated training of surgical trainees will not feel pain or have memories of such events, if they are sacrificed immediately after completion of the training and research procedures.

Reports of experiences with insulin coma therapy for psychiatric conditions, provide precedence for this approach, and suggest that if the ethical principles and guidelines for this type of activity are still in place, that the technique may be acceptable for application to animals being prepared for research or training activities, prior to slaughter. (Ref 5, 6, 7, 8)

This proposal seeks to establish protocols for the preparation and management of laboratory animals that would enable the training of surgical trainees, who are expected to demonstrate technical competencies, before being allowed to perform procedures on human subjects.(9)

An illustration of benefit from adversity in surgical practice introduces another related challenge for surgical services, frequently without supplies of analgesics, and anaesthetic agents.

A challenge to investigate the significance of reports of patients benefiting from emergency surgery, performed during incidental hypoglycemia. Patients who had no recollection of pain or the procedures and experienced full and normal post-operative recovery. (10)

Such investigations are justified by the accepted protocols for treatment of hyperkalemia with insulin and dextrose infusions,(11) and the reported birth of normal babies to mothers treate*d* with insulin coma therapy for psychiatric conditions.(12).

The challenge is to consider the options available in limited resource situations, when no recognized anaesthetic or analgesic medicines are available to provide emergency surgical services to disturbed and violent patients.
The findings of the supporting references are summarized in the précis of the publications which follow a brief outline of the proposed research activity of this discussion paper.

Outline of Proposed activity

Identification of an abattoir facility in the Caribbean with a room that has all the requirements of a surgical operating theatre.

Training of staff, on the selection and preparation of animals to become stress free prior to procedures.

Establish dosage requirements for induction of hypoglycemia and somnolence by subcutaneous injection of insulin, the establishment of intravenous access for continuous insulin cocktail infusion, monitoring of blood investigations, endotracheal intubation and manual ventilation during the surgical training or research procedures.

Establish protocols for conduct of procedures which may include Chest, Abdominal, Head, Neck vascular and peripheral soft tissue procedures.

Establish protocols for operative procedures.

Establish protocols for disposal of animal remains.

Establish protocols for procedures which require resuscitation of the animals, to verify the effectiveness of surgical procedures, prior to sacrifice of the animals.

This project will be guided by the established guidelines and procedures established in the Animal laboratory facility at McGill University, and will comply with existing legislation regarding this activity in the country which is the host of the project.

Ref 1
Swine in the Laboratory.Surgery, Anaesthesia, Imaging and Experimental techniques.
M Michael Swindle. Illustrator Richard Hughes CRC PRES

Ref 2
Smith A C, Swindle M M
Swine in the laboratory. Surgery, Anaesthesia, Imaging and Experimental techniques CRC Press (2016) Smith A C, Swindle M M

Ref 3
Neuroprotective Effects of Ketone Bodies during Hypoglycemia by Peter W. Schutz B.A. (Hons.), University of Cambridge, 1993 M.Phil., University of Cambridge, 1995 M.D., Medical University of Vienna, 2004. An Illustration of EEG controlled Hypoglycemia
Ref 4
Cerebral energy metabolism in insulin induced hypoglycemia in newborn piglets: *in vivo*^{31}P-nuclear magnetic resonance spectroscopy
Authors Tadashi Omai, Masatoshi Kondo, Kenichi Isobe, Susumu Itoh, ShojuOnishi

Department of Pediatrics, Kagawa Medical School, Ikenobe, Mikicho, Kitagun, Kagawa 761-07, Japan.

Ref 5
John Adams PhD FFNMRCSI Temporary Lecturer Anglia Ruskin University, Peterborough, UK
ADAMS J. (2014) The nursing role in the use of insulin coma therapy for schizo-phrenia in Britain, 1936 –1965. Journal of Advanced Nursing 70 (9), 2086–2094. doi: 10.1111/jan.12366

Ref 6

A history of insulin coma therapy in Australia
Robert M Kaplan Associate Professor and forensic psychiatrist, Graduate School of Medicine,
University of Wollongong, Wollongong, NSW, Australia
Australasian Psychiatry 21(6) 587 –591

Ref 7
J Neurol. Neurosurg. Psychiatry 1957, 20, 108
D. M Lieberman, J Hoenig, I Auerbach et al Bethlem Royal and the Maudsley Hospital London UK
The effect of Insulin Coma and ECT on the 3 year prognosis of schizophrenia

Ref 8
http:archneurpsyc.jamanetwork.com Shagass C, Rowsell P U Montreal Canada

This paper reviews relevant literature and describes clinical and EEG findings in a case of prolonged coma following insulin therapy for schizophrenia. EEG changes reflected the neurological and mental complications. An attempt is made to interpret thee correlations with reference to the properties of midbrain and thalamic reticular systems.

Ref 9
J Clin Endocrinology and Metabolism V18 March 1958 No 3
Leon J Marks et al. Psychiaatry and Neurology Service and Steroid Research Laboratory. Veterans Administration Hospital, Boston Mass. USA
The adrenocortical response to insulin coma therapy on the urinary excretion of Hydroxy corticosteroids and 17-Keto steroids and on circulating eosinophils.

Ref 10 Appendix Ic
Emergency surgery in the 21st Century for developing countries and remote communities
Lewis L, Richards S, Radhakrishnan S. www.RCSEd.AC.UK

Ref 11 Protocols for treatment of hyperkalemia

Ref 12 Delivery of normal babies from mothers after insulin coma therapy for psychiatric conditoons

Precis of references

Ref 4
Cerebral energy metabolism in insulin induced hypoglycemia in newborn piglets: *in vivo* ^{31}P-nuclear magnetic resonance spectroscopy
Authors Tadashi Omai, Masatoshi Kondo, Kenichi Isobe, Susumu Itoh, ShojuOnishi

Department of Pediatrics, Kagawa Medical School, Ikenobe, Mikicho, Kitagun, Kagawa 761-07, Japan.
The effect of insulin induced hypoglycemia on cerebral energy metabolism was examined in four newborn piglets. The present study has clarified that cerebral energy failure occurs when the blood glucose level is about 20 mg/dL or lower. The critical point of blood glucose exists to maintain brain energy metabolism.

Ref 5
John Adams PhD FFNMRCSI Temporary Lecturer Anglia Ruskin University, Peterborough, UK
ADAMS J. (2014) The nursing role in the use of insulin coma therapy for schizo-phrenia in Britain, 1936 –1965. Journal of Advanced Nursing 70 (9), 2086–2094. doi: 10.1111/jan.12366

A nuanced account of the rise and fall of insulin coma therapy provides a lens through which to examine the development of mental health nursing and a case study of the challenges involved in implementing care based on the best evidence.

Keywords:
insulin coma, mental health nursing, nursing history, shock therapy Introduction

Electro-convulsive therapy had its origins in the belief, based on both epidemiological and neuropathological studies carried out in the 1920s, that patients with epilepsy were unlikely to develop schizophrenia.

This finding led to a new focus on methods for artificially inducing seizures in patients with a diagnosis of schizophrenia.

Insulin was first used in psychiatry in the 1920s as a sedative for ‘excited patients’ and in cases of delirium tremens (Kalinowsky& Hoch 1961).

