FUSE

Fundamental Use of Surgical Energy

FUSE™

Fundamental Use of Surgical Energy

FUNDAMENTAL USE OF SURGICAL ENERGY

Japanese Surgical Education Summit 2nd Annual Meeting

Instructional Design and the Use of Simulation for Surgical Training: Theory to Practice

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Centre universitaire de santé McGill

McGill University Health Centre

The Steinberg-Bernstein Centre for MINIMALLY INVASIVE SURGERY at McGill University

Disclosures

- Nothing to Disclose

Surgical Training

Apprenticeship model:

Changing Surgical Paradigm

Changing surgical education paradigm*:

- Limited work hours
- Decreased case volumes
- Increased emphasis on safety and accountability
- Cost control
- Emerging technologies

* Frank JR, Snell LS, Cate OT, Holmboe ES, Carraccio C, Swing SR, et al. Competency-based medical education: theory to practice. Medical teacher. 2010;32(8):638-45.

What is Competence?

- "Expert surgeon":
  - Technical skills
  - Judgment, decision-making
  - Teamwork
- Deficiency in these aptitudes strongly contribute to surgi rors

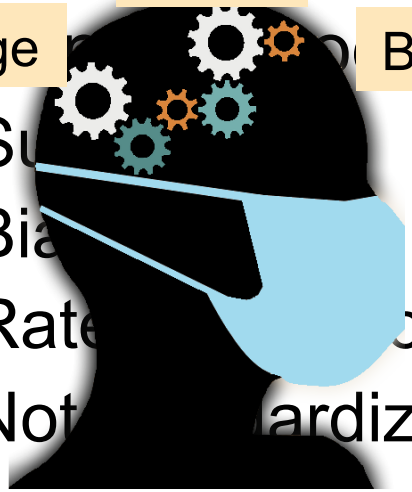
Skills

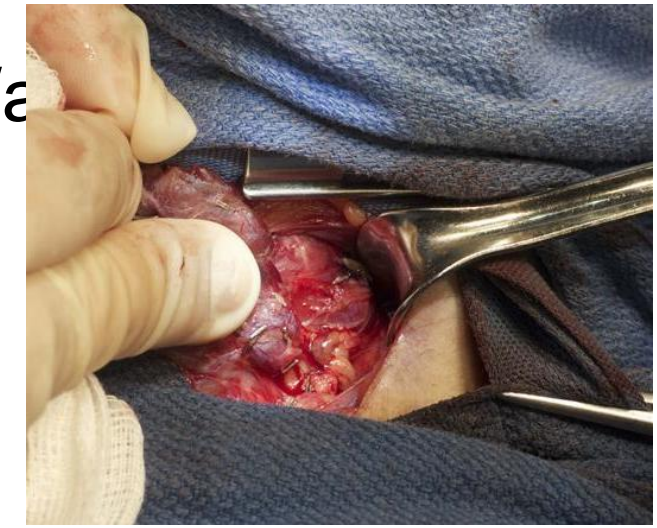
Knowledge

Behaviors

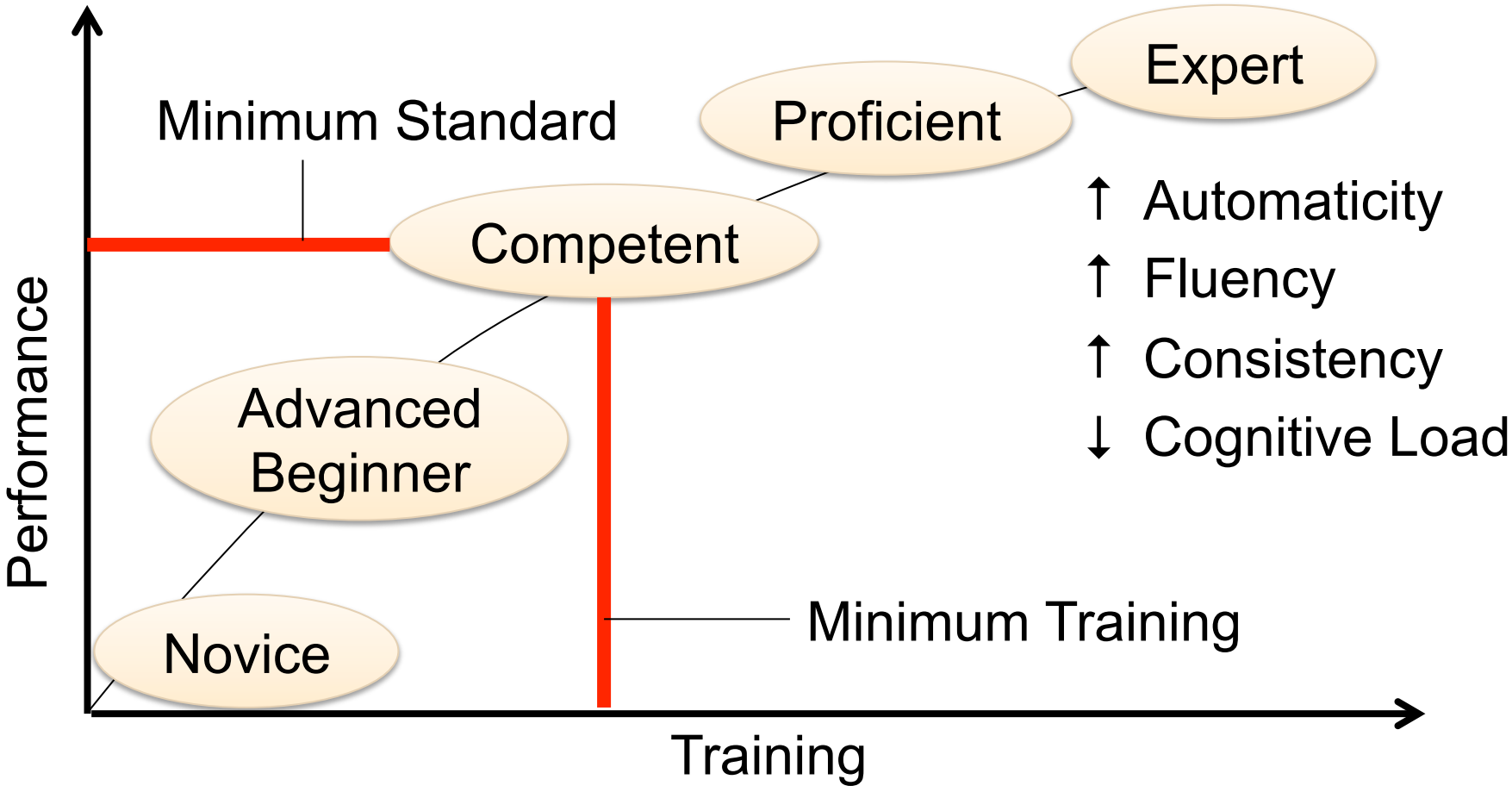
aching/a

  - Su
  - Bia
  - Rate or-dependent
  - Not ardized



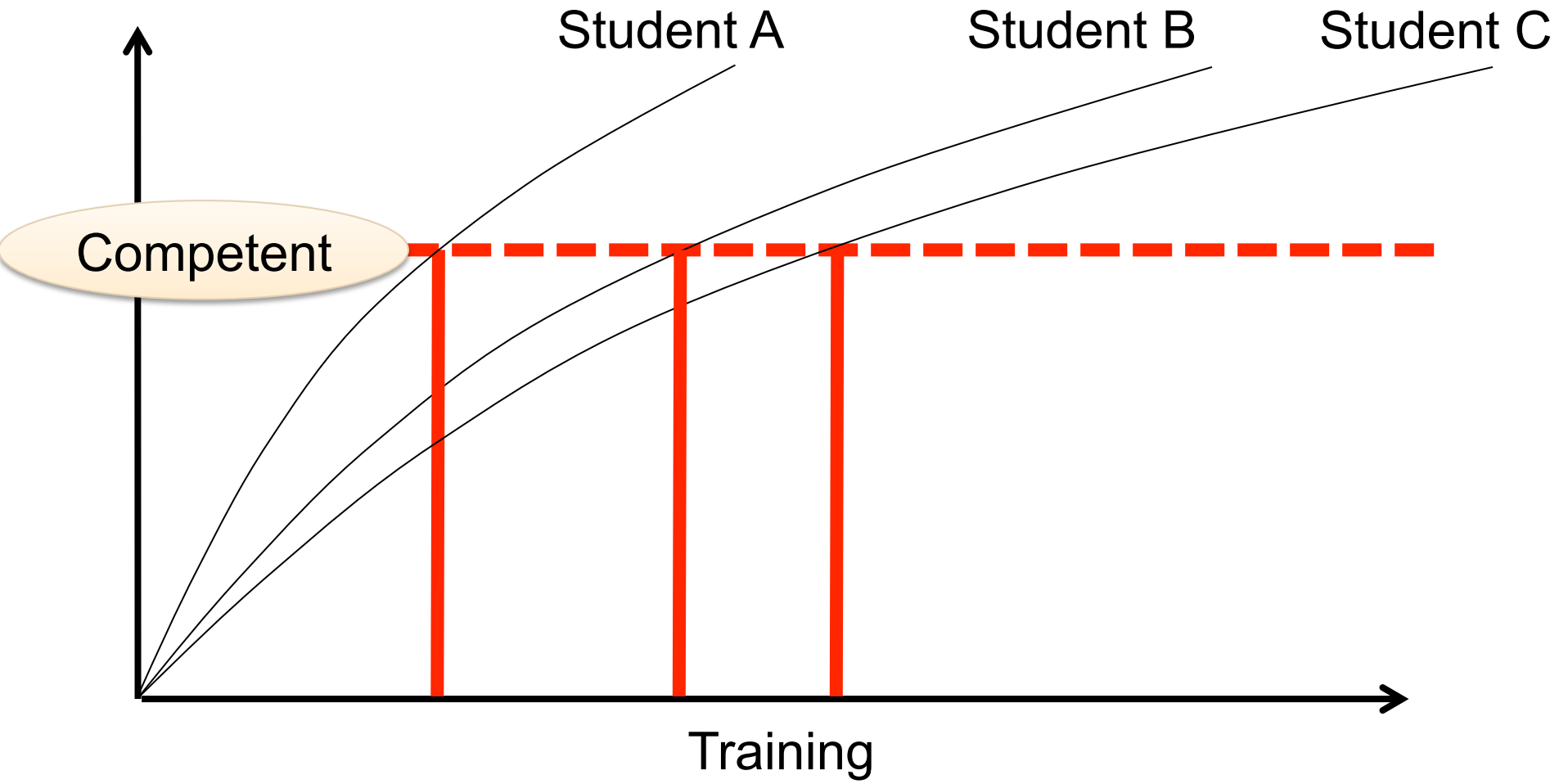


What is Competence?

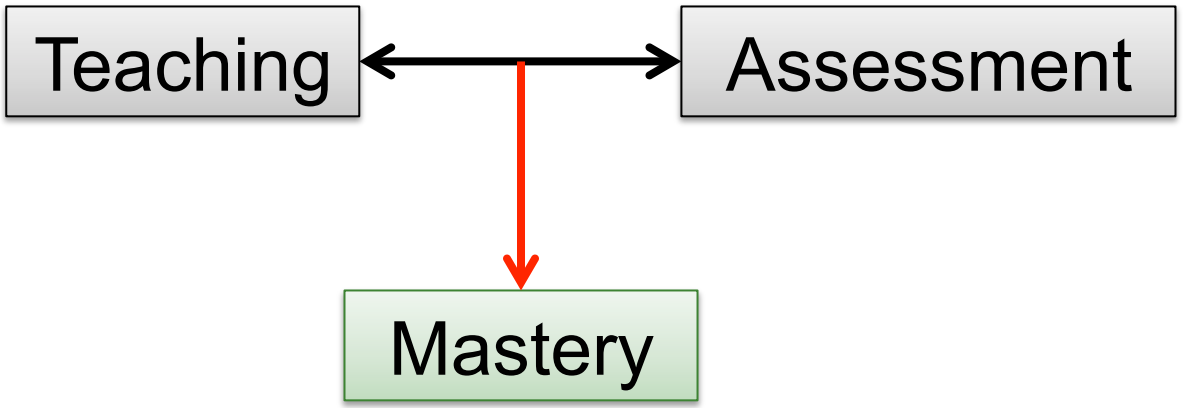


Dreyfus, H. L., & Dreyfus, S. E. (1986). *Mind over machine: The power of human intuition and expertise in the era of the computer.* New York: The Free Press.

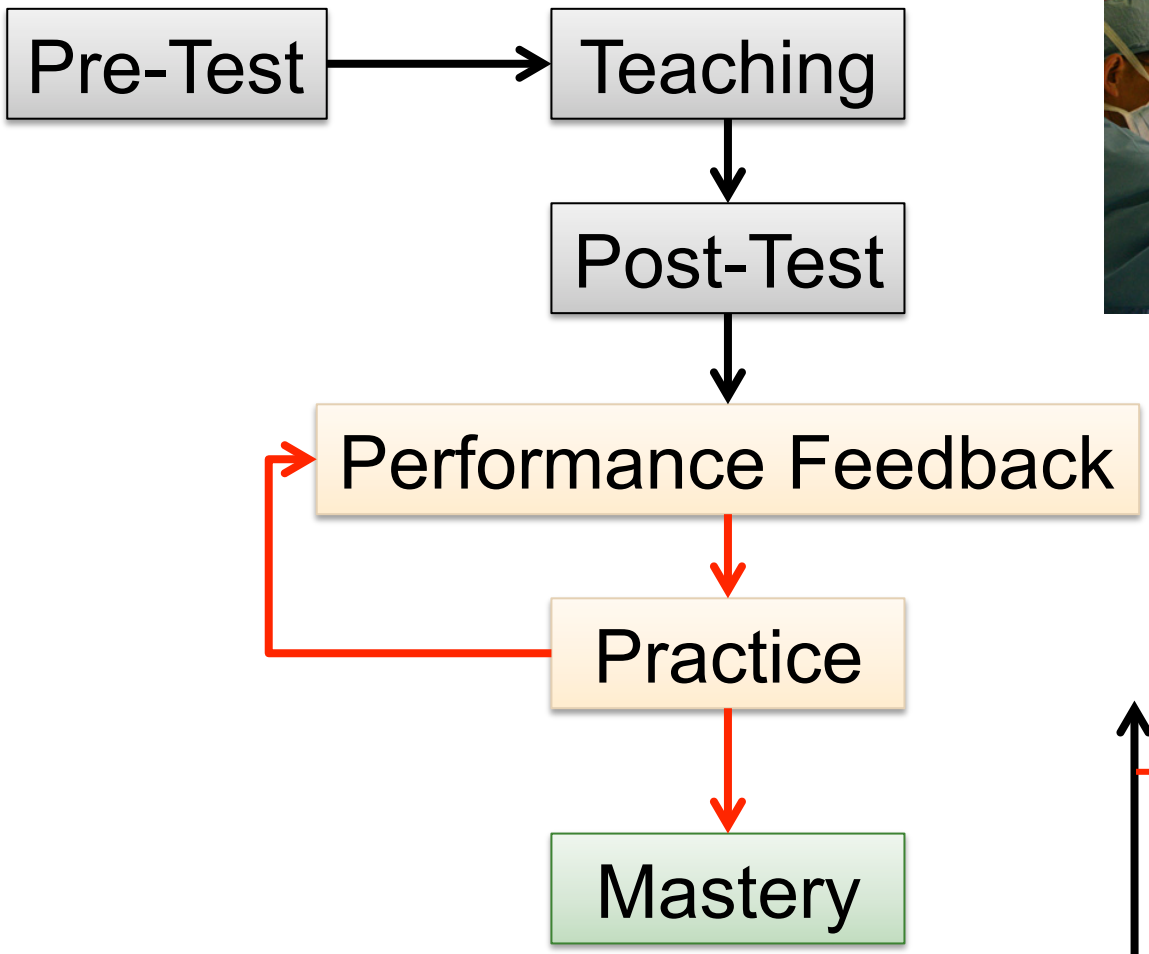
What is Competence?

