Using Technology to Help Anesthesiologists with Managerial Decisions

Franklin Dexter, M.D., Ph.D.
Director, Division of Management Consulting
Professor, Department of Anesthesia
University of Iowa
Franklin-Dexter@UIowa.edu
www.FranklinDexter.net
Financial Disclosure

• I am employed by the University of Iowa, in part, to consult and analyze data for hospitals, anesthesia groups, and companies.

• Department of Anesthesia bills for my time, and the income is used to fund our research.
  – I receive no funds personally other than my salary and allowable expense reimbursements from the University of Iowa, and have tenure with no incentive program.
  – I own no healthcare stocks (other than indirectly through mutual funds).
Scope of Talk
Scope of Talk

Strategies for Net Cost Reductions with the Expanded Role and Expertise of Anesthesiologists in the Perioperative Surgical Home

Franklin Dexter, MD, PhD, and Ruth E. Wachtel, PhD, MBA
Scope of Talk

Strategies for Net Cost Reductions with the Expanded Role and Expertise of Anesthesiologists in the Perioperative Surgical Home

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Anesthesia & Analgesia 2014;118:1062-71
Substantive Opportunities for Cost Reduction

1. Reduce unnecessary interventions that do not have potential to benefit patients
   – Use encouraged by “Choosing Wisely” campaign
   – Use related to new payment systems
   – Research additional interventions and assess their value
   – Anesthesiologists’ roles are as managers (systems-based practice)
     • Director of Anesthesia Informatics
     • Medical Director Preoperative Assessment Clinic
2. Staffing & provider mix, staff scheduling, staff assignment, and case scheduling
– Cost reduction applies principally to facilities with workdays > 8 hours (e.g., hospitals)
– Anesthesiologists’ roles are as managers (systems-based practice)
  • Director of Anesthesia Informatics
  • Medical Director Operating Room(s)
    – In this role, anesthesiologist has other opportunities to reduce costs such as best use of expensive disposables and implants
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Most Typical Method to Identify Evidence-Based Practice
Most Typical Method to Identify Evidence-Based Practice

Difficulties and Challenges Associated with Literature Searches in Operating Room Management, Complete with Recommendations

Ruth E. Wachtel, PhD, MBA,* and Franklin Dexter, MD, PhD*†
Most Typical Method to Identify Evidence-Based Practice

Difficulties and Challenges Associated with Literature Searches in Operating Room Management, Complete with Recommendations

Ruth E. Wachtel