Its use was further developed in the early 1930s by the Austrian psychiatrist Dr Manfred Sakel, as a treatment for schizophrenia (Sakel 1937).

He had initially been using insulin to induce a state of hypo-glycaemia as a treatment for morphine addiction.

As he became more confident that he could reverse the hypoglycaemic coma, he decided to experiment on patients with early schizophrenia in the Vienna Clinic.

Even his later British admirers Sargant and Slater admitted that ‘the idea seemed bizarre’, but its apparent dramatic success led to the technique’s very rapid acceptance worldwide (Sargant & Slater 1954, p. 20).

By 1936, the Board of Control for England and Wales, the official inspectorate for mental hospitals, was actively promoting its introduction (Jones 2000).

In the only British history of mental health nursing, insulin coma therapy is given minimal coverage.

What are the key findings?
Insulin coma therapy was very widely adopted in the middle years of the twentieth century.
Nurses were often enthusiastic participants in the newly established insulin units.
Research findings proved to be difficult to interpret and the therapy can be said to have been superseded rather than abandoned as worthless.

In 1954, an article in the British Journal of Nursing reported on the success of treatment by ICT for patients with schizophrenia in the USA (Goddard 1954).

ICT involved injecting a patient with insulin to reduce conscious level and then giving glucose to restore consciousness, but, in some hospitals, it was combined with other interventions such as electro-convulsive therapy (ECT) or drug administration and this made outcome comparisons difficult.

A nurse writing about his career in mental hospitals south of London remembered the introduction of physical therapies such as ICT as part of a narrative of steadily improving treatment and living conditions for patients.

He stressed the ‘special observation’ required and the presence of the nurse in charge with a bottle of glucose ready to give a drink to any patient showing signs of sinking into a coma (Clarke 1985, p. 28).

Ref 6

A history of insulin coma therapy in Australia
Robert M Kaplan, Associate Professor and forensic psychiatrist, Graduate School of Medicine,
University of Wollongong, Wollongong, NSW, Australia
Australasian Psychiatry 21(6) 587 –591

A good description of the Australian experience of ICT comes from Cramond, who was to say that he experienced more anxiety carrying it out than he had before or since (with the possible exception of LSD abreaction sessions).

A typical unit at the hospital was six to nine beds. The daily dose of insulin given to the fasting patient at 7 am was increased until they went into a hypoglycaemic coma about 3 hours later.

After 30 minutes the coma was terminated by a gastric feed or intravenous injection of dextrose.

This routine was carried out on six mornings a week, often for 10 weeks at a time.
About an hour after the insulin was given, the patient became restless and sweaty, slipping into a low-grade delirious state known as ‘sopor’.

As the patient recovered consciousness, they were given a carbohydrate breakfast, changed into dry clothing and, in general, fussed over.

For the next 48–72 hours, the unit was in crisis as the fluid balance and cardiovascular status of the patient had to be maintained. At the same time, blood sugar levels had to be monitored.

Morale in such units was high unless the day was disturbed by an occasional ‘irreversible’ coma –the usual cause of death with ICT.

But that was well over half a century ago, and we now see many problems from use of psychotropic medication, not least of which is metabolic syndrome.

A pioneer of that era, Lothar Kalinowski, was vocal in stating his regret that ICT was replaced by the newer drugs.

With the vastly improved technology and better insulin preparations that are now available, is there not scope for using ICT in selected cases of psychosis?

Intranasal insulin is now being used for several conditions.
Frey WH. Intranasal insulin to treat and protect against post traumatic stress disorder. J NervMentDis 2013; 201: 538–589.

What goes around comes around is an aphorism worth remembering in psychiatry.

Ref 7
J Neurol. Neurosurg. Psychiatry 1957, 20, 108
D. M Lieberman, J Hoenig, I Auerbach et al Bethlem Royal and the Maudsley Hospital London UK
The effect of Insulin Coma and ECT on the 3 year prognosis of schizophrenia

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J Clin Endocrinology and Metabolism V18 March 1958 No 3
Leon J Marks et al. Psychiaatry and Neurology Service and Steroid Research Laboratory. Veterans Administration Hospital, Boston Mass. USA
The adrenocortical response to insulin coma therapy on the urinary excretion of Hydrxy corticosteroids and 17-Keto steroids and on circulating eosinophils.

This reference presents a record of the type of protocols that were used for Insulin Coma Therapy, (summarized below), and suggests a template for animal laboratory protocols for Insulin assisted research and training activities, but with the omission of all medications except insulin and IV fluids and electroytes to maintain normal serum biochemistry levels except for glucose levels.

Day 1	8 .00 pm	Nil by mouth after dinner Insulin 25 u s/c
Day 2	6.45 am	Basal Blood glucose and other blood tests
	7.00 am	Phenobabarbito0.1gm PO, Atropinte 0.4 mg s/c, Insulin S/C ? dose
	8.30 am	Blood glucose
	10.00 am +	Blood glucose at onset of coma
	11.00 am	Blood glucose prior to termination of coma
	11.00	Administration of 400 mls 50% glucose in water orally

IV 30 mls 50% Glucose if not possible orally.

11.30	Shower Breakfast and blood tests.
5-8 pm	Night feeding
11 pm	Urine collection and Insulin 25 u s/c

Protocol repeated for days 3 to 6
Patient discharged home on Day 7
Repeated once per month for 3 months
More than 80% patients continued to require long term therapy for their condition.

REB Proposal

Insulin induced Hypoglyaemia sedation of animals for simulated surgical training.

Surgical training and research programs on anaesthetized pigs are well established in many parts of the world, but are at present a very expensive undertaking, which cannot be extended to countries of limited resources, where there is a severe deficiency of surgeons who are competent to undertake procedures, or deal with surgical situations not encountered before.

Such activities are unlikely to be approved and introduced unless evidence is provided to demonstrate compliance with the ethical standards for research on living animals.

Animal Studies have shown that hypoglycaemia of sufficient severity causes cessation of spontaneous EEG activity, and that recover to normal activity and function takes place following a 30 minute period of such hypogycaemia.(1)

This indicates that animals prepared in this way for simulated training of surgical trainees are unlikely to feel pain or have memories of such events, even if they were not sacrificed immediately after completion of the training procedures.

This proposal seeks to establish protocols for the preparation and management of laboratory animals that would enable the training of surgical trainees, who are expected to achieve practical and technical competencies, before being allowed to practice on human subjects/patients.

Proposed research activity

Identification of an abattoir facility in the Caribbean with a room that can be adjusted to meet the requirements of a surgical operating theatre.

Training of staff on the selection and preparation of animals to be stress free prior to procedures.

Establish dosage requirements of the animals to induce hypoglycemia and somnolence by subcutaneous injection of insulin, to permit establishment of intravenous access for continuous insulin cocktail infusion, monitoring of blood investigations, and endo-tracheal intubation for manual ventilation during the surgical training procedures.

Establish protocols for conduct of procedures which may include Chest, Abdominal, Head, Neck , vascular and peripheral soft tissue procedures.

Establish protocols for operative procedures.

Establish protocols for disposal of animal remains.

Establish protocols for procedures which require resuscitation of the animals, to verify the effectiveness of surgical procedures, prior to sacrifice of the animals.

Montserrat Abattoir -- Potential partner for a Surgical Research and Training facility.

