Designing for Uncertainty

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“Uncertainty is in the head, but anxiety is in the pit of the stomach. (Kuhlthau, 1991, pp. 370)”

p. 1

Heisenberg's Uncertainty Relation

Assume two hermitian operators A and B do NOT commute:

$$[A, B] \neq 0$$

Assume

$$\langle\psi| A B |\psi\rangle = a + ib$$

(real, real)

Then

$$\langle\psi|[A, B]|\psi\rangle = \langle\psi|AB|\psi\rangle - \langle\psi|BA|\psi\rangle$$

$$\langle\psi|BA|\psi\rangle = \langle\psi|(BA)^{+}|\psi\rangle^{*} = \langle\psi|A^{+}B^{+}|\psi\rangle$$

$$= \langle\psi|AB|\psi\rangle^{*} \quad (A, B \text{ hermitian})$$

$$\Rightarrow \langle\psi|[A, B]|\psi\rangle = (a+ib) - (a+ib)^{*} = 2ib$$

Similarly $\{A, B\} \equiv AB + BA$

$$\Rightarrow \langle\psi|\{A, B\}|\psi\rangle = (a+ib) + (a-ib) = 2a$$

Thus

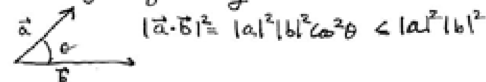
$$|\langle\psi|[A, B]|\psi\rangle|^2 + |\langle\psi|\{A, B\}|\psi\rangle|^2 = 4(a^2+b^2)$$

$$= 4|\langle\psi|AB|\psi\rangle|^2$$

The 2nd term on the l.h.s. is positive definite

$$\therefore |\langle\psi|[A, B]|\psi\rangle|^2 \leq 4|\langle\psi|AB|\psi\rangle|^2$$

Schwartz inequality



$$|\vec{a}\cdot\vec{b}|^2 = |a|^2|b|^2\cos^2\theta \leq |a|^2|b|^2$$

“A unique, important, and wonderful book . . . You'll never look at your own doctor in the same way again.” — Steven D. Levitt and Stephen J. Dubner, authors of *Freakonomics*

How Doctors Think

Jerome Groopman, M.D.

Proposal

To explore the role that uncertainty plays in health care and search for opportunities for design to improve the current situation.

What role does uncertainty play in doctor/patient communication/teamwork/decision making?

What scenarios in health care should we design for?

Literature review

Build a base of knowledge

Interviews

Generative research approach

Gather stories of coping with uncertainty in health care

Doctor, patient and student perspectives

Nancy

50 years old

described two negative healthcare experiences

Age 23– misdiagnosed ectopic pregnancy

Age 47—misdiagnosed shoulder injury

Communication gaps:
doctor to therapist, patient to doctor

Lack of acknowledged uncertainty led to misdiagnosis and preventable hospitalization

Patients may feel they have no other option than to listen to medical professional

Paul

23 years old

- 1st year of residency at OHSU
- patient health/social history is very important
- puzzeling cases are anamolies
- range of uncertainty is highly situational

Paul

Time is key in determining the scope

General practioners are the decision makers

Getting a patients trust is essential

Patient faced with uncertainty

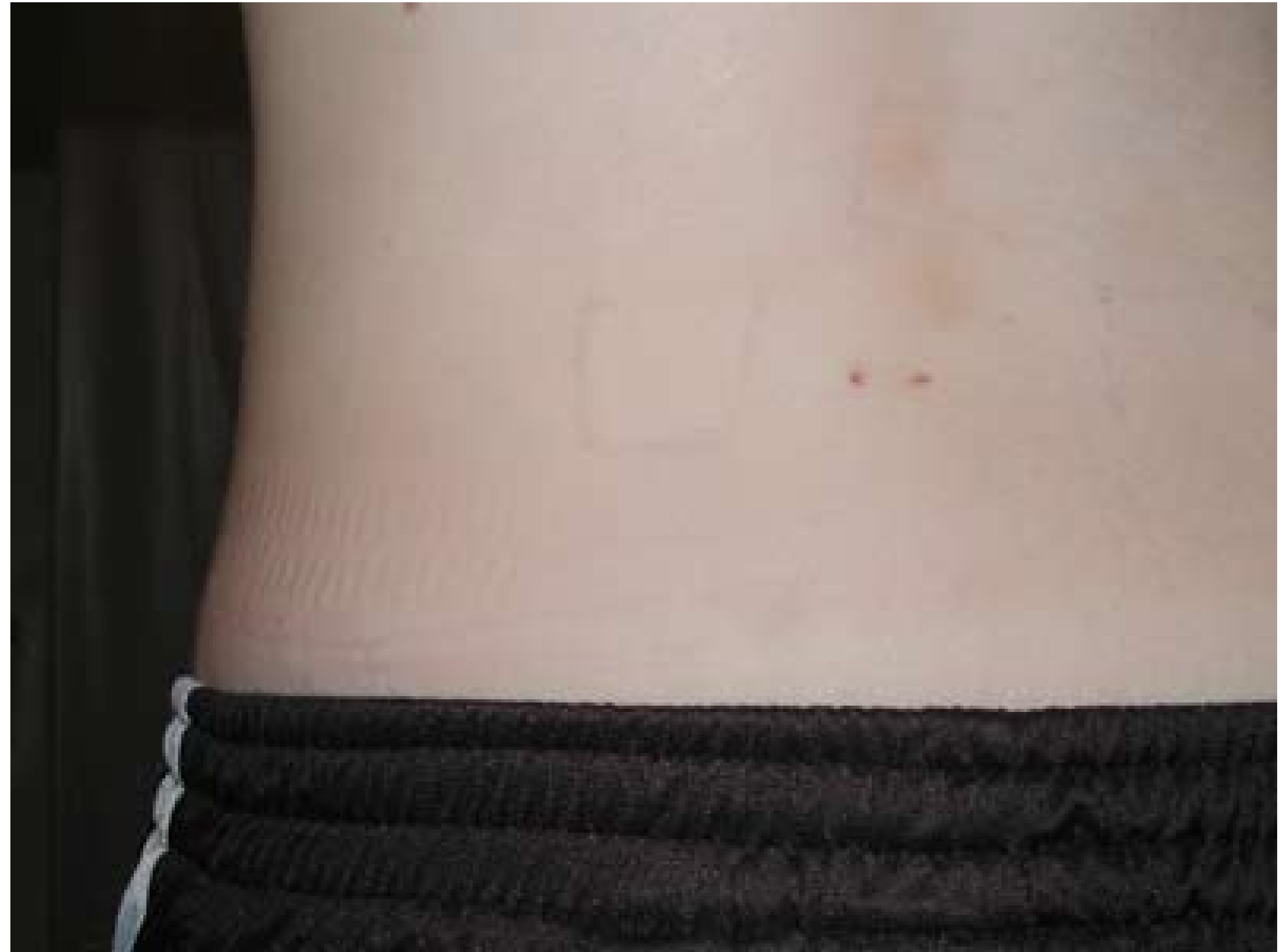
In-person interview, artifact and written account.