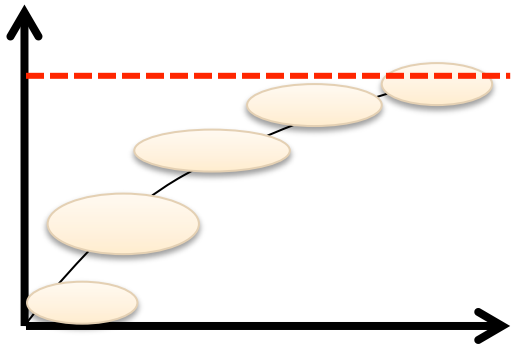


Instructional Design



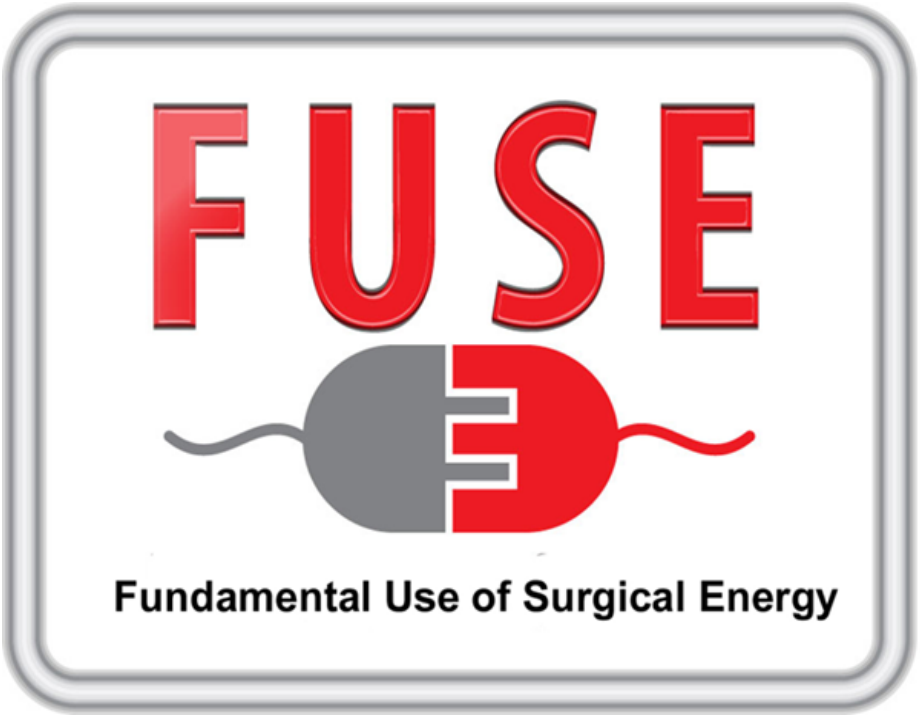
Instructional Design





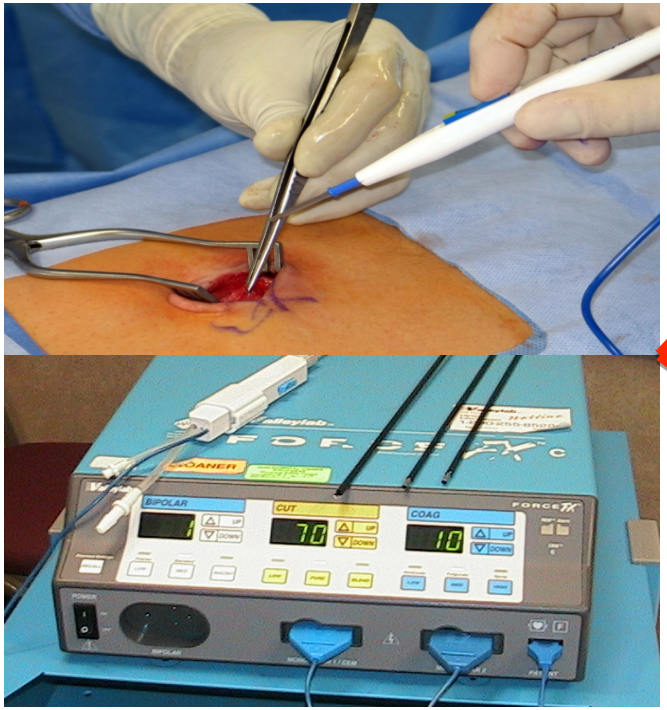
Example: FUSE

- Fundamental Use of Surgical Energy™ (FUSE)



Example: FUSE

ほとんどの外科的手技でエネルギーデバイスを使用



合併症

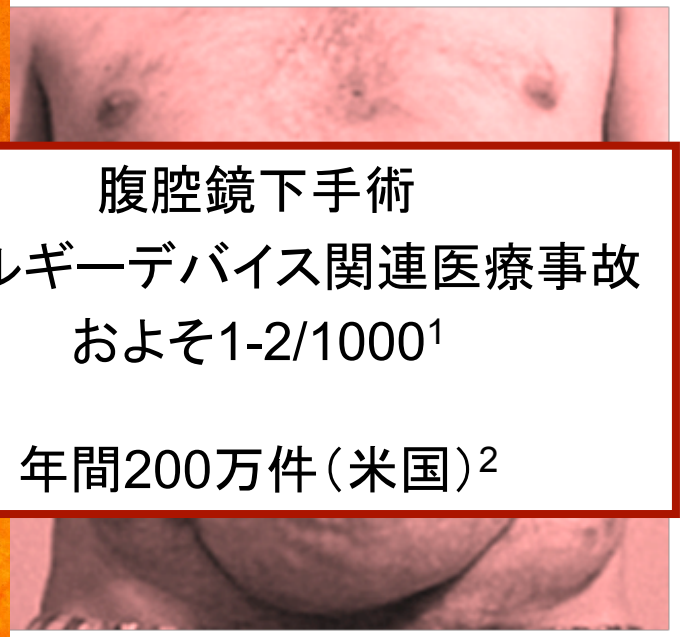
- 手術室火災
- 患者熱傷
- 他デバイスへの干渉

理解不十分

Example: FUSE

NBC Today Show: November 2011

Example: FUSE

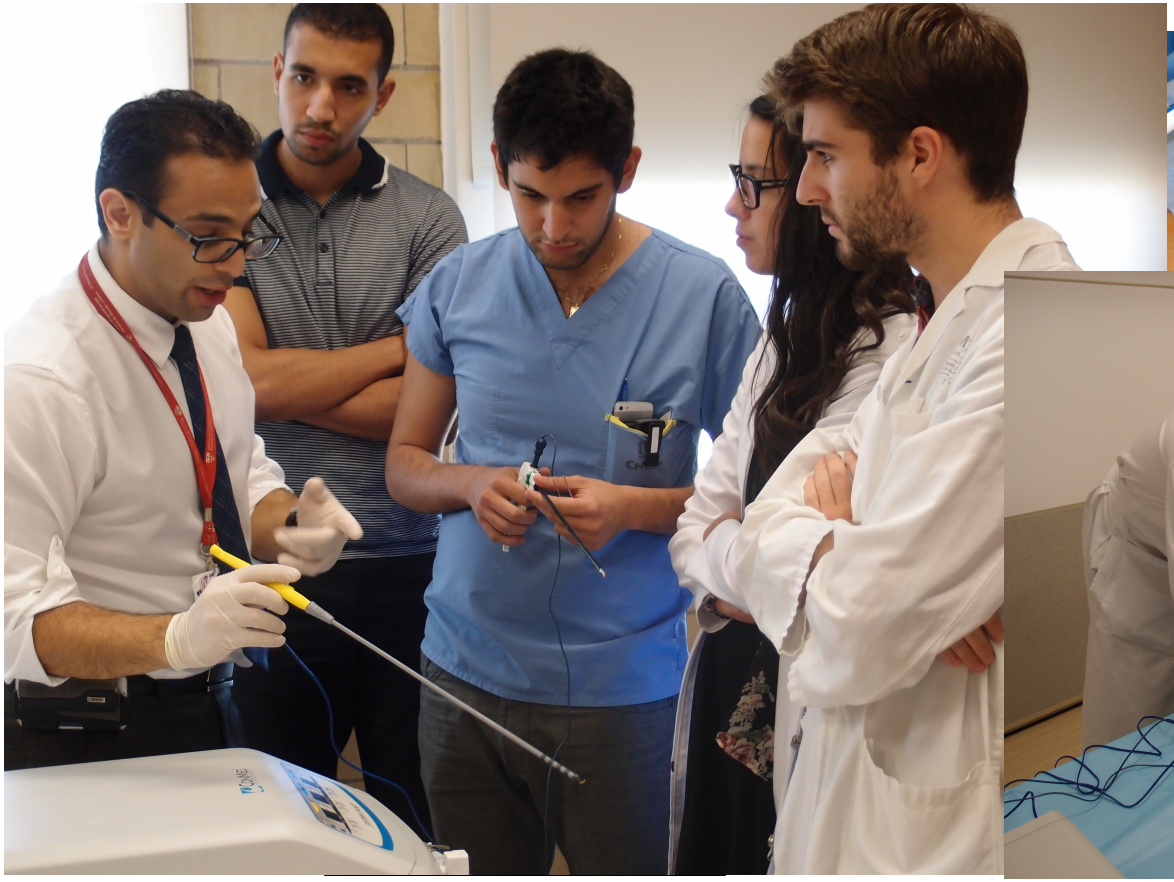


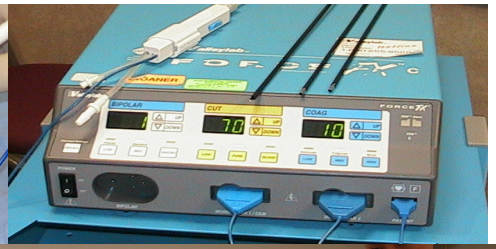
腹腔鏡下手術
エネルギーデバイス関連医療事故
およそ1-2/1000[1]

年間200万件（米国）[2]

1. Nduka CC et al. Cause and pr scopy. 1994 J Am Coll Surg 179:161-170
2. Market engineering research f roscopy access and closure instruments. Medical and Healthcare Marketplace Guide. 1999. Frost and Sullivan, London, UK

Example: FUSE





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FUNDAMENTAL USE OF SURGICAL ENERGY

Objectives

- To outline the steps for designing a surgical curriculum
- To perform a task analysis
- To list the steps for developing a metric
- To design a curriculum using best-practices in education
- To describe the utility of simulation for surgical training

Instructional Design

ADDIE Framework:

- **A**nalyze
- **D**esign
- **D**evelop
- **I**mplement
- **E**valuate

Instructional Design

ADDIE Framework:

- **A**nalyze
- **D**esign
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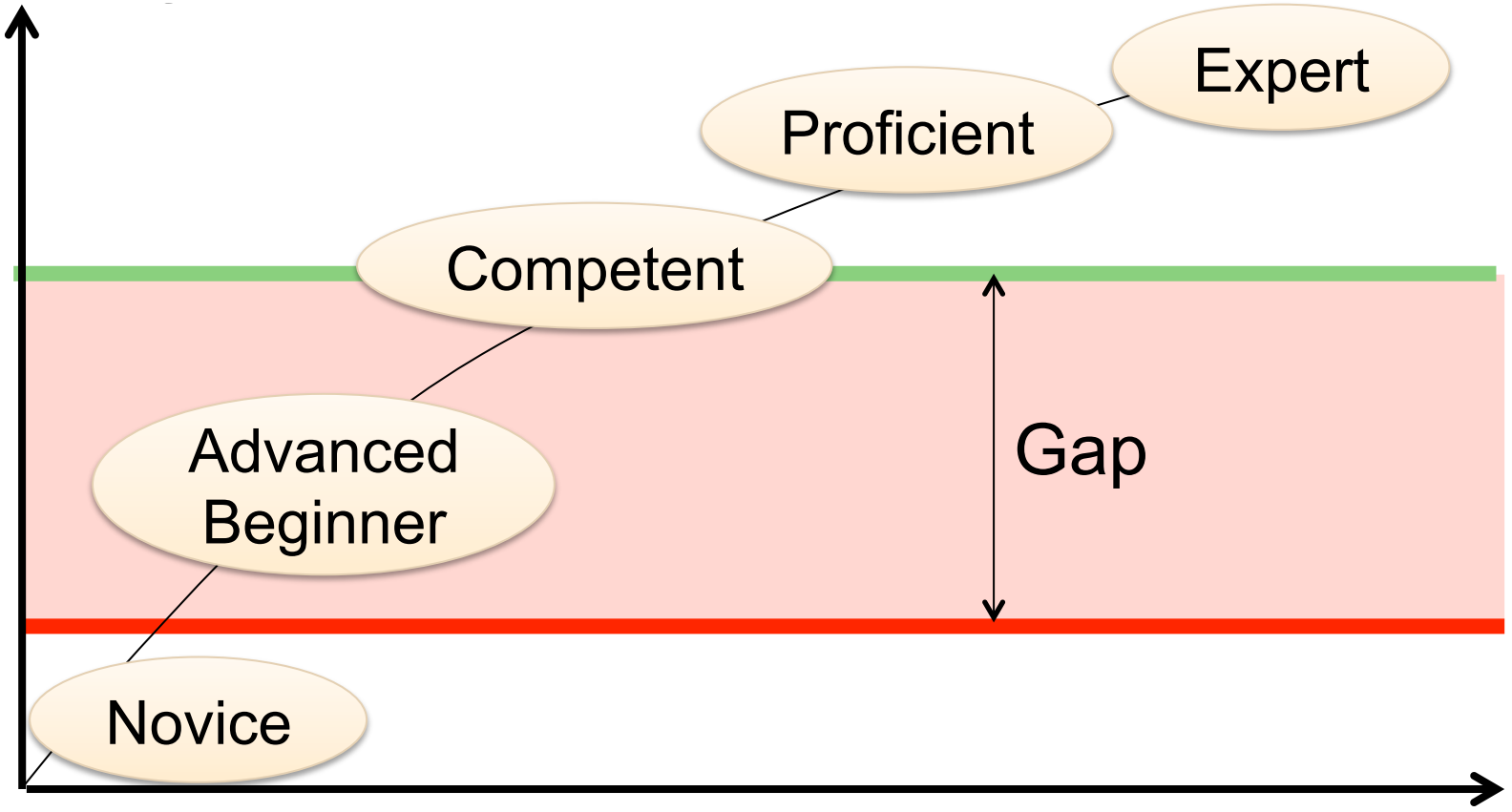
- **E**valuate