This proposal is presented in support of the attached discussion paper which has been prepared in part defense of a MSc Thesis with the title:- "Appropriate Surgical Education for countries with limited resources."

Introduction

Surgical training and research programs utilizing anaesthetized pigs are established in many parts of the world, but are very expensive systems, which cannot be extended to countries of limited resources. (1)(2)

Affordable programs to provide similar opportunities in resource limited countries are required to reverse the deficiency of surgeons who are competent to perform certain lifesaving procedures.

Such programs will not be approved or introduced unless evidence is provided to demonstrate compliance with the ethical standards expected for the use of living animals for medical research and skills training programs.

Proposed activity

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This project will be guided by the established guidelines and procedures established in the Animal laboratory facility at McGill University, and will comply with existing legislation regarding this activity in the country which is the host of the project.


Small Ruminants Slaughter Facility
Funded by :
CARIBBEAN DEVELOPMENT BANK
GOVERNMENT OF MONTSERRAT

Chapter 9

Digital technology in surgical education, research and services EXSU 692
Review of literature

Selection for general surgery programs now includes assessment of trainees' familiarity with surgical procedures. On line learning tools, operative modules and hands on simulation resources are ideal for this approach. (1)

Smart phone technology in the trainees hands, has led to a revolution of accessible information (2) and tele-mentoring is a practical and cost effective alternative mentoring tool, which has had a proven impact on surgical education and the reduction of complication rates. (3, 4)

Augestad K M et al. reported on reviews of 517 articles and concluded that video conferencing is a common clinical tool for surgeons that provides a great opportunity to alter surgical practice and to offer patients the best expertise in surgical treatment, despite long distances, especially in rural areas. (5)

Berger et al. reported on the use of head mounted video cameras to build a surgical video database, which promotes decision making and technical skills of surgical trainees, who have prior competence in anticipatory and cognitive skills. (6)

Similarly, emerging technologies such as a tele-mentoring and virtual reality simulation, provide a solid ground for delivering surgical education to rural areas, thus giving young surgeons a safety net and confidence when performing newly learned techniques. (7)

Byrne AJ et al., in a 2008 review of comparative studies of clinical skills training, which included lectures, computer based teaching, manikins and video assisted feedback , reported that teaching methods have little effect on outcomes, and that better outcomes were associated with workplace based training and courses which provide repeated episodes of training , spaced out over a period of weeks or months, with facilities for practice of skills.(8)

Chang J V et al. reported experiences from different groups which demonstrated the Google Glass (a smart phone i.n the form of spectacles, with a display system, bone conduction speaker, video camera and connectivity via WiFi or Bluetooth Technologies, with or without voice command control,) These glasses have the potential to improve peri-operative care, intra-operative communication and documentation , surgical outcomes as well as surgical training. (9)

Their use was, howeve,r associated with limitations of battery life and the need for the protection of patient privacy. (10)

Implementation of video-based training requires basic knowledge of computer technology and IT training is necessary for students to benefit from computer based tutorial systems available on the internet. (11, 12)

Video based objective structured assessment of technical skills (Motion analysis) is recognized as a valid objective measure of skill.13 This is useful for rapid acquisition of surgical manual skills such as knot tying, excision of tumours with clear margins, and dissection with minimal trauma, minimal functional delay and the avoidance of complications. (14)

Application of You Tube productions to surgical training remains guarded. Fisher et al, in a study of web based formats, concluded that "The low average mean global score for overall educational value suggests an improvement of future video-based instructional materials on You Tube would be necessary, before regular use for teaching could be recommended. (15)

Nevertheless, amateur digital video recordings for training, assessment and re-validation of surgical skills, is now an accepted and recommended activity, since "such recordings and video log books and portfolios, promote quality-based and competence-based surgical training and self evaluation." (16)

Virtual reality simulators supplement standard training . From the Cochrane Database, Gurusamy KS et al, in 2009, reported on 23 trials with 612 participants. For trainees without prior surgical experiences, virtual reality training decreased the time taken to complete tasks, increased accuracy and decreased errors compared with no training. The virtual reality group was more accurate that video trainer training group.

These were randomized clinical trials, comparing virtual reality training with other forms of training, including video trainer training, no training, or standard laparoscopic training of surgical trainees, with little or no prior laparoscopic experiences.
Also included were trials comparing different methods of virtual reality training (17)

Heath MD et al presented developments based on the incorporation of 3D stereoscopic imaging in neurosurgical education Stereoscopic displays included enhancement of subjective images quality allowing proper identification of the structures of interest.

They concluded that 3D stereoscopic viewing of anatomy, accelerates the learning curve of trainees and improves the standards of surgical teaching. (18)

Hedican et al., in a review of video tape mentoring and surgical simulation in laparoscopic courses, acknowledge that the acquisition of laparoscopic skills have been aided greatly by the introduction of hand assisted laparoscopic surgery (HALS), and concluded that "Improvements in laparoscopic surgical education and application of these newly acquired skills to a simulated patient will ultimately eliminate the learning curve on actual patients and provide a useful means of establishing competence." (19)

Ponsky T A, in his publication on Seminars in Paediatric Surgery, records the contribution of virtual partners, who through telementoring and new developments in multimedia technology, has enabled "giant leaps" in paediatric surgical education. (20)

"Similarly, legal and ethical concerns for patient safety, work hours restrictions, cost of operating room time and complications, have been mitigated by surgical simulation and skills training opportunities for teaching and practicing advanced skills outside of the operating room environment, before attempting them on living patients" (21)

Rosser, J C et al contributes the following to this discussion:-
“Tele-mentoring is a live two way interactive video communication, linking a data base and clinical adaptive capability.”

"Maximal health care delivery potential requires responsible, academically credible training programs with directional guidelines.” (22)

The advent and expansion of robotic surgery demands competency based assessment in surgical training . Advance engineering technology for skills assessment, include “quantification of hand movements (instrument tracking), direction of visual attention (eye tracking), levels of stress (physiologic marker measurements) location and pressure of palpation (force measurements).” (23)

These form a combination of observer and technology based assessment of competence which guarantees successful performance and maximum ratings, desirable for high volume specialist areas such as cataract surgery.

An Edinburgh University systematic review of the role of multimedia in the role of surgical training and assessments in 21 studies, concluded that "Multimedia effectively facilitates technical and cognitive skills acquisition. (24)

Willaert et al, in their paper on training models in laparoscopy, conclude that Virtual Reality and Video Technology training are valid models for achieving similar improvement in surgical skills and that Virtual Reality training is superior to unstructured traditional training in the operating room. (25)

Finally Zerhouni, Y A, N Abu-Bonsrah, et al 2015, in their paper " General surgery education : a systematic review of training world wide,” conclude from 5229 abstracts and 228 articles fully reviewed, that the provision of effective surgical care is a priority to reduce death and disability.

They identified general surgery training programs in 52 counties. Duration of programs ranged from 2 to 8 years with a median of 5 years, and a focus in low and middle income countries on the training of non physician clinicians.

They noted a global trend towards standardization of curricula and competency-based training. (26, 27)

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Script of Video Production Project EXSU 692 c

Digital Technology , including mobile cell phones, video films and video conferencing have transformed the delivery of surgical education , research and clinical services to remote communities and countries with limited resources.