Expert advisor, Anesthesiologist

Telephone Interview.

Case 3

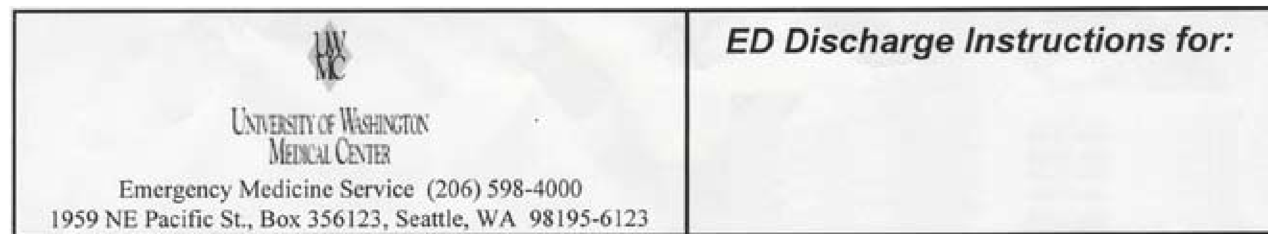
Patient



Cat scan... clean but only 97% correct... spinal tap to "clear the table"

Maybe a headache in a day or two but everything is fine. Went through the doomsday situations post spinal-tap, but did not bring up the most common side effect.

"To be fair"... the emergency room is concerned with life threatening situations - attention is diverted quickly.



UWMC

University of Washington Medical Center

Emergency Medicine Service (206) 598-4000

1959 NE Pacific St., Box 356123, Seattle, WA 98195-6123

ED Discharge Instructions for:

Name:

Address:

Medical Rec #:

Phone:

Visit Date/Time:

Evaluation

Evaluation in the Emergency Department included triage, and a screening exam by the nurse. You were treated by the following Emergency Department staff:

Diagnosis-1

Based on the evaluation and tests, the following diagnoses have been made. Remember that these are preliminary diagnoses and follow up with your referral physician may be necessary.

* BACK PAIN AFTER LP

Additional Instructions

* TYPE IN INSTRUCTIONS: The pain should continue to improve over the next few days, and is from the lumbar puncture you had. If you develop fever, increasing pain, or nerve symptoms (shooting pains, etc) please return to the emergency room.

RETURN TO EMERGENCY: IF SYMPTOMS WORSEN.

* RETURN TO EMERGENCY: FEVER, CHILLS

* RETURN TO EMERGENCY: SIGNIFICANTLY INCREASING BACK PAIN

I have received the above instructions on January 6, 2007 at 21:20. The risks and benefits of being discharged home have been explained to me and I agree with the plans outlined above.

Signed: ______________________ **Relation:** ______________

Witnessed: ______________________

"It never came out of his mouth that it (post-dural puncture headache) was a possibility..."

"For me, the biggest problem has been navigating the system"

"...Emblematic of the problems with the health care system, over treatment that leads to a cascade of new problems."

"...No road into the system"

"80/20% rule... more often than you think, and those are the cases you remember."

"...When you're a hammer everything looks like a nail (Doctor Krane)."

Themes

Patterns vs. Outliers - 80/20 rule.

Role of personal relationship with doctor

Continuity vs. discontinuity across providers

Dangers of over-under treatment

Doctor-patient communication gaps

Making doctor's plans visible, post visit

Provide patients with a representation of the diagnosis and a map, should things go wrong.

Medication maps

What to do if you forget a dose? What happens if you stop taking the medication when symptoms subside?

Simulation in medical school:

Representing decision-making in the face of uncertainty for reflection. Patterns in the outliers.

Patient coach or interpreter

What to expect. How to communicate your ideas. Bypass time-pressure and anxious situations.

Encourage people to develop relationships with primary care providers.

Gatekeepers who provide entry into the system.

Understanding subdomain perspectives at different medical touch-points.

When you’re a hammer everything looks like a nail.

Focus on one opportunity, clarify the audience and narrow our scope.

Reactions, questions and thoughts?