Instructional Design – Analyze

Needs-Assessment:

1. Gap analysis



Instructional Design – Analyze

Needs-Assessment:

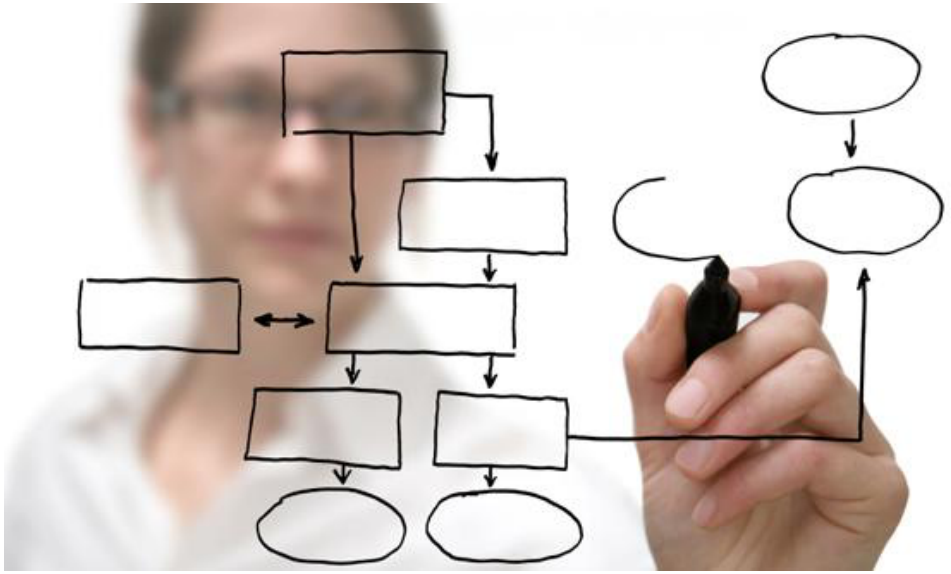
2. Task analysis

Instructional Design – Analyze

Needs-Assessment:

2. Task analysis

- Evidence-based if possible
- If no evidence: expert consensus

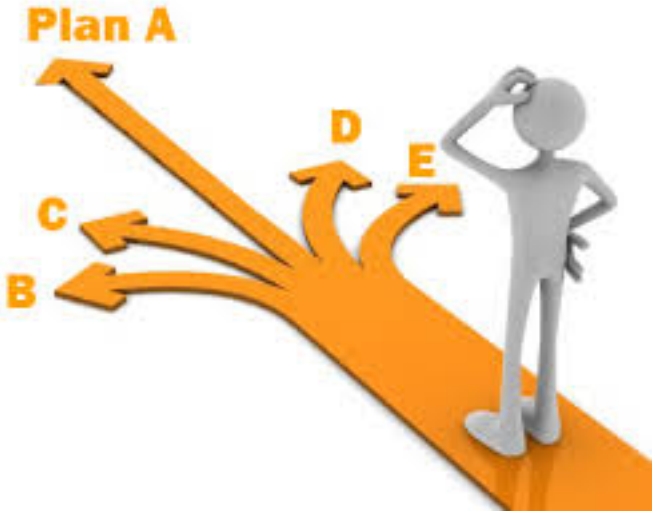


Instructional Design – Analyze

<u>Needs-Assessment:</u>

2. Task analysis

- Challenges:
  - Difficulty unpacking expert knowledge*
  - Lack of consensus
  - Lack of data/standards



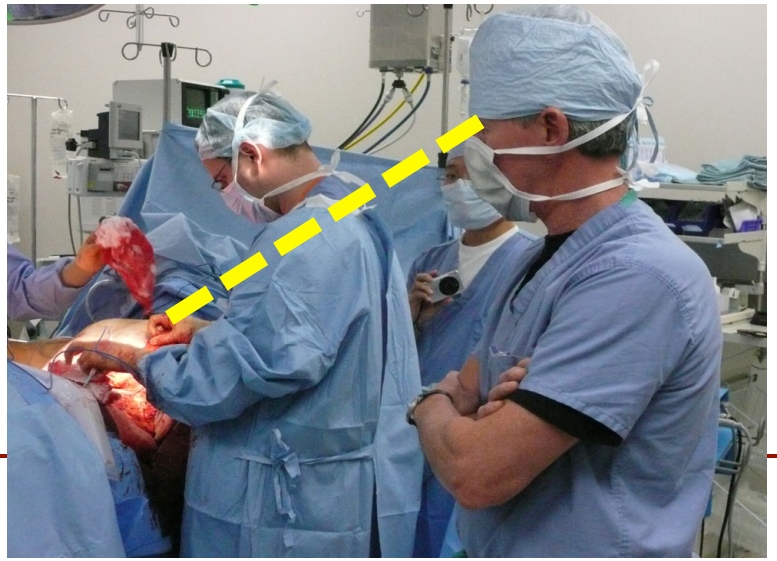
* Sullivan ME, et al. The use of cognitive task analysis to reveal the instructional limitations of experts in the teaching of procedural skills. *Acad Med* 2014; 89(5):811-6

Instructional Design – Analyze

Needs-Assessment:

2. Task analysis

- Techniques:
  - Interviews +/- video
  - Focus groups
  - In-vivo observation
  - Literature analysis
  - Think aloud



Instructional Design – Analyze

Needs-Assessment:

3. Specification of performance standards

- What is successful performance?
- What defines expertise?
- What needs to be done, under what conditions?
- Standards will be used as basis for assessment tools

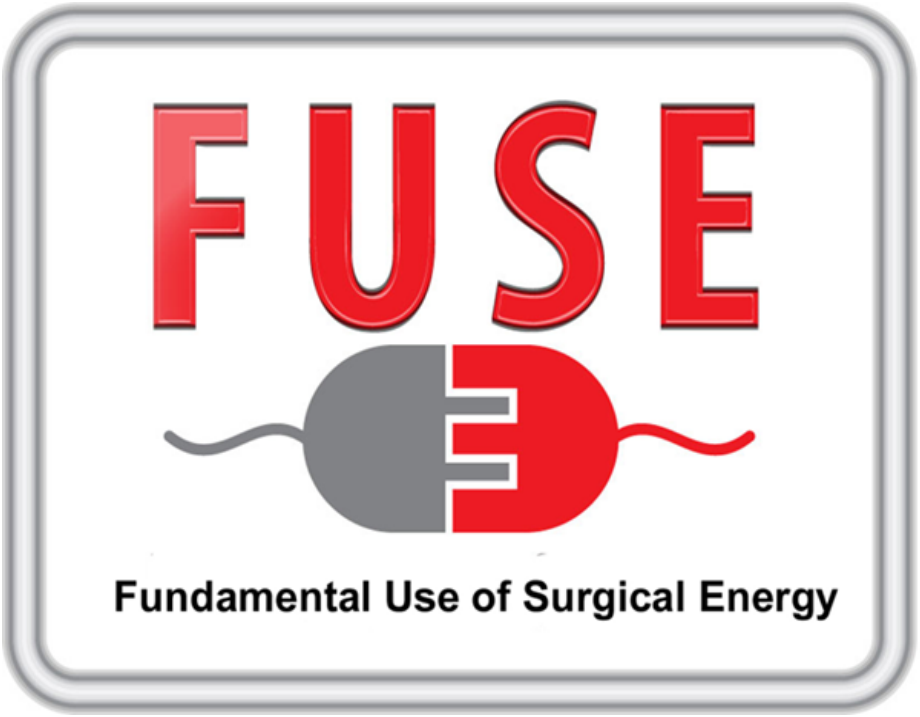
Instructional Design – Analyze

Needs-Assessment:

4. Learner analysis
   - Who are the learners? What level are they?
   - Are they motivated to learn a new skill?
5. Organizational analysis
   - Barriers to successful performance?
   - Available resources?
   - Poor climate can hinder transfer of training
   - Timeline?
   - How does this fit into the training curriculum

Example: FUSE

- Fundamental Use of Surgical Energy™ (FUSE)



Example: FUSE

Surg Endosc (2012) 26:2735–2739
DOI 10.1007/s00464-012-2263-y

Surgeons don't know what they don't know about the safe use of energy in surgery

Liane S. Feldman · Pascal Fuchshuber · Daniel B. Jones · Jessica Mischna · Steven D. Schwaitzberg · the FUSE (Fundamental Use of Surgical Energy™) Task Force

Received: 24 January 2012 / Accepted: 10 March 2012 / Published online: 27 April 2012

FUSE™ Fundamental Use of Surgical Energy

FUNDAMENTAL USE OF SURGICAL ENERGY

Example: FUSE

Surg Endosc
DOI 10.1007/s00464-015-4243-5

Surgeons have knowledge gaps in the safe use of energy devices: a multicenter cross-sectional study

Yusuke Watanabe[1,2] · Yo Kurashima[1] · Amin Madani[2] · Liane S. Feldman[2] · Minoru Ishida[3] · Akihiko Oshita[4,5] · Takeshi Naitoh[6] · Kazuhiro Noma[7] · Keigo Yasumasa[8] · Hiroshi Nagata[9] · Fumitaka Nakamura[10] · Koichi Ono[11] · Yoshinori Suzuki[12] · Nobuhisa Matsuhashi[13] · Toshiaki Shichinohe[1] · Satoshi Hirano[1]

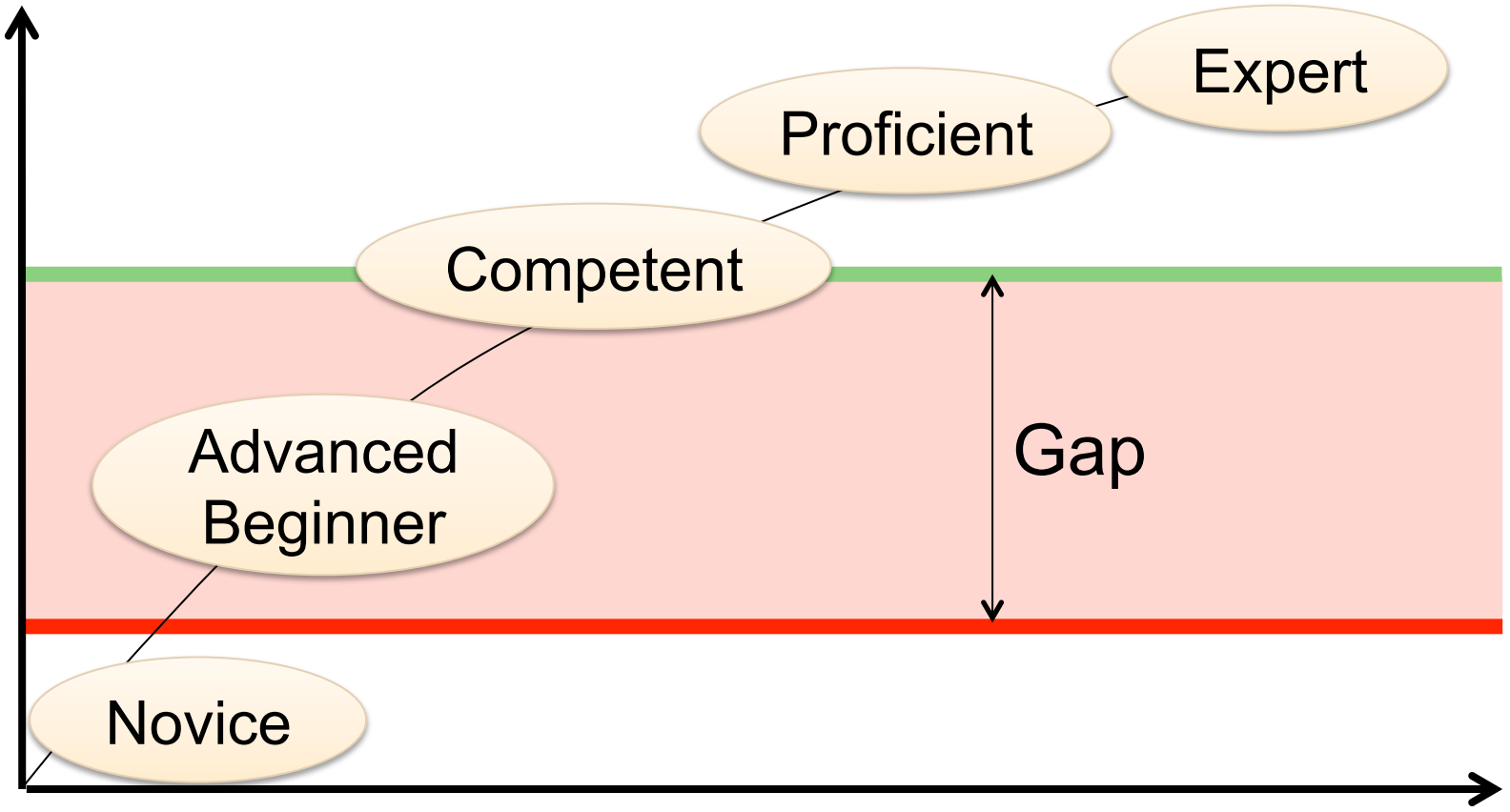
Received: 15 February 2015 / Accepted: 10 May 2015

Watanabe Y, et al. Surgeons have knowledge gaps in the safe use of energy devices. Surgical Endoscopy. 2015. In Press.