This fifteen minute production, presented in fulfillment of Experimental Surgery Research Project, EXSU 692 of my McGill University MSc program includes presentation of two original methodologies, one for selection of video material for classroom sessions and the other for demonstration of the impact of the making of video films, on the acquisition and retention of surgical skills.

This production was made by taping a mobile phone to a chair in the classroom, for the recording of a presentation to a symposium of the McGill University Health Professions Education HPE 637 Course of 2017, which was a live video conferencing session, with active participation by a student located at a University in Boston U.S.A.

The clinical information presented in the production is done with the full consent of patients and the institutions involved.

In Summary, we discussed the applications of video technology in surgical practice which included :-

Teaching, assessment and improvement of teaching skills, demonstration of technical procedures, specialist overseas consultations, patient education, monitor of patient's post - operative events, recording of patient consent and use of video technology in the prevention and resolution of medico-legal issues, a protocol for the validation, performance and teaching of alternative standards of care, and video assisted trauma surgery.

The production ends with an excerpt from a Basic Life Saving training and certification session, conducted in Montserrat in the West Indies, utilizing approved material from the American Medical Association, available on the internet.

In conclusion, we have confirmed the important role of Digital Technology, in the provision of surgical education, research and clinical services.

Video Assisted Surgical Education Research and Services

Presentation to Education of Health Professionals Course Symposium June 15 2016

Video production Appendix VIII

Objective: To illustrate and discuss the potential applications of video technology in the delivery and improvement of Surgical Education, Research and Services.

The presentation began with the showing of a 2 minute film from a TV series, "Velvet Mania", which in my opinion presented illustrations of many aspects of the topics discussed during the EDP 637 course.

Class members were deliberately given the list of topics before the showing and given only a single chance to record their assessments so that responses were not subject to the views of other participants.

The result of this exercise is summarized in the following table, which indicates that the group considered the video to be very relevant, for at least 3 subjects and that the video was therefore suitable, for use in classroom discussion on those subjects.

Video selection Assessment tool

1=Strongly disagree 2=Disagree 3=Neutral 4 =Agree

									Max 32	%
Competency Based medical education	4	4	1	1	4	1	2	3	20	
Simulation and patient safety	4	4	1	1	3	2	2	3	20	
Research and Policy Change	1	2	1	1	1	1	2	3	12	
Faculty Development	1	4	4	1	1	1	2	3	17	
Emotions and learning	4	4	4	4	4	3	3	4	30	96.5
Organizational change and leadership	4	4	1	1	1	4	3	4	22	
Assessment	4	4	3	1	4	0	2	3	21	
Clinical Reasoning	4	2	4	3	4	4	3	4	28	87.5
Evaluation of HPE Programs	1	2	1	1	1	1	2	3	12	
Professional Identity	4	4	4	2	4	4	4	4	30	96.5
Total Score	31	34	21	16	21	26	23	34	205	64

The group appeared to enjoy the exercise and made suggestions during the discussion, for improvements on the conduct of this teaching material assessment exercise.

I then presented a series of slides which illustrated other uses of video technology in surgical education.

These included:-

- Teaching. Assessment and Improvement of teaching skills
- Demonstration of Technical procedures
- Assessment of surgical skills
- Specialist overseas consultation
- Patient Education
- Monitor of patient progress
- Recording consent, and the prevention and resolution of medico-legal issues

- Research – Generate evidence for protocols for the validation, performance and teaching of alternative standards of care.
- Video assisted trauma Surgery

My presentation also included the introduction of a protocol, to determine the impact of video assisted education on the acquisition of surgical skills.

The material included entertaining examples of surgical applications and focused on alternative protocols of care, which are appropriate for use in countries of limited resources, and elsewhere, when the preferred choice is not available or affordable.

Attached is a PDF copy of the power point and video presentation, which was also video-taped by a single appropriately placed cellular phone, to further illustrate the ease, efficiency, effectiveness, economy and benefits of video technology in Surgical Education.

It is my opinion that class members enjoyed the presentation and were for the first time, introduced to several new concepts.

The time used to carry out the assessment exercise at beginning of the presentation prevented completion of the presentation, suggesting that this activity should have been at the end of the presentation.

Applications of video technology in surgical practice

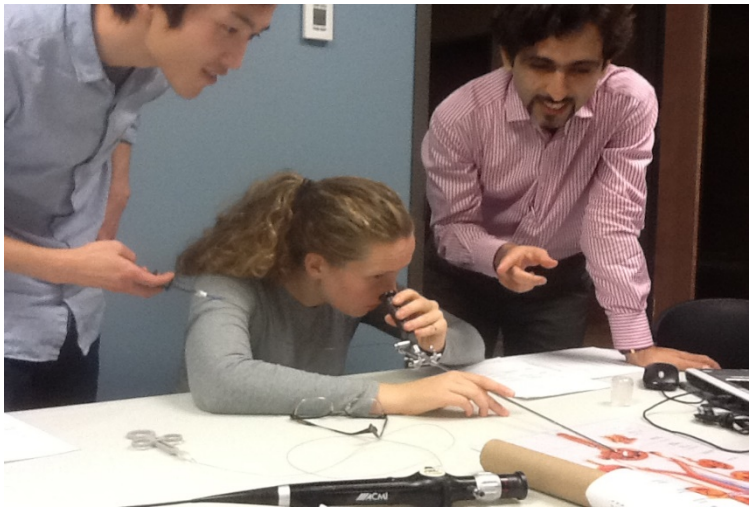
- Teaching. Assessment and Improvement of teaching skills
- Demonstration of Technical procedures
- Assessment of surgical skills
- Specialist overseas consultation
- Patient Education
- Monitor of patient progress
- Recording consent, and the prevention and resolution of medico-legal issues
- Research – Generate evidence for protocols for the validation, performance and teaching of alternative standards of care.
- Video assisted trauma surgery

Teaching -Review of Mini-lecture Presentation
Position of Presenter and Camera

Presentation Critique

- Bad positioning of presenter and camera
- Soft voice. No visual cues for speech
- Too fast for non medical personnel
- Too much for time allocated
- Inappropriate attire
- Too much movement of arms and hands
- Improper use Power Point presentation

Teaching skills by simulation Alooshuretero lithotomy video

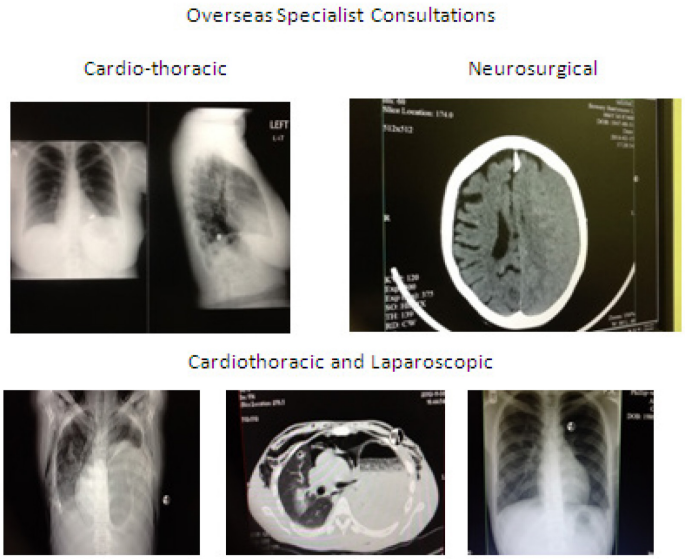


Publication – Journal of Telemedicine and Telecare
April 2000 Vol 6 No 4 Suppl 2: 45 – 47 RSM Press Lewis L, Jones J, Haynes E
School of Clinical Medicine and Research, University of the West Indies. Bridgetown Barbados

Low cost video films in the teaching of undergraduate and postgraduate medical students

A survey of medical students exposed to teaching with video films, as part of lecture presentations confirmed that a majority of students indicated that the subject matter being taught was more easily understood and enjoyable, and that such sessions generated more discussion than other forms of teaching.

Other uses of video technology
The following case histories illustrate other uses of video technology in surgical practice.
Overseas Specialist Consultations



First patient - Gun shot wound to left chest, stable condition. Bullet in the left chest. Stable enough for a CT scan.

Video tape with mobile camera. Scroll down on the CT scan. Email to cardiothoracic surgeon.

Decision made in consultation with experts at distance so that patient have the benefit of expert advice. In this particular case, bullet in lower lobe of left lung, just behind the heart.

Taken to operating theatre, Prepared for thoracotomy, Chest drain inserted. Condition stable. Observations only, Transfused, watched. Bullet was just behind her heart. Recovered without surgical intervention.

Second patient.
A neurosurgical referral, subdural. Patient GCS 14/15
Decision? To operate or wait. Craniotomy performed 7 days later by visiting neurosurgeon

Third Patient.
Bilateral chest stab wounds. Bilateral Pneumothorax., Left Diaphragmatic Hernia, containing stomach.
CT scan video consultations. After consultations by email with overseas specialists..
Transfer to private institution for 24 hours.
Endoscopic deflation of stomach. Laparoscopic return of stomach and spleen to abdominal cavity. Mini laparotomy to repair splenic laceration. .

Video technology for patient diagnosis and education.
Patient Education

- Internet Dermatology and ENT specialist care
- Cellular phones
- You Tube
- Direct consultation

Dermatology consultations.
ENT Surgeons make diagnoses and prescribe treatment at a distance for patients who email video recordings of ear nose and throat disorders.

Monitor of patient progress Post op Thyroidectomy voice recovery

I was able to demonstrate to a patient, that her vocal chords were working. A novel ways of demonstrating other applications of video technology. has many applications.
Case History

RB F Age 59 Radio iodine for thyrotoxicosis 2010 DM HT Over weight 250 lb
Enlarged thyroid with voice change May 2015 TSH 1.46

CT Scan 8/5/15 T&T Multi-nodular enlargement of the isthmus and the left lobe of thyroid. Mild retro-sternal extension of the left lobe ?the inferior limit of the enlarged left lobe is just superior to the origin of major aortic branches . Deviation of the trachea to the right and mild compression effects on the oesophagus.

Dental plate with single upper incisor at risk during laryngoscopy.

Total Thyroidectomy with identification and preservation of a parathyroid gland performed.
Discharge Day 3 Video recorded removal of sutures and Post op monitor of voice recovery.

Video 1 - Voice recovery *IMG 1478* *Video 2 - Suture Removal IMG 1083*

Research - Validation Projects

Validation Grades -Recommendation

1A Benefits clearly outweigh the risks and burdens

Evidence: High quality: Consistent evidence from randomized trials

Overwhelming evidence of some other form. ? Such as **Live video recording**

Video technology for research.

Credible research is expected to be associated with randomized control studies which require appropriate sample sizes and time consuming expensive observations.

In some situations, the use of video technology permits the presentation of over-whelming evidence of the indication, safety, method and the result of interventions.

This is illustrated by a case history of a patient with life threatening haemothorax following a stab wound to his back, whose life was saved and major thoracic surgery avoided by the use of the haemothorax blood for autologous transfusion.

The videotaped performance of the procedure and the consent for its performance and use of the videotaped material for teaching, are an illustration of the role of video technology in surgical research, education and practice.

Another illustration of innovative research using video technology was of an elderly man with a large necrotic lower limb ulcer infested with ants, which was not responding to treatment with alcohol, vinegar or betadine.

The only agent which caused immediate demise of the ants in vitro, was an insecticide fly spray, which when combined with daily sea water baths, resulted in a cheap complete healing of the patient's ulcer. led to rapid healing of the patients ulcer.

Video technology application to validation projects

Generate credible evidence on which to base protocols for the performance and teaching of alternative standards of care. For example **Autologous Blood Transfusion**

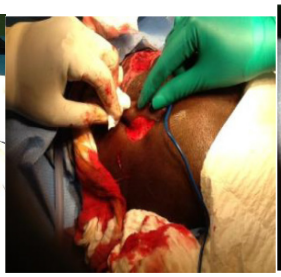
Topical Insecticide ? Leg Ulcer Research

Hospital ward out of supplies. No betadine or alcohol available. Patient not fit for general anaesthesia. Ant infested necrotic leg ulcer recovered after debridement with local anaesthesia treatments with Fish insect spray and sea water baths. Choice determined by video assisted research IMG 713, 714, 720

Video validation projects

Excerpts from Slide and Video Power Point Presentations (SVPPP)

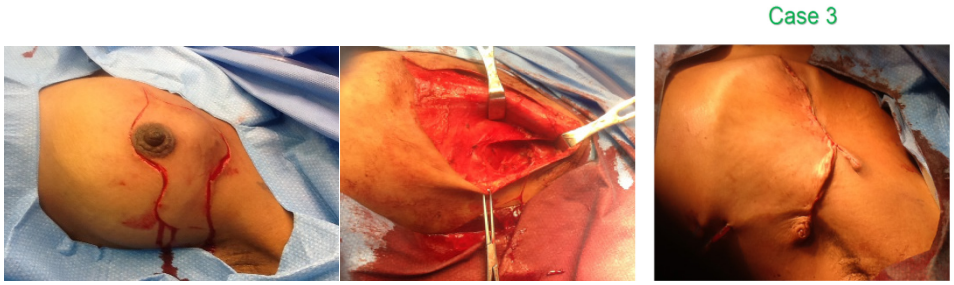
Postauricular Wolf graft repair of full thickness facial skin loss LA