Example: FUSE

Needs-Assessment:

Gap analysis

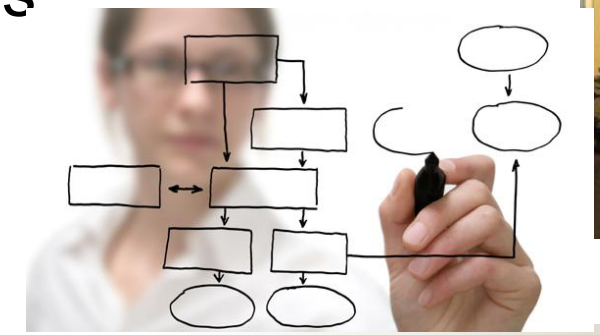


Example: FUSE

Task Analysis:

SAGES – FUSE Task Force

- Surgeons
- Anesthesiologists
- Nurses
- Engineers



Instructional Design – Design

ADDIE Framework:

- **A**nalyze
- **D**esign
- **D**evelop
- **I**mplement
- **E**valuate

Instructional Design – Design

Design Training:

1. Develop instructional/learning objectives

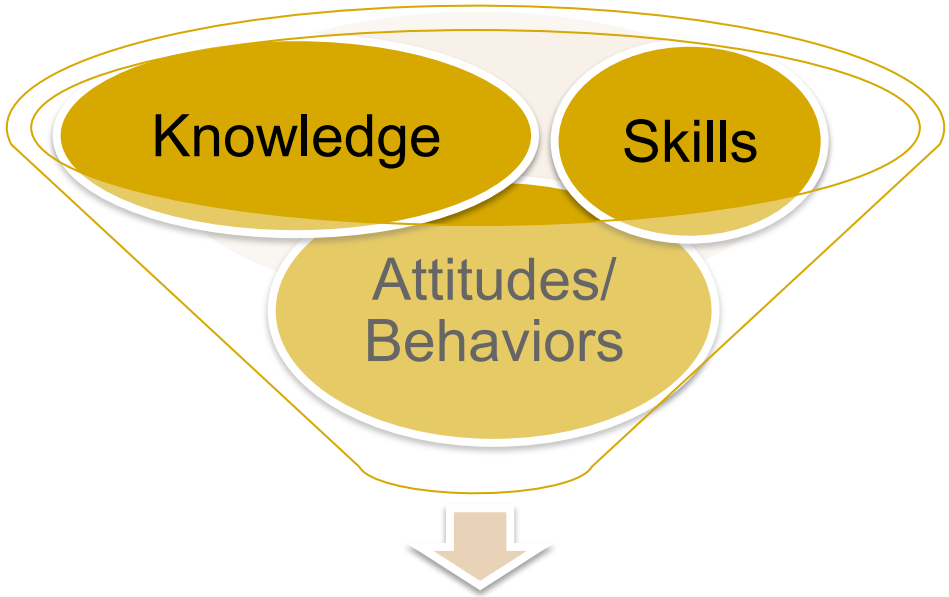
- Objectives for achieving competencies
- Separate statement for each competency
- For surgical procedure, involves translating procedure into appropriately sized steps

Instructional Design – Design

Design Training:

1. Develop instructional/learning objectives

- Bloom's Taxonomy of learning:



Learning Surgical Procedure "Competency"

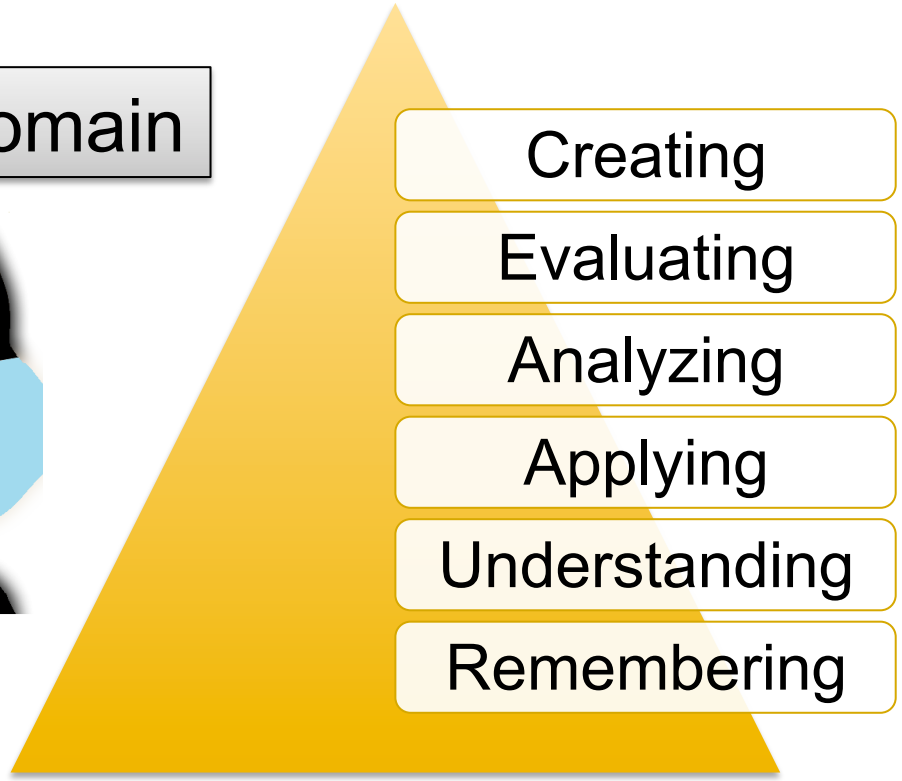
Instructional Design – Design

Design Training:

1. Develop instructional/learning objectives

- Bloom's Taxonomy of learning:

Cognitive Domain



Instructional Design – Design

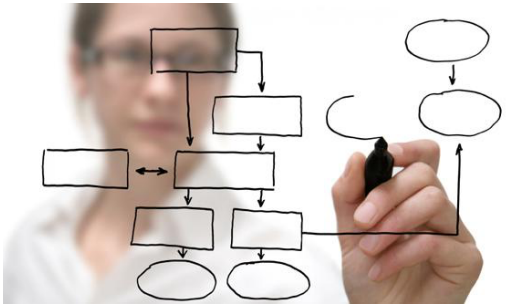
Design Training:

1. Develop instructional/learning objectives

- Describes the outcome – **measurable**
- Describes what the learner will be doing when demonstrating achievement of the objective - **specific**
- Define important conditions, if any
- Define criterion for acceptable performance

Example: FUSE

SAGES – FUSE Task Force



63 Learning Objectives

FUSE Curriculum

	Curricular Domains (10)	Objectives (63)
1	エネルギーデバイスの基本	7
2	有害事象のメカニズムとその予[illegible]	20
3	モノポーラデバイス	[illegible]
4	バイポーラデバイス	5
5	アブレーション	4
6	軟性内視鏡デバイス	4
7	超音波エネルギーデバイス	5
8	マイクロウェーブエネルギーデバイス	2
9	小児におけるエネルギーデバイス	3
10	他の医療機器との組み込み	9

手術室での患者
安全性に重視

FUSE Example: 学習目標

1. 高周波エネルギーが細胞／組織におよぼす影響
2. 高周波エネルギーデバイスに関わる用語
3. エレクトロサージカルユニット（電気メス本体）の役割
4. モノポーラとバイポーラの違い
5. エネルギーデバイス関連有害事象の発生メカニズム
6. 有害事象の回避する方法
7. 手術室火災を防ぎ、また手術室火災にどのように対処するか

Instructional Design – Design

Design Training:

2. Develop performance standards for each objective (**"metrics"**)

- Acceptable level of performance for "passing"
- Metric for each learning objective or "competency" based on task analysis
- Pass score determined empirically
- Oriented towards individual or team

Instructional Design – Develop

ADDIE Framework:

- **A**nalyze
- **D**esign
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- **E**valuate

Instructional Design – Develop

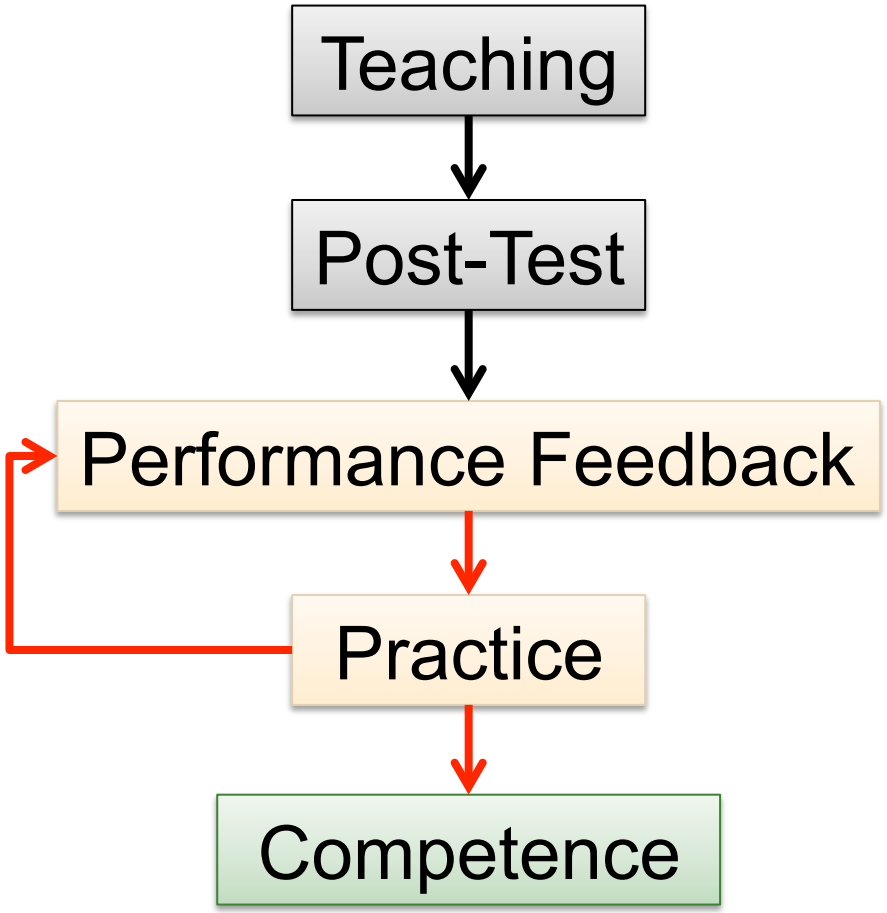
Develop Instruction:

- Establish prerequisites
- Develop didactic material (*keep to minimum for performance-based training)
- Develop computer/web-based components
- Develop simulation scenarios, virtual patients
- Tie instruction back to learning objectives (“blueprints”)

Instructional Design – Develop

Develop Instruction:

- Developing good learning strategies
  - Feedback
  - Tailor practice to weaknesses (deliberate practice)
  - Integrate metrics into teaching strategy



Example: FUSE

Instructional Design – Implement

ADDIE Framework:

- **A**nalyze
- **D**esign
- **D**evelop
- **I**mplement
- **E**valuate

Instructional Design – Implement

Implement Instruction:

- Train instructors:
  - Cover curriculum and learning objectives
  - Method of delivery
  - Testing procedure
- Train learners on any new tools, registration
- Pilot (dry run) the course
- Ensure all equipment is ready/functional
- Teach the course!
- Collect data for feedback

Example: FUSE

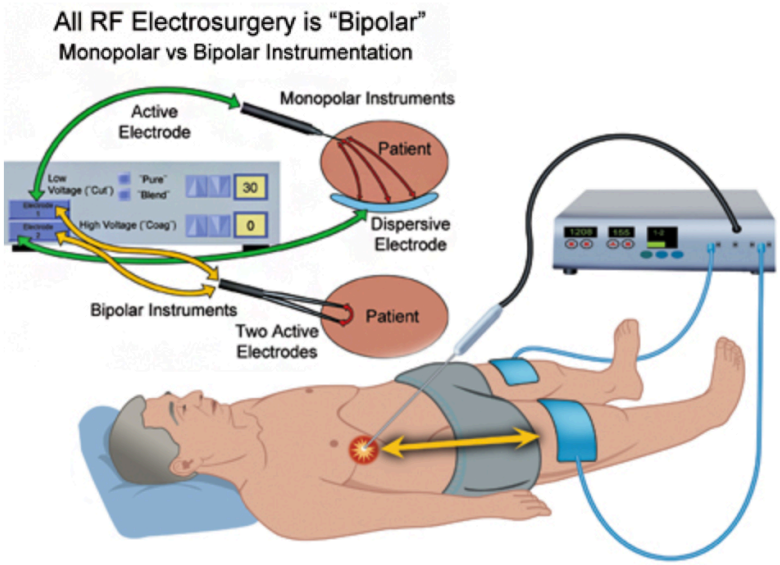
FUSE™ Fundamental Use of Surgical Energy

FUNDAMENTAL USE OF SURGICAL ENERGY™ | FUSE

A SAGES Fundamentals Program

Search

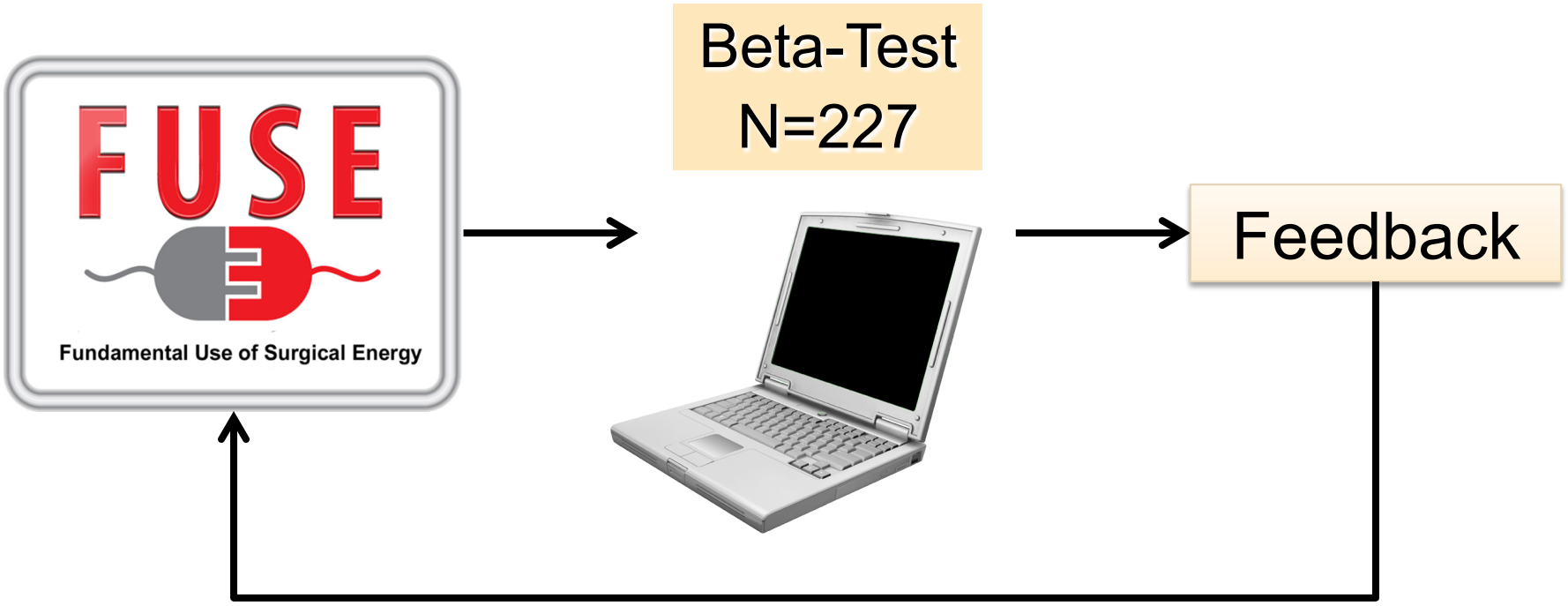
Home | About FUSE | Didactic Content | Testing Information | Program Coordinators | Test Proctors



Fundamental Use of Surgical Energy™ (FUSE)

FUSE, is an educational program comprised of an interactive web-based multimedia-enhanced didactic curriculum and an online multiple choice cognitive exam. The program is being designed to certify that a successful candidate has the demonstrated knowledge fundamental to the safe use of surgical energy-based devices in the operating room, endoscopic suite and other procedural areas.