Result 1 year later

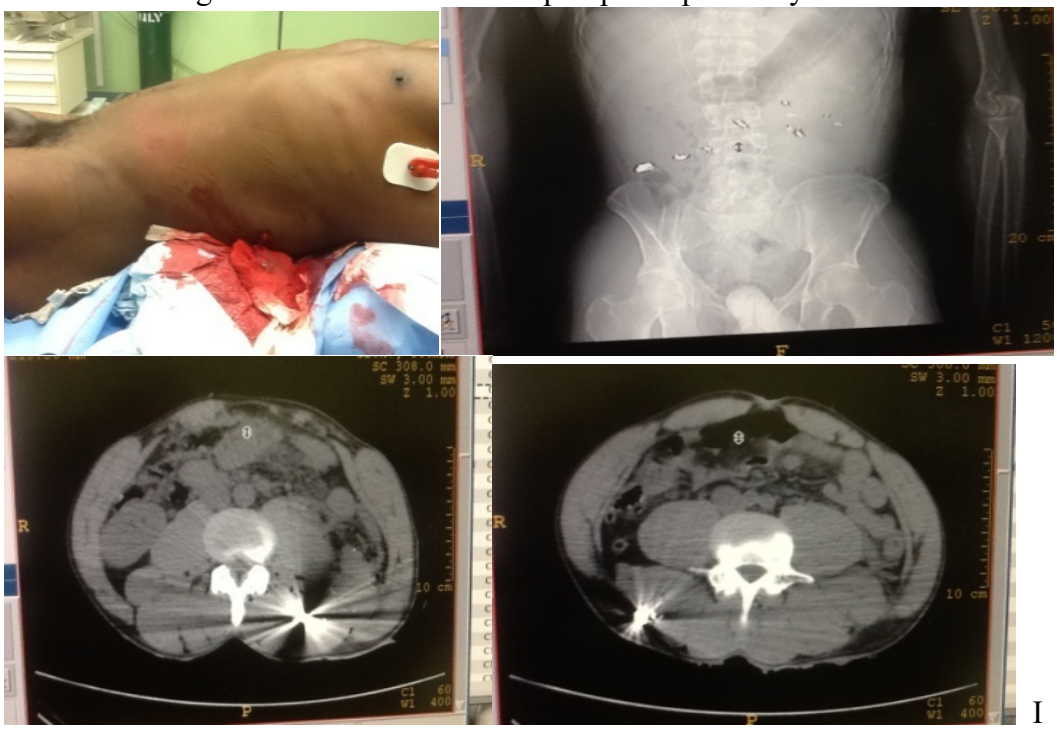
Two day inpatient care of advanced Breast cancer.

Non-resident patients with limited resources. Cost reduction treatment plan implemented. Modified Radical Mastectomy GA 2 day hospital stay.



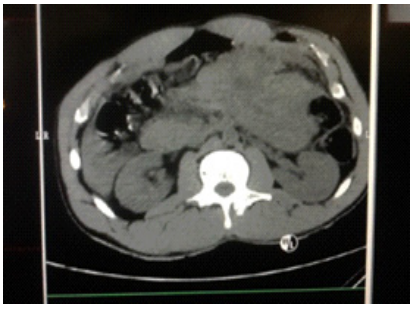
Video assisted trauma surgery

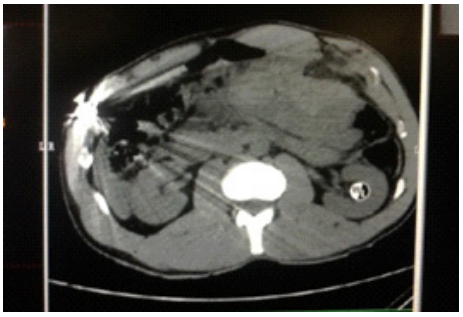
GSW Left posterior sub costal entry wound Tender abdomen but bowel sounds present. Normal vital signs. CT Scan with video preop Laparotomy avoided **IMG 9600**

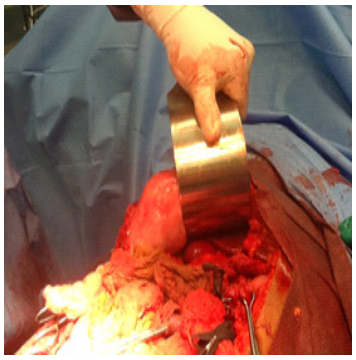


I

GSW Left anterior costal margin 9 ICS RUQ Rigid abdomen, Hypotensive CT Scan on route to Operating theatre within 30 minutes of arrival. Lacerated stomach and liver repaired. Nasogastro- jujenal tube. 4 units blood transfused. Discharged Day 21 **IMG 9778**







Conclusion

Research, development and validation of alternative standards of care can be enhanced by video assisted surgical education activities, which provide credible evidence of the results of alternative methods of practice.

Video assisted surgical education has the potential to be a major contributor to the reduction of the rising unmet surgical needs of developing countries, and the associated high morbidity and mortality rates for many surgical conditions. It will also make a major contribution to reducing the escalating costs of surgical services in developed countries.

Video assessment and monitor of surgical skills is now a common practice in hospitals which closely monitor activities in operating theatres.
This research paper includes a protocol for demonstrating that using video technology can improve training of students. This protocol includes Tutor and self-assessment forms which should demonstrate that students of Group 4, who are required to make a teaching video recording of the procedure, achieve the highest performance and competence scores.

Summary: Video technology for research.

Credible research is expected to be associated with randomized control studies which require appropriate sample sizes and time consuming expensive observations.

In some situations, the use of video technology permits the presentation of over-whelming evidence of the indication, safety, method and the result of interventions.

This is illustrated by a case history of a patient with life threatening haemothorax following a stab wound to his back, whose life was saved and major thoracic surgery avoided by the use of shed blood for autologous transfusion.

The videotaped performance of the procedure and the consent for its performance and the use of the videotaped material for the purpose of teaching, are an illustration of the role of video technology in the surgical research, education and practice.

Another illustration of innovative research using video technology was presented in a case of an elderly man with a large necrotic lower limb ulcer, infested with ants, which was not responding to treatment with alcohol, vinegar or betadine.

The only agent which caused immediate demise of the ants in vitro, was an insecticide fly spray, which when combined with daily sea water baths, resulted in a low cost complete healing of the patient's ulcer.

We have shown the application of video technology in the teaching and the assessment of teaching skills, the demonstration of technical procedures, the assessment of surgical skills, monitor of patient's progress, specialist overseas consultation, and research activities.

It permits continuous review and critique of our performances to enable maintenance and improvement of standards of care.

Digital technology has been shown to be useful in the improvement of teaching skills. The correct positioning of a lecturer in class, the quality and volume of voice, and the avoidance of distractions of hand movements and mannerisms which are inappropriate.

Recordings provided illustrations of how video technology can give better feedback to enhance improvement of teaching skills.

The making of a video of the teaching of any procedure, provides the instructor, with a permanent record and teaching aid, that will allow him to maintain excellent standards of practice, despite prolonged pauses of several years, between performance of any operation.

This was confirmed by a review of my service as a kidney transplant surgeon and an organ retrieval specialist Portsmouth United Kingdom from 2003 to 2005. Video recordings of the planned procedures were shown to the operating theatre team prior to start of operations.

Instruments and materials were promptly available when asked for, operating times were shorter and complications fewer than when no video recording was shown, prior to the organ retrieval and transplantation procedures.

A publication from the Cave Hill Barbados Campus of the University of the West Indies, published in 2000, reported that medical students confirmed that they learnt more from lectures which included video presentations.

Assessment of surgical skills Locations

Simulation Centers, Outpatient and inpatient activities, Operating Theatre

During the period 1986 to 2010, the performance of teams witnessing an operation for the first time, or at intervals exceeding 6 months, was improved significantly by the showing of a video recording of the procedure, prior to the start of operations.

Surgical Trainees, given the task of making video recordings of the procedures, were noted to achieve competency and gain approval to proceed to unsupervised surgical practice more quickly. This experience was confirmed for patients with chronic renal failure, dependent on haemodialysis and peritoneal dialysis access, renal transplantation and donor kidney retrievals.

Video assessment and monitor of surgical skills is now a common practice in hospitals which closely monitor activities in operating theatres.

Protocol to assess impact of video assisted education on the acquisition of surgical skills

Tutor and self-assessment forms expected to demonstrate that students of Group 4, who are required to make a teaching video recording of the procedure, achieve the highest performance and competence scores.
Groups of 5 students to be taught a variety of surgical procedures in the following ways.

- Group 1 Instructor demonstration only
  Group 2 Video film demonstration only
  Group 3 Instructor demonstration followed by video demonstration.
  Group 4 Group 3 Students assigned to make a training video production of the instructor's demonstration

- Assessment criteria Maximum Points 20

1	Number of listed procedural errors avoided	5
2	Duration of procedure	0 - 5
3	Listed complications avoided	0 - 3
4	Self assessed level of performance	0 - 2
5	Observer assessed level of performance	0 - 5

Good 5 Satisfactory 3 Poor 1

Chapter 10

Cognitive Apprenticeship Training for countries with limited resources

The final chapter of this thesis begins with a list of questions for surgeons practicing in remote communities, with limited resources and restricted access to the current standards of care, established in university teaching centers.

I then review the published descriptions of programs and recommendations for the improving surgical services to developing countries.

The chapter ends with a template for self assessment of surgeons who wish to provide evidence of competence in the provision of essential surgical services in resource limited communities, and justification for continuation of medico-legal insurance coverage for their surgical services.

It also serves as a guide for content of training and revalidation programs required for such surgeons.

With this chapter, I verify, and illustrate the importance of surgical training programs built on a foundation of cognitive apprenticeship, consistent with the Applied Clinical surgery course designs, Animal Laboratory Competency based training programs, Health Technology Assessments and Validation protocols advocated in this Thesis.

Questions for surgeons practicing in remote communities

These questions are based on a series of case histories of challenging cases, encountered over a 40 year period of personal cognitive surgical apprenticeship training, practice and teaching.

They clearly demonstrate the potential impact of Cognitive apprenticeship training programs on the morbidity and mortality of surgical conditions, many of which remain untreated or have poor outcomes because of delayed or unavailable interventions

1. What preoperative laboratory investigation is as effective as a CT scan with contrast, in confirming the need for appendectomy, in a patient with suspected acute appendicitis?
2. When would you proceed to craniotomy for suspected intra-cranial haemorrhage following a traumatic head injury, when CT scan services are not available?
3. How would you convert a Burr hole into a craniectomy exploration?
4. Does a road traffic accident victim with facial factures and respiratory difficulties require endotracheal intubation?
5. When is subcapsular orchidectomy under local anaesthesia indicated for patients with clinical features of prostatic carcinoma?
6. When is insertion of a supra-pubic catheter under local anaesthesia indicated for retention of urine?

7. At what stage of presentation should a patient who is hypo-volaemic from upper or lower gastro-intestinal tract haemorrhage, have emergency laparotomy rather that endoscopic intervention?
8. Does prophylactic feeding gastrostomy or enterostomy after major gastro-intestinal surgery, reduce occurrence of aspiration pneumonia and post operative malnutrition?
9. Is gastro-enterostomy under local anaesthesia for gastric outlet obstruction by a pyloric carcinoma, an acceptable palliative treatment for patients considered not fit for general anaesthesia?
10. Would you perform a selective vagotomy, following pyloroplasty for control of a bleeding duodenal ulcer?
11. When would you repair, rather than remove a lacerated spleen at a trauma laparotomy?
12. When is cholecysto-juneostomy, accompanied by an entero-enterostomy indicated for obstructive jaundice?
13. Is sigmoid colectomy under local or spinal anaesthesia for recurrent volvulus of the sigmoid colon an acceptable option for patients not fit for general anaesthesia?
14. Is total colectomy for torrential colonic bleeding, accompanied by an ileal pouch formation and ileorectal anastomosis, an acceptable option for an elderly patient presenting with torrential bleeding from both sides of the colon?
15. Are inguinal hernia repairs using nylon darn Bassini repair as effective as mesh repair procedures?
16. Should a patient with a gun shot wound causing severe life threatening injuries to larynx be considered for immediate emergency tracheostomy?
17. Should autologous transfusion of haemothorax blood be considered for patients in hypovolaemic shock, if no blood transfusion services are available.
18. Is Pyloro myotomy under local anaesthesia for a 1 month old child with clinical features of pyloric stenosis, an acceptable option for infants at risk of death?
19. Should a patient with suspected torsion of a testicle, with ultrasound doppler signs of blood flow in the epidydimis, be considered for exploration of scrotum and orchidopexy?
20. Should irreducible umbilical herniae, associated with pain and episodes of intestinal obstruction have surgical repair?
21. Should an emergency caesarian section be performed on a patient presenting with pre-eclampsia induced cardiac arrest and maternal death?

These questions present a range of surgical situations and procedures which illustrate the need for a special approach for the training of surgical practitioners in low income countries.

Nevertheless we recognize that the factors affecting outcomes and mortality are similar to those in high income countries. These factors not normally being determined by surgical skills, but by the equipment and supplies resources available and the management and administration systems in place.

This is illustrated by the results of a review in 2014, of 298 admissions to the Intensive Care Unit of the MSJMC in Antigua on 298.

Grades A = Frequent > 80% , B = Common > 30%, C = Unusual<30% and D = Rare.<10%

Causes and factors for poor outcomes.

	Grade	%
Congestive Cardiac failure, Malignancy, Major Trauma	A	86
Late presentation for care	B	37
Inadequate experience and skills of medical staff	B	33
Absence of medical supplies and essential medicines	C	29
Suboptimal communication between members of staff	C	25
Non compliance with established protocols	C	25
Delays or absence of laboratory and imaging services	C	20
Limited access to operating theatre facilities	C	20

Causes of inpatient mortality

Sepsis including decubitus ulcers	B	35
Cardiac or respiratory failure or Pulmonary embolus	C	27
Dehydration, hypovolaemia, hypoxia, hypoglycaemia	C	22
Missed or delayed diagnosis	C	20
Unavailable or incorrect investigations or treatments	C	16
Inadequate observations and responses to critical findings	C	11
Electrolyte abnormalities	C	10
Posture or sedation induced aspiration and pneumonia	D	5
Prescription errors	D	3
Poorly controlled diabetes and hypertension	D	3

The listed factors and causes for adverse outcomes and mortality indicate the potential impact of Cognitive Apprenticeship programs on the morbidity and mortality of surgical conditions in low income countries, many of which remain untreated or have poor outcomes because of delayed or unavailable interventions.

The approach of cognitive apprenticeship is ideal for low income countries which are unable to cope with the escalating costs of changing surgical practice, related to the growing influences of new technology and commercial business.

Scope of Practice for General Surgeons in remote communities

The following Template for Assessment of surgical practitioners, serves as a guide for the range and content of a surgical training program, which should aim to provide graduates who are at least **Category C** and preferably **Category B.**

Category A: Conditions managed or procedures performed frequently (>5/year). Self-evaluated competence is high without reservation.
Category B: Conditions managed or procedures performed infrequently. Self-evaluated competence is high without reservation
Category C: Conditions managed or procedures performed infrequently. Self-evaluated competence is moderate, but one could manage these conditions if requested.
Category D: Conditions or procedures one prefers not to perform.