Example: FUSE



*Feldman LS, Fuchshuber P, Jones DB, Mischna J, Schwaitzberg SDFundamental Use of Surgical Energy (FUSE) Certification: Validation and Predictors of Success. Surg Endosc. 2015 In Press.

Instructional Design – Evaluate

ADDIE Framework:

- **A**nalyze
- **D**esign
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- **E**valuate

Instructional Design – Evaluate

Evaluate Training:

- Development of surgical expertise
- Levels of outcomes: Kirkpatrick framework

Results (patient outcomes)

Behavior (performance)

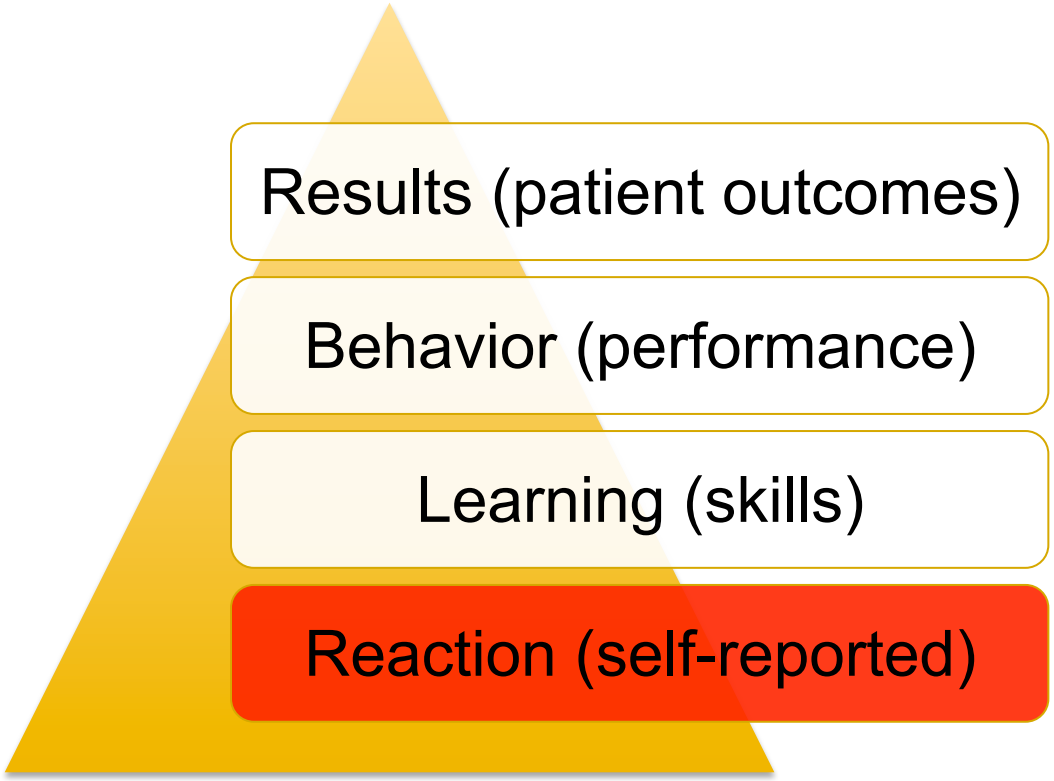
Learning (skills)

Reaction (self-reported)

Instructional Design – Evaluate

Evaluate Training:

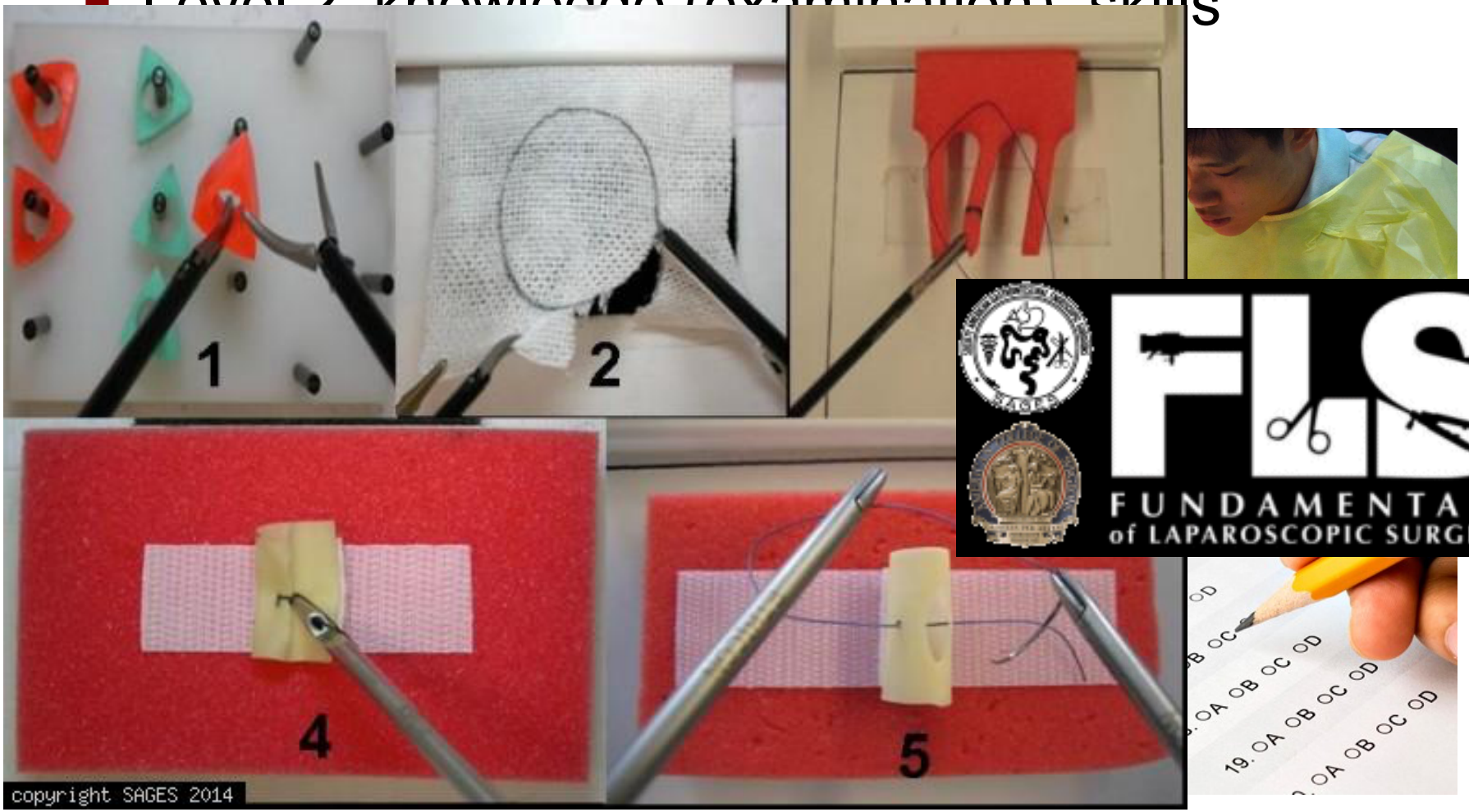
- Level 1: questionnaires



Instructional Design – Evaluate

Evaluate Training:

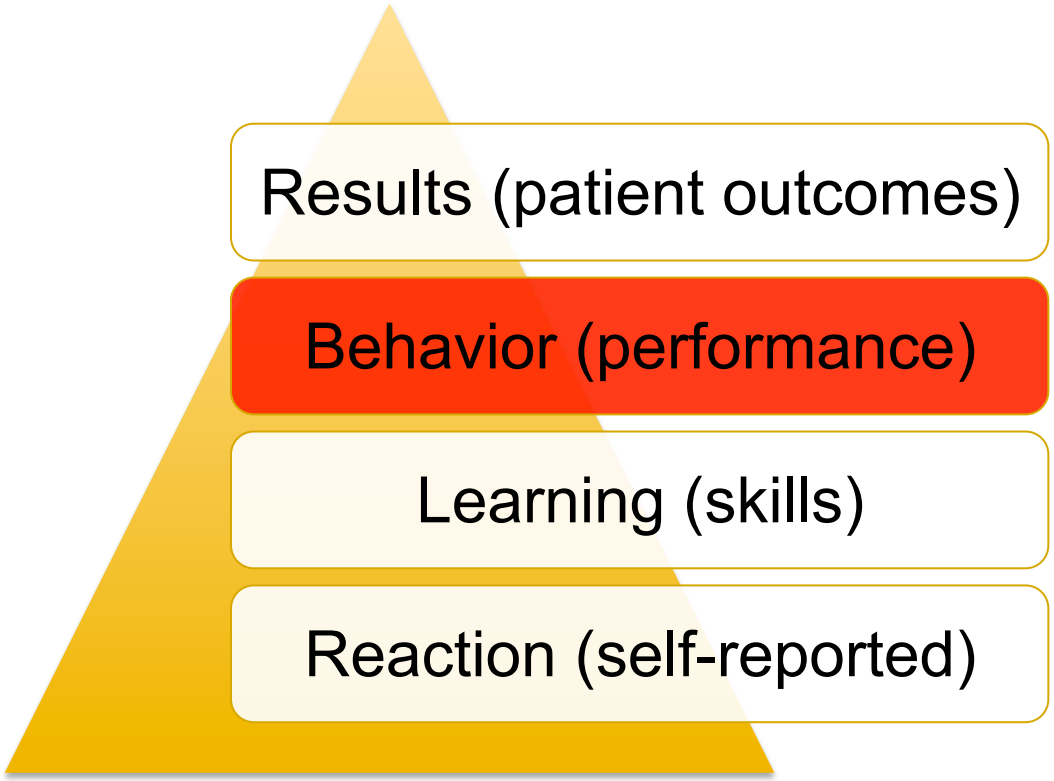
- Level 2: knowledge (examination), skills



Instructional Design – Evaluate

Evaluate Training:

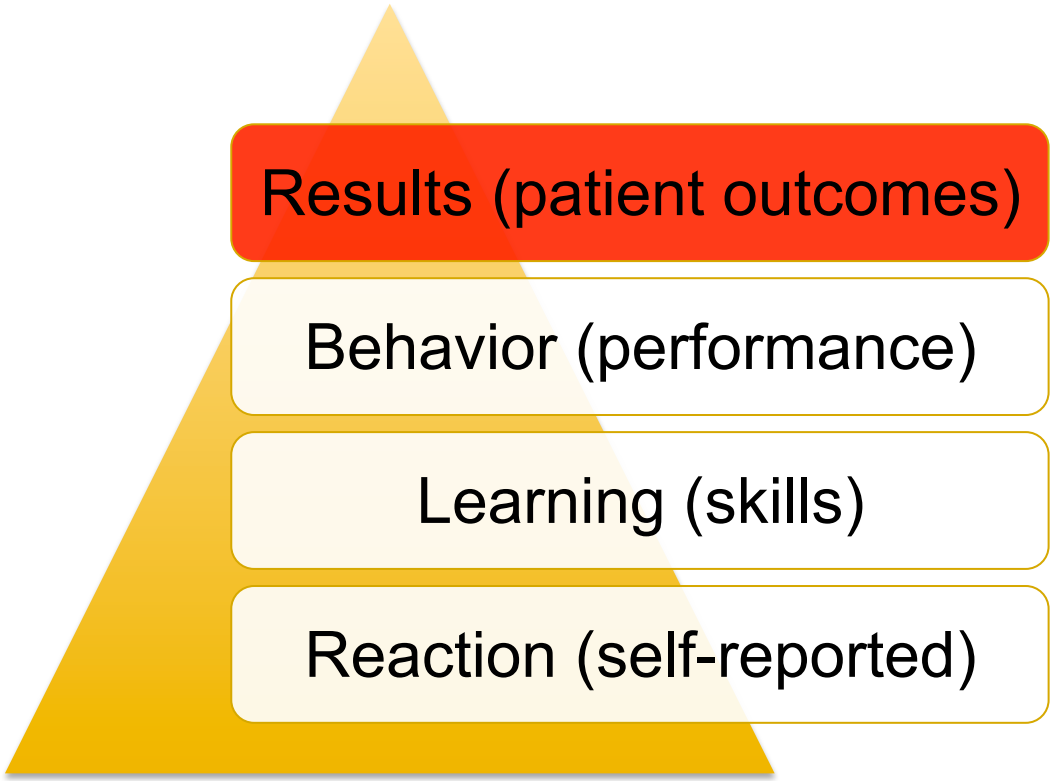
- Level 3: performance on patients (errors, global rating scales, checklists, time, accuracy)



Instructional Design – Evaluate

Evaluate Training:

- Level 4: patient outcomes (complications, mortality, patient-reported outcomes)



Instructional Design – Evaluate

Evaluate Training:

- Developing metrics and assessment tools:
  - Objective
  - Measurable
  - Specific
  - **Validity**
  - Evidence-based
  - Task/skill dependent

Instructional Design – Evaluate

Evaluate Training:

- Choosing metrics and assessment tools:
  - Appropriate learning domain (cognitive, attitudes, psychomotor)
  - Depth of learning
  - Current proficiency
  - Available resources
  - Fidelity
  - Psychometric properties

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  - L re, h

GLOBAL RATING SCALE OF OPERATIVE PERFORMANCE

Please circle the number corresponding to the candidate's performance in each category, **irrespective of training level.**

	1	2	3	4	5
Respect for Tissue:	Frequently used unnecessary force on tissue or caused damage by inappropriate use of instruments		Careful handling of tissue but occasionally caused inadvertent damage		Consistently handled tissues appropriately with minimal damage
Time and Motion:	Many unnecessary moves		Efficient time/motion but some unnecessary moves		Clear economy of movement and maximum efficiency
Instrument Handling:	Repeatedly makes tentative or awkward moves with instruments by inappropriate use of instruments		Competent use of instruments but occasionally appeared stiff or awkward		Fluid moves with instruments and no awkwardness
Knowledge of Instruments:	Frequently asked for wrong instrument or used inappropriate instrument		Knew names of most instruments and used appropriate instrument		Obviously familiar with the instruments and their names
Flow of Operation:	Frequently stopped operating and seemed unsure of next move		Demonstrated some forward planning with reasonable progression of procedure		Obviously planned course of operation with effortless flow from one move to the next
Use of Assistants:	Consistently placed assistants poorly or failed to use assistants		Appropriate use of assistants most of the time		Strategically used assistants to the best advantage at all times
Knowledge of Specific Procedure:	Deficient knowledge. Needed specific instruction at most steps		Knew all important steps of operation		Demonstrated familiarity with all aspects of operation

OVERALL ON THIS TASK, SHOULD THE CANDIDATE: **FAIL** **PASS**

Instructional Design – Evaluate

Evaluate Training:

- How do you interpret scores?