Career Numbers code
Less than 5 – 1, 5 to 20 - 2, 20 to 50 - 3, Over 50 - 4, Over 100 – 5, Over 200 – 6, Over 500 - 7
For example Inguinal Herniae repairs - A7, Renal Transplant D4, Caesarian section C6

Minor Surgery
Abscess incision & drainage__ Laceration suture__ Cutaneous biopsy or excision __
Burns treatment __ Skin grafting __ Lipoma, lymph node excision__

Abdominal Surgery
Herniorrhaphy __ Inguinal __ Femoral __ Umbilical __
Appendicectomy __ Trauma Laparotomy __ Small Bowel __ Colorectal __
Splenectomy ___ Splenorrhaphy __
Oesaphogoscopy __ Gastroscopy __ Proctoscopy __ Sigmoidoscopy __
Flexi Sigmoidoscopy__ Colonoscopy __
Biliary tract __ Hepatic __ Pancreatic __ Retroperitoneal __
Pelvic Organs __ Anorectal __ Haemorrhoids __ Fistulae __
Laparoscopic procedures Herniae __ Biliary __ Intestinal __ Gynecology__ Dialysis __

Urogenital Surgery
Exploration and repairs of Kidney, Ureter and Bladder __ Orchidopexy __
Cystoscopy __ Ureteroscopy __ Cystostomy __ Priapism __
Prostate biopsy __ Prostatectomy __ Transurethral P __ Peritoneal dialysis__
Renal Transplant __ Donor Nephrectomy__Graft Nephrectomy

Vascular Surgery
Venous access __ Arterial access __ Thrombectomy__ Varicose Veins __
A-VShunt(Dialysis)__Renal Vascular__ Porto systemic__ Carotid Artery __
Aneurysm Repair __Peripheral Vascular Amputation __ Traumatic repair __

Thoracic Surgery
Thoracostomy __Thoracotomy __ Rib Resection __ Rib repair __
Pulmonary resection__Esophageal expl__ Diaphragmatic __ Intrathoracic vascular__

Breast Surgery

Biopsy Needle Aspiration__ Trucut __ Lumpectomy__ Quadrantectomy__

Mastectomy Simple __ Modified Radical__ Sentinel Node Bx _ Axillary node dissection __
Implant insertion__ Augmentation Mammoplasty__ Reduction Mammoplasty__

Head and Neck

Removal of foreign bodies - ears, eyes, nose and throat __
Tracheotomy __ Tracheostomy __ Lymph node excision___Central Venous Access__
Thyroidectomy __ Parathyroidectomy__ Submandibular G exc __ Parotidectomy ___
Radical neck node dissection__ Exploration of retropharyngeal space __
Head and Neck laceration and fracture repairs __
Craniotomy__ Craniectomy__Application of skull traction calipers__

Obstetrics and Gynaecology

D& C __ Vaginal Delivery__ Forceps Delivery __ Caesarian section__
Myomectomy__ Tubal ligation___ Salpingectomy__
Ovarian wedge resection and excision__ Hysterectomy__ Cone Biopsy of Cervix

Paediatric surgery

Laparotomy __ Herniotomy___ Ramstedt__ Circumcision___Orchidopexy___Hypospadias

Orthopaedic Fracture reductions__ Internal Fixations___ Tendon and Muscle repairs___

Surgical education programs for developing countries

The governments of many countries with limited resources are now expected by their populations who have access to worldwide television, to provide high quality, up to date surgical services, even though the majority have inadequate access to basic health care services. (1)

Modern technology now allows a closing of the gap between demand and supply, but must be appropriately applied to meet the needs of each country.

The adaptation of modern technologies such as laparoscopic and robotic surgical services for countries with limited resources is desirable, but must not replace the retention of traditional surgical skills and clinical approaches, which are the only affordable and therefore appropriate services for the vast majority of the world's population. (2)

Choy I , S Kitto, et al have provided clear guidelines for overcoming the "Barriers to the uptake of laparoscopic surgery in a lower middle income country." They identified the three overarching barriers to be:- 1 - the organizational structure for funding laparoscopic procedures, 2 - the hierarchical nature of the local surgical culture, and 3 - the expertise and skills associated with change in practice. (3)

The 1904 William Halsted models of surgical residency programs adopted world-wide, have been modified in some developing countries, to include primary examination, rural surgical posting and submission of dissertation for final certification. (4)

The authors Ajao O G and A Alao, who reported this in their paper of 2016, concluded that "The innovations introduced into surgical residency training programs in developing countries are the result of the misconception of what surgical residency training programs entail." (4, 5)

Other researchers in this subject, such as Blankstein et al, support a model of online distance education, and conclude that structured online courses in neurosurgery allow for dynamic feedback, and delivery of educational material in a "time locked "curriculum." They also add that curriculum design should create courses that "fill specific needs or identify educational objectives." (6)

Special attention is required for dealing with the demand for coping with the large burden of orthopaedic diseases in developing countries. A significant increase in the number of service providers and orthopaedic training programs, is required to address these conditions.(7, 8)

International collaboration has a role in meeting this deficiency, as illustrated by the report of Cameron, BH and colleagues in 2010, "International surgery: the development of postgraduate surgical training in Guyana." (9)

They concluded that "Guyana has proven that, with visiting faculty assistance, it can mount its own postgraduate training suitable to national needs and will provide a career path to encourage its own doctors to remain and serve their country."

Medical student clerkships and electives make a contribution though "supervised, independent student learning and global health service, integrated into a traditional surgical clerkship." (10)

The consortium approach to surgical education is illustrated by Cook M and Howard B.T They identified six areas of educational need: formal didactic, increased clinical mentorship, longer term alliance presence, equitable distribution of teaching time, improved coordination and language skills, and reciprocal exchange rotations at US hospitals. (11)

Similar missions to Haiti (12) and Brazil (13) have provided surgical services to underserved populations, training local doctors and building local sustainability.

In addition, several institutions have reported on successful global health activities for surgical residents and faculty which were effectively integrated into an academic surgical residency program through relationships with training programs in low income countries.(14)

The role of the internet in promoting new surgical skill in developing countries has been recognized. Medical students in Nigeria participating in a cross sectional survey by a structured self administered questionnaire made responses which led to the following conclusion.

"In our setting, a substantial number of undergraduate medical students are familiar with the use of internet tools for learning and believe that the tools may have utility in surgical education. However, to further consolidate and enhance learning experience, it may be useful to integrate the learning modality with the traditional mode if teaching through a well thought out curriculum modification." (15)

In 2008, Udwadia T E and G Sen, (16) reflecting on 50 years' experience of surgical education in India, concluded that:-

> Surgical training has to be tailored to the specific needs of each country. Surgery is a humanitarian science." "The thrust of surgical training in India should be, and hopefully will be, not just to be on par with the developed world, but more important, to ensure good surgical care to all Indians, in all places.

These published opinions, encompass the objectives of this Thesis on "Appropriate Surgical Education for countries with limited resources." and support my view that "The approach of cognitive apprenticeship, when applied to traditional methods of surgical education, as well as the newer methods which utilize digital technology for tele-simulation training, is the approach most likely to reduce the unmet surgical needs and burdens of communities which are remote and have limited resources." (17, 18)

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