High score = (?) Expert

- Validity evidence for metrics:
  - Content
  - Response process
  - Internal structure
  - Relationship to variable
  - Consequences

* Downing SM. Validity: on the meaningful interpretation of assessment data. *Medical Education* 2003; 37:830-7.

Instructional Design – Evaluate

Evaluate Training:

- Providing feedback
  - Summative
  - Formative

Instructional Design – Evaluate

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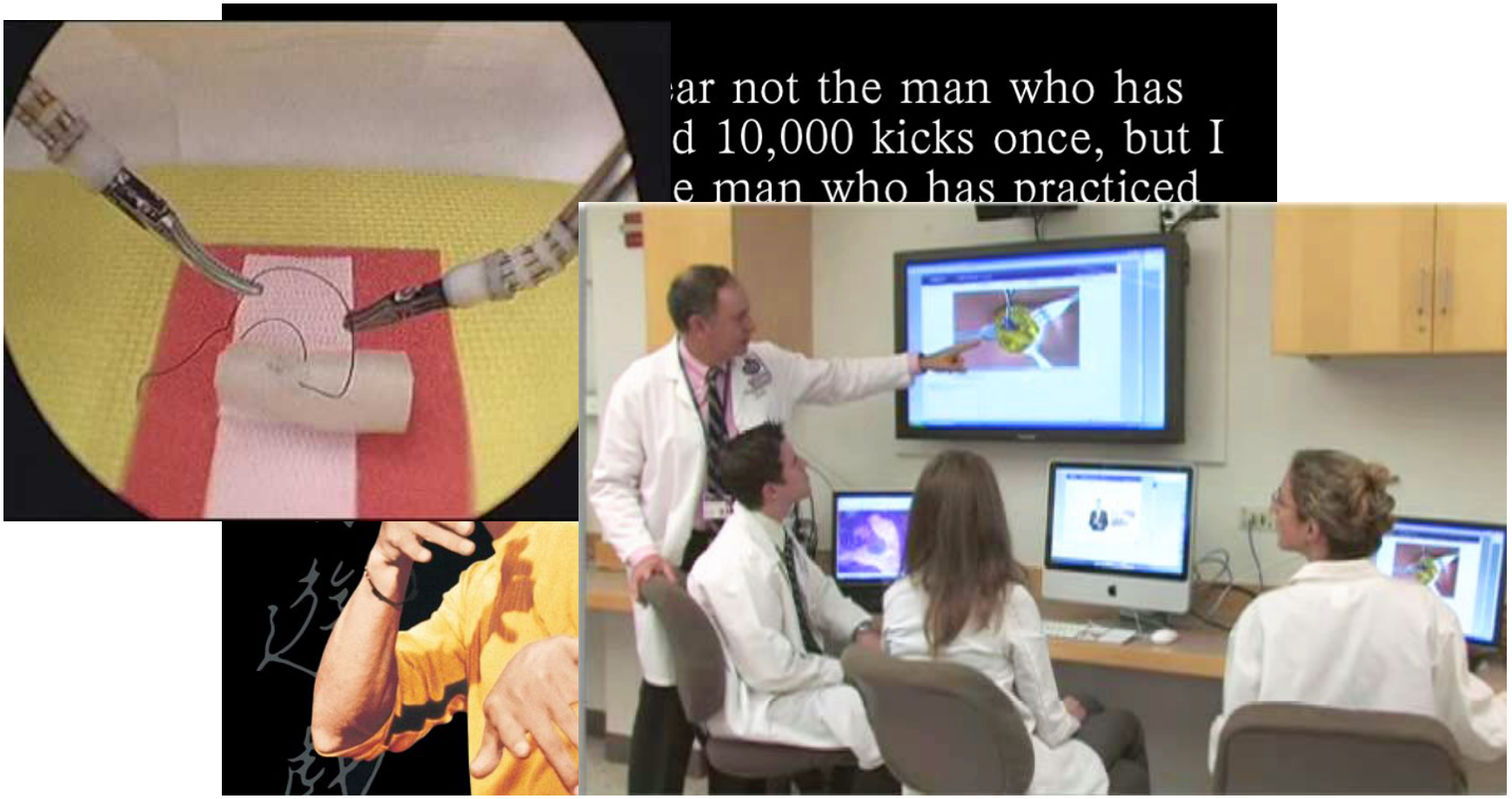
Performance " Psychol Rev 100(3): 363-406.

Instructional Design – Evaluate

Evaluate Training:

- Deliberate practice



Instructional Design

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Instructional Design

Other Considerations:

- Spacing effect:
  - "Bolus" training vs. distributed training
  - Distributed training improves long-term performance*
- Example
  - 1 session, 4 hours

  ...or
  - 4 sessions over 1 months, 1 hour each

*Moulton CA, et al (2006). Teaching Surgical Skills: what kind of practice makes perfect? Annals of Surgery 244(3): 400-409.

Instructional Design

Other Considerations:

- Mixed Practice:
  - Training multiple skills mixed together improves performance, compared to teaching one skill at a time
- Example: teaching skills **a, b, c**
  - aaaaa → bbbbb → ccccc

  …or
  - abc → abc → abc → abc → abc
- FUSE – free online modules

(http://www.fuseprogram.org)

Example: FUSE

Surg Endosc (2013) 27:4054–40
DOI 10.1007/s00464-013-3059-4

Table 3 Most highly rated objectives in the FUSE program (score > 5.70)

Objective	Section	Score
Identify various mechanisms whereby electrosurgical injuries may occur	2	6.38
Identify general patient protection measures for setup and settings for the electrosurgical unit	2	6.24
Identify circumstances, mechanisms, and prevention of dispersive electrodes-related injury	2	6.05
Identify the characteristics of monopolar and bipolar instruments and the differences between them	1	5.97
Identify circumstances which promote OR fires and identify prevention strategies	2	5.90
Identify circumstances, mechanisms, and prevention of direct coupling-related injury	2	5.85
Identify implanted devices and patients with implanted devices that might be adversely affected by RF energy	10	5.84

The score is the average rating for importance, relevance, and frequency (range = 1–7)

Rationale for the curriculum asses

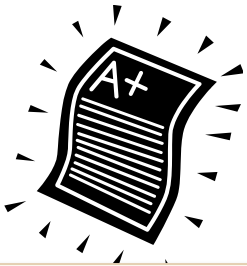
'gy™ (FUSE)

**Liane S. Feldman · L. Mic
Stephanie B. Jones · Jessic
Steven D. Schwaitzberg · f**

Received: 25 February 2013 / Ac

FUNDAMENTAL USE OF SURGICAL ENERGY

Example: FUSE

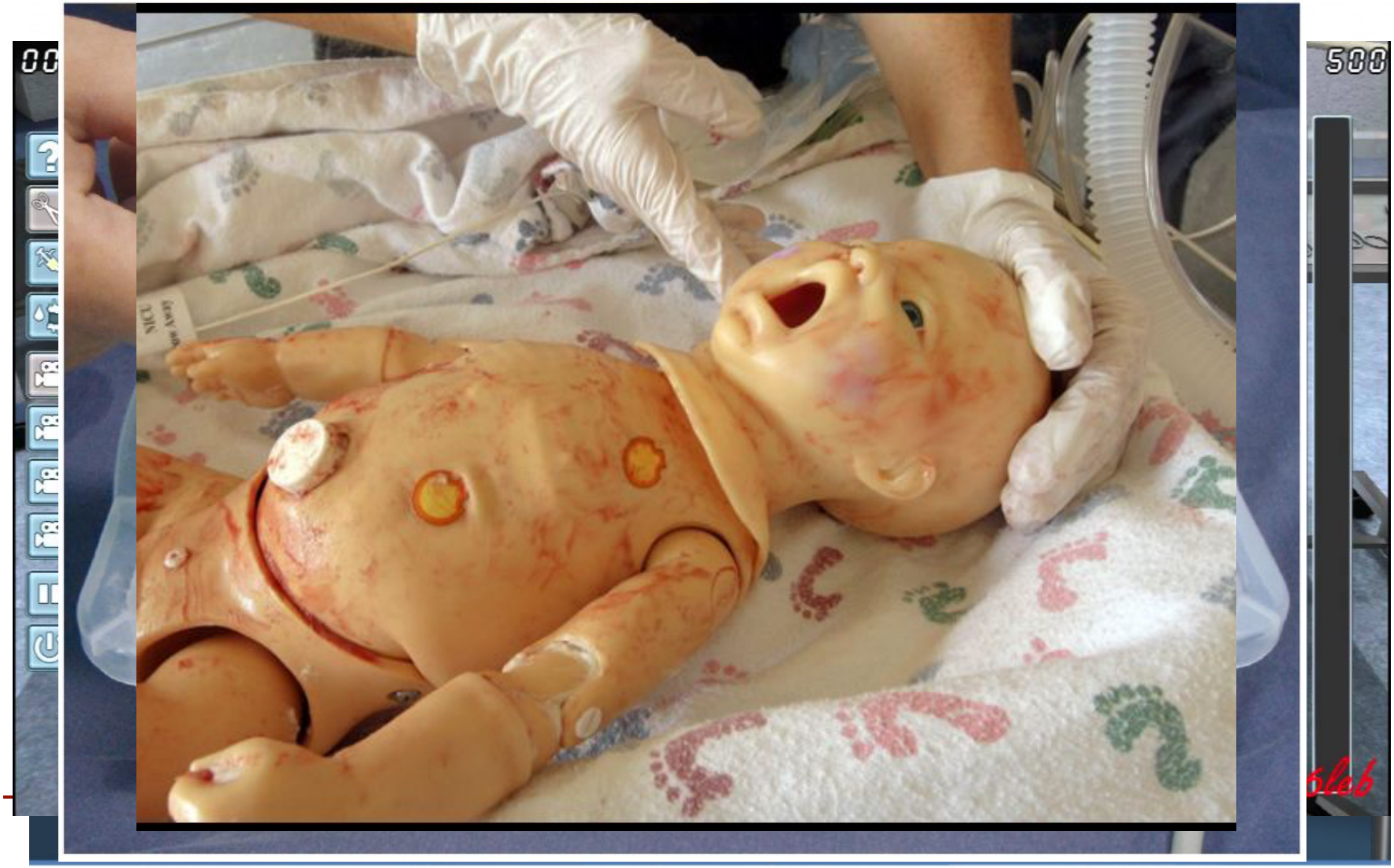


FUSE
Fundamental Use of Surgical Energy

FUSE Blueprints → Beta-Test N=227 → Certification Examination

Simulation for Surgical Education

Simulation for Surgical Education



Simulation for Surgical Education

Types of simulation for surgical training:

- Simulated patients
- Virtual patients
- Mannequin simulators
- Task trainers (e.g. FLS)
- Low-technology screen-based simulation (e.g. serious games)
- Virtual reality

Simulation for Surgical Education

Why simulation:

- Immersive learning ("learning in context")
- Experiential learning ("learning by doing")
- Re-create rare scenarios
- Re-create difficult scenarios
- Re-create scenarios that allow learner to work on weaknesses (i.e. focused training → deliberate practice)
- Provides an environment to obtain formative feedback (e.g. replay video of performance) and immediately practice after
- Reproducible for repetition

Simulation for Surgical Education

Why simulation:

- Improves training
- Improves patient safety (free of adverse events)
- Decreases long-term costs (i.e. reducing time and costs for training)
- Improves communication and team dynamics

Simulation for Surgical Education

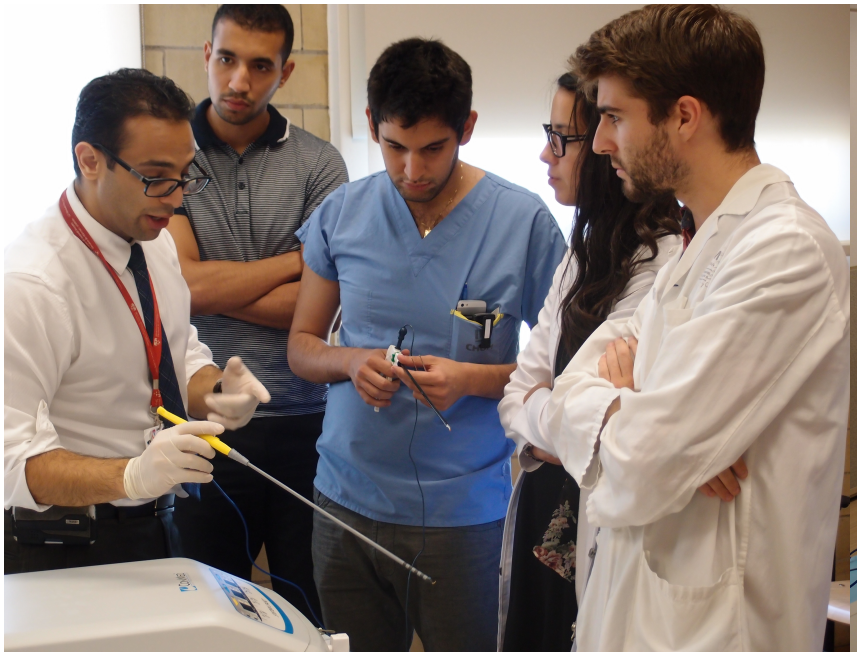
Barriers to simulation for surgical training*:

- Inadequate resources (personnel, equipment, costs)
- Limited availability of faculty to teach
- Limited incentives for faculty to teach
- Inadequately trained faculty
- Not tailoring the simulation-based curriculum for local training needs
- Does not replace “real” clinical experience - complimentary

*Stefanidis D, et al (2015). Simulation in Surgery: What’s Next? Annals of Surgery 261(5): 846-853.

Simulation for Surgical Education

FUSE Simulation Course for Surgeons:



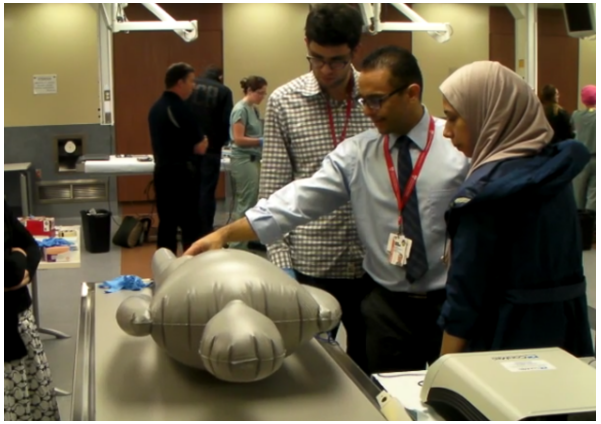
FUSE™ Fundamental Use of Surgical Energy

FUNDAMENTAL USE OF SURGICAL ENERGY

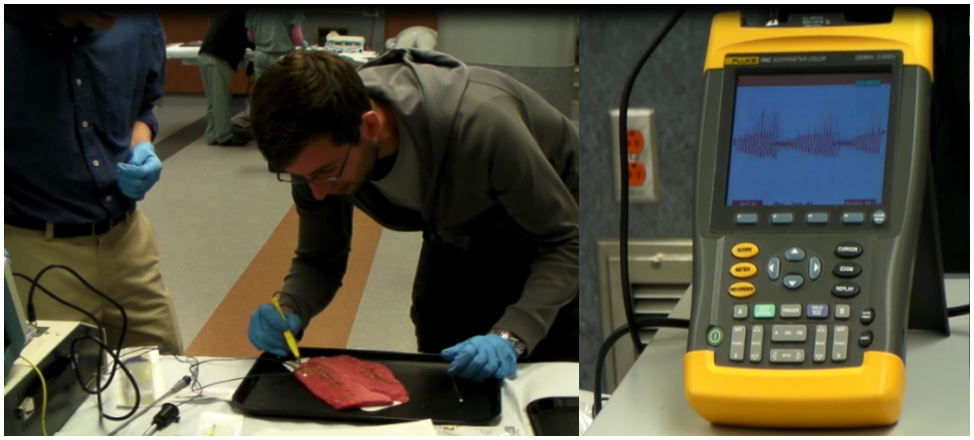
Simulation for Surgical Education

FUSE Simulation Course for Surgeons:

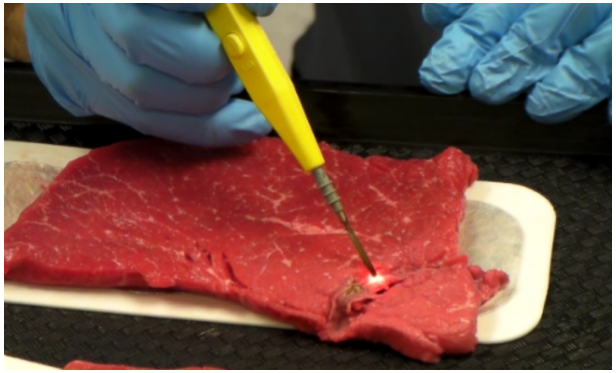
1. Device Setup



2. Tissue Effect



3. Adverse Events (Open)



4. Adverse Events (Laparoscopy)

Simulation for Surgical Education

FUSE Simulation Course for Surgeons:

- [redacted]

Simulation for Surgical Education

FUSE Simulation Course for Surgeons:

- 20 courses; 4 countries; 500 surgeons/residents

Surg Endosc
DOI 10.1007/s00464-015-4260-4

Structured simulation improves learning of the Fundamental Use of Surgical Energy™ curriculum: a multicenter randomized controlled trial

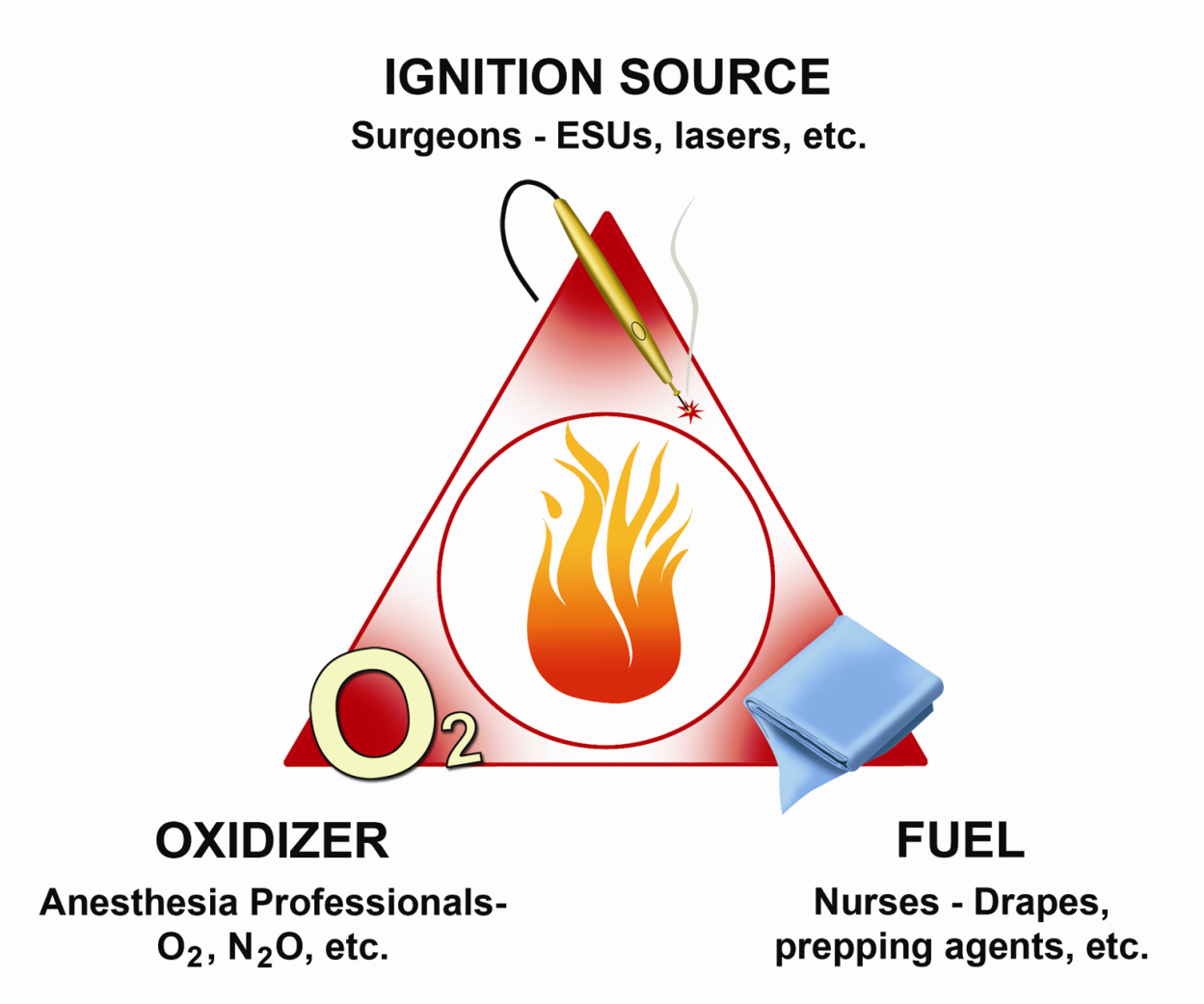
Amin Madani[1] · Yusuke Watanabe[1] · Nicole Townsend[2] · Philip H. Pucher[3] · Thomas N. Robinson[2] · Patricia E. Egerszegi[4] · Jaisa Olasky[5] · Sharon L. Bachman[6] · Chan W. Park[7] · Nalin Amin[8] · David T. Tang[9] · Erika Haase[10] · Davide Bardana[11] · Daniel B. Jones[5] · Melina Vassiliou[1] · Gerald M. Fried[1] · Liane S. Feldman[1]

Received: 14 February 2015 / Accepted: 24 April 2015

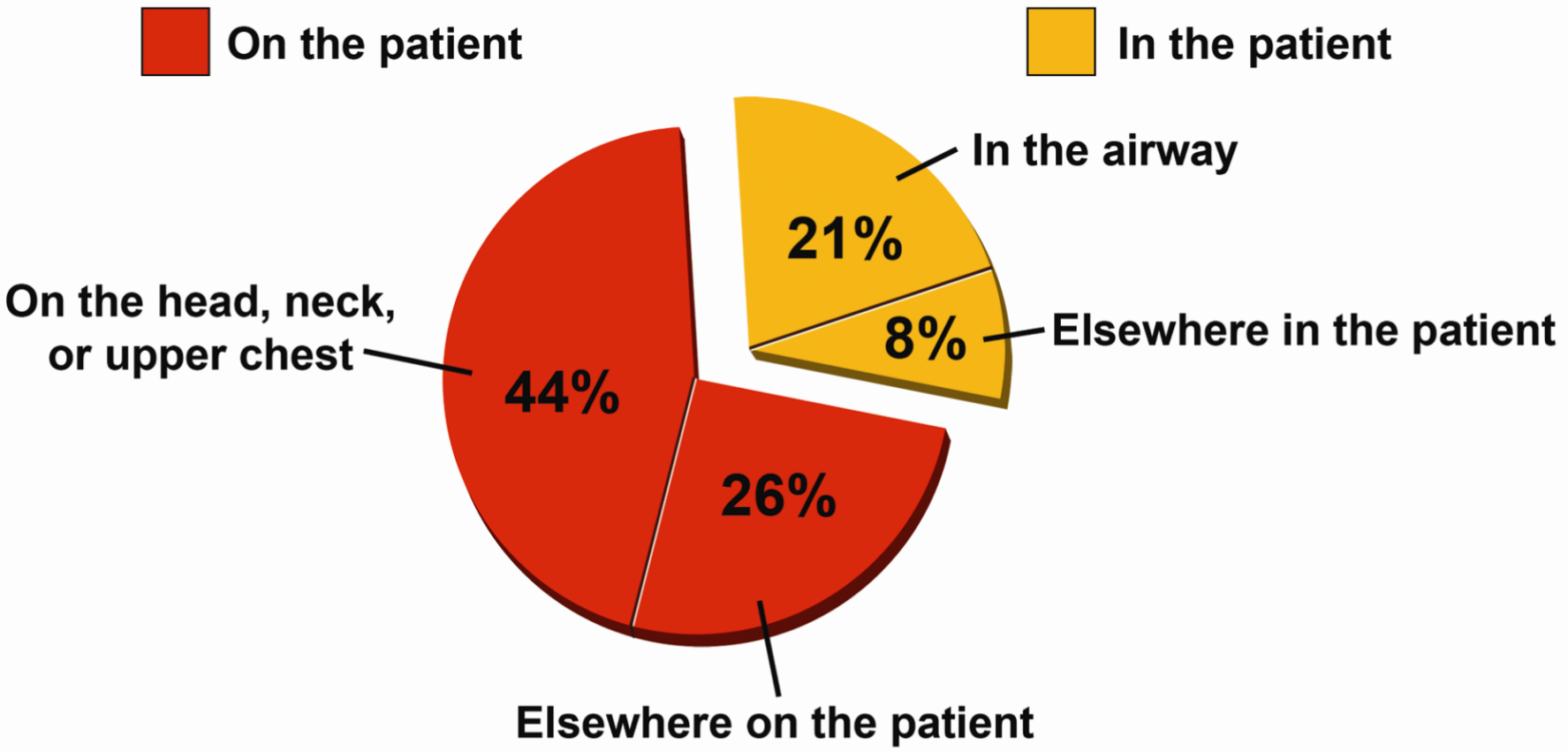
学習目標

1. 高周波エネルギーが細胞／組織におよぼす影響
2. 高周波エネルギーデバイスに関わる用語
3. エレクトロサージカルユニット（電気メス本体）の役割
4. モノポーラとバイポーラの違い
5. エネルギーデバイス関連有害事象の発生メカニズム
6. 有害事象の回避する方法
7. 手術室火災を防ぎ、また手術室火災にどのように対処するか

OR Fires – Fire Triangle



Locations of Surgical Fires



手術室火災　OR fires

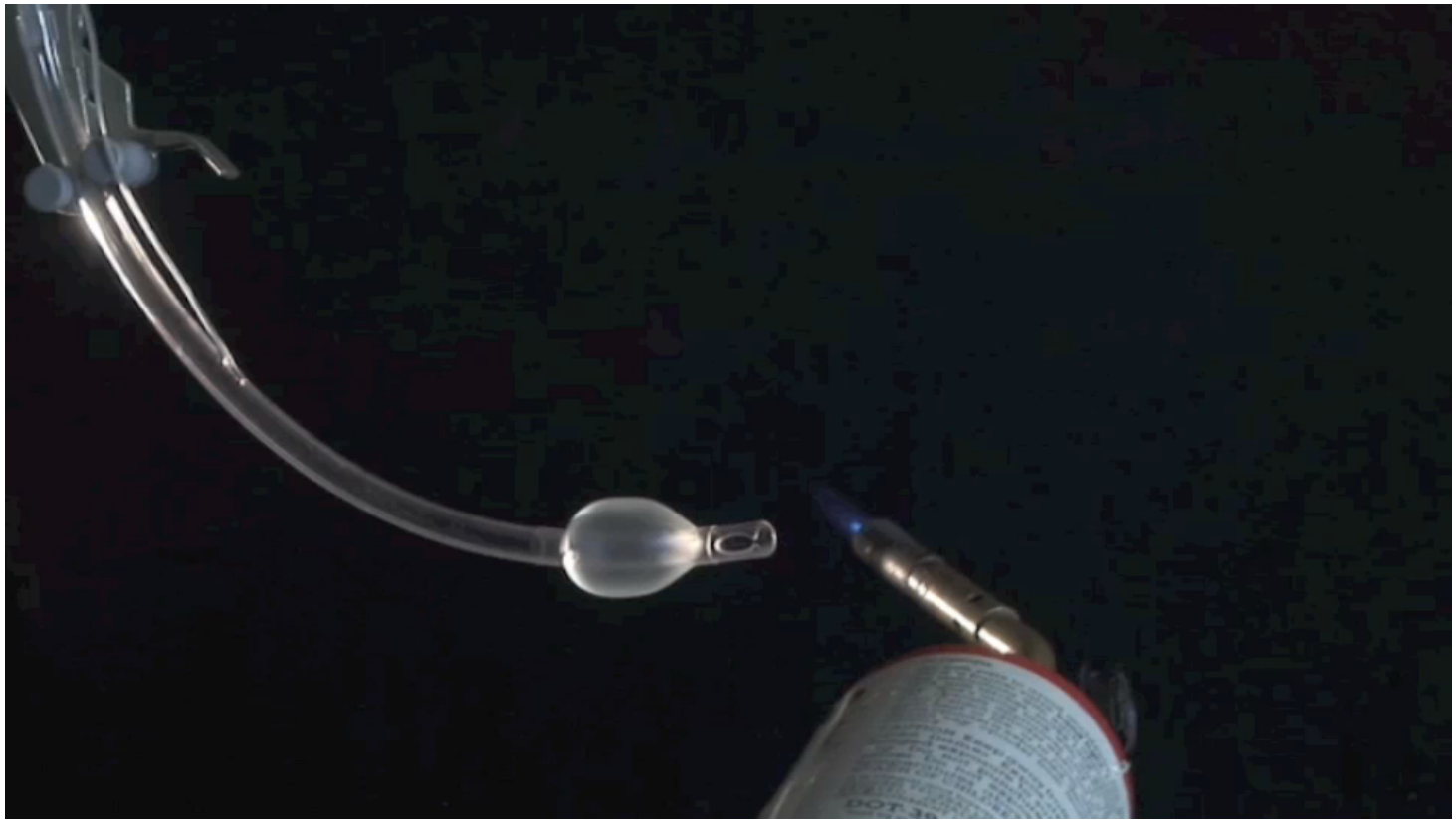
Fire Triangle – Oxidizer (oxygen, nitrous oxide)

- マスク使用時は酸素流量を最小化
- ラリンゲルマスクを考慮
- 酸素濃度は30%以下に
- 気管切開：実際に気管を切る際は、電気メスを使用しないようにする

手術室火災　OR fires

Fire Triangle – Oxidizer (oxygen, nitrous oxide)

– 気道熱傷は特に危険

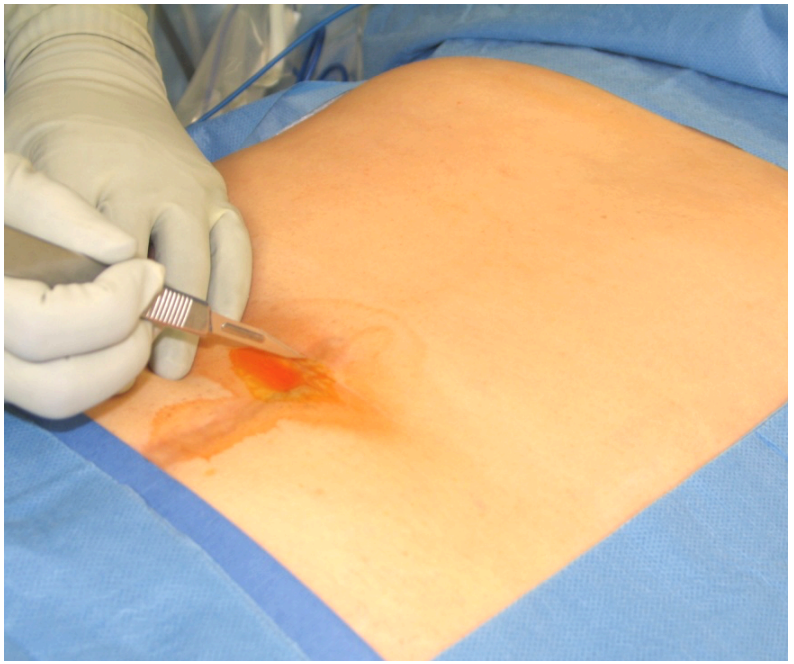


手術室火災　OR fires

Fire Triangle – Fuel (prepping agent, drapes)

- アルコール系消毒薬による熱傷（4%）

乾いた後のドレーピング



Pooled Alcohol-Based Prep

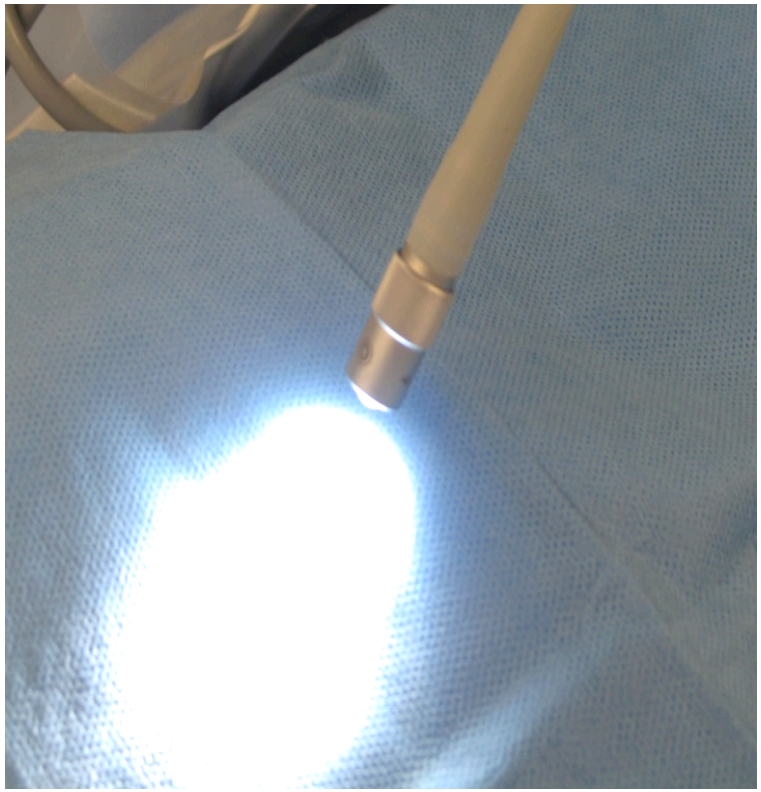
手術室火災　OR Fires

Fire Triangle – Ignition Source

- 70%はエレクトロサージャリーに起因
- 10%はレーザー
- 20%は光源機器関連、手術用ドリル、除細動器

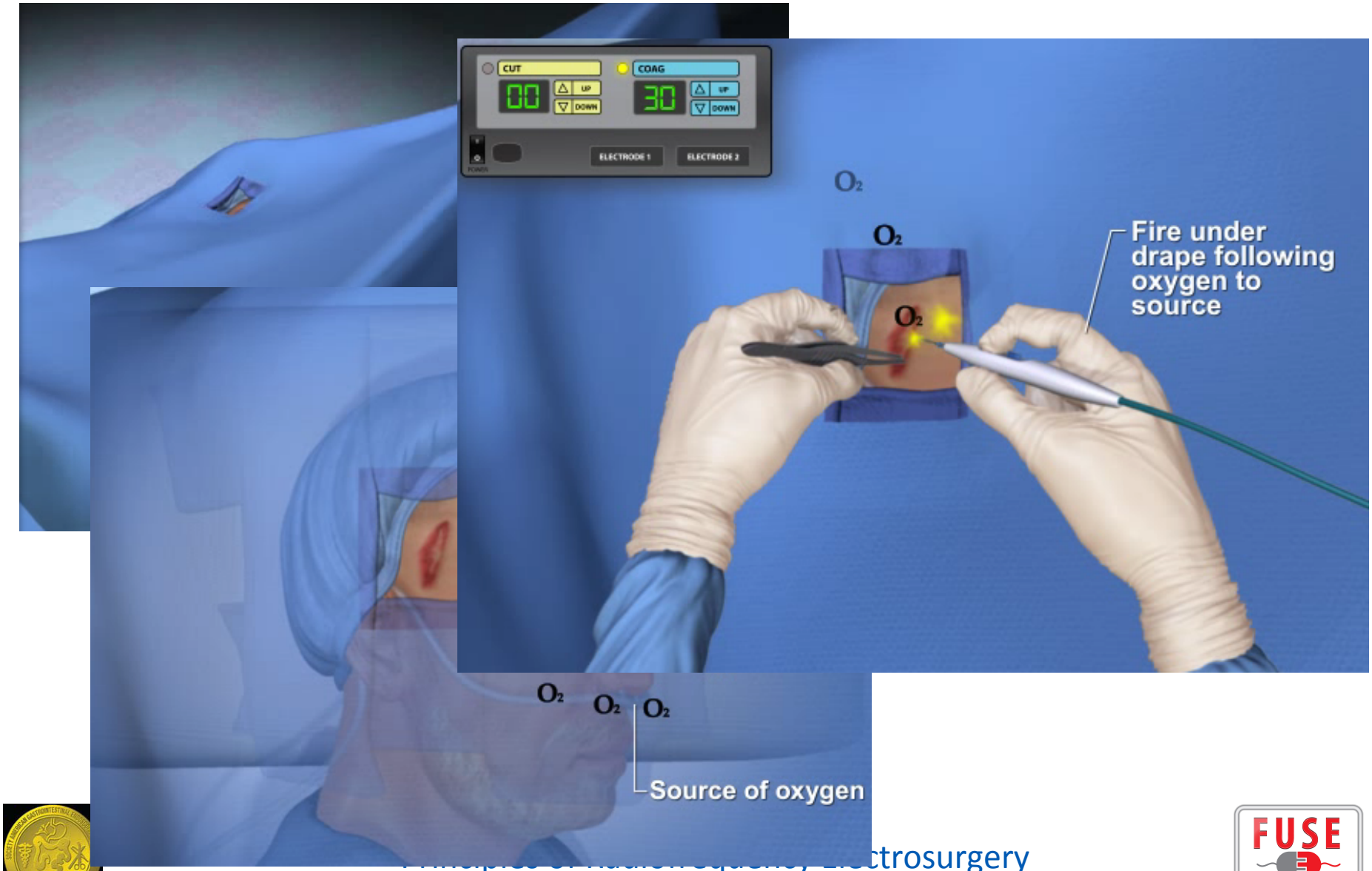
ALWAYS

- 光源機器の電源は直前に入れる
- 光源を外す前に電源を切る使用しない
- 使用しない時にケース（プラスチック）に収納



High Intensity Light Source

OR Fires


CUT
COAG
00
30
UP
DOWN
ELECTRODE 1
ELECTRODE 2
O2
O2
O2
Fire under drape following oxygen to source
O2
O2
O2
Source of oxygen

手術室火災　OR Fires

最良の対処は:

予防
(Minimize all risks)

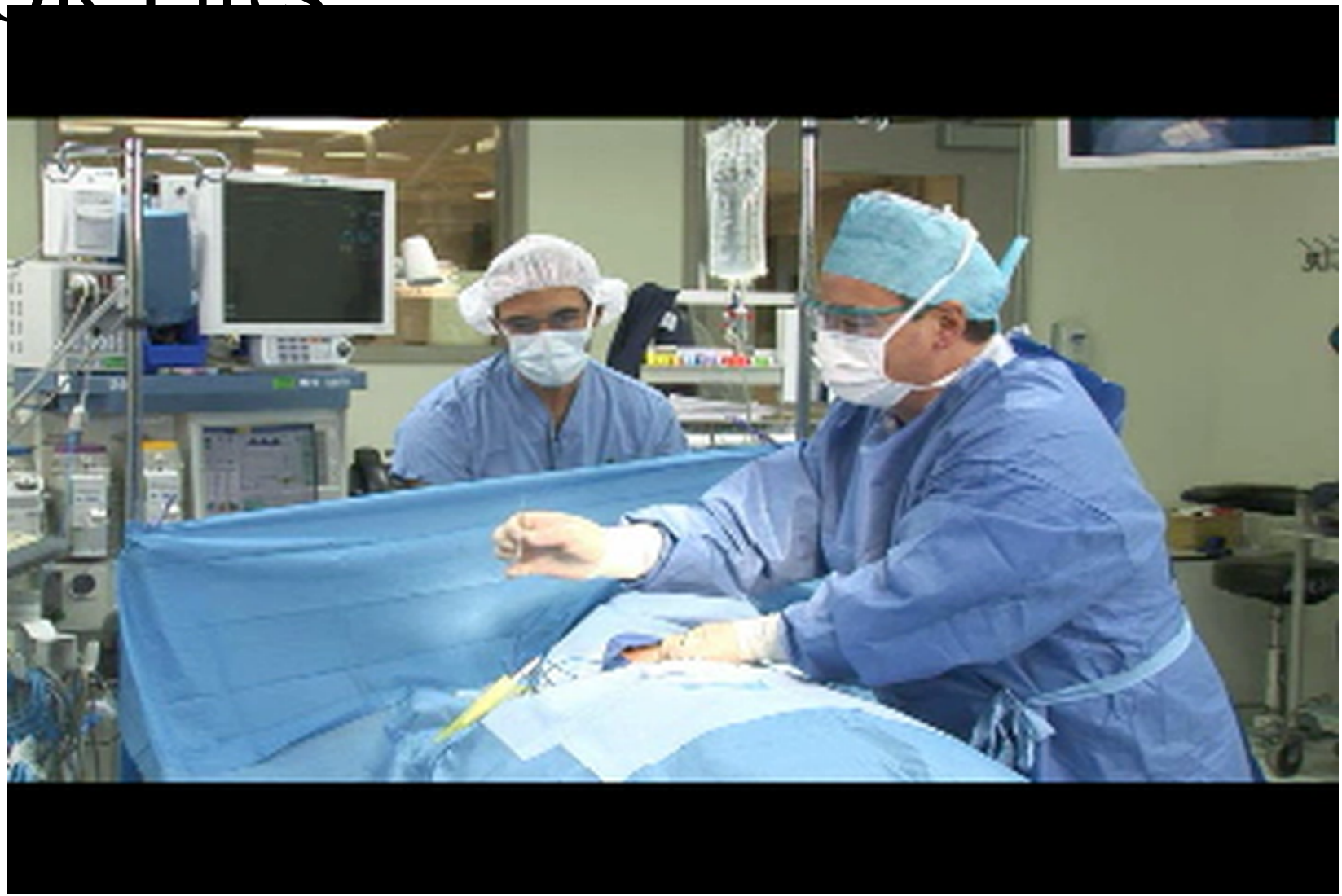
手術室火災 予防策

- 頭頸部手術では使用する酸素をできるだけ減らす
- ドレープの下で酸素が充満していることがある（ドレープをしっかりはる）
- 消毒液が完全に乾くまでドレープをしない（余剰液の除去）
- 光源の電源は使用する直前に入れる
- できるかぎり低い出力設定で使用

手術室火災 – 対処

1. 酸素使用の中断
   - 呼吸器回路からはずす
   - Airway fires: 抜管
2. 可燃物の除去　（ドレープ等）
3. 燃えている炎の消火
4. 患者ケア
   - 必要があれば再抜管 (Airway fires)
   - 熱傷への処置

OR Fires

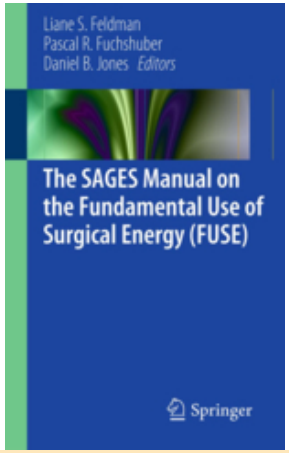


Summary

- Surgical performance is complex
- No “perfect” way for training experts
- A systematic process will help ensure effective training is produced
  - Adhering to best-practices in education
- Simulation can add significant value to training and for assessment

Example: FUSE

FUSE
Fundamental Use of Surgical Energy



Book

Certification Examination

Simulation Course

Online Modules

THANK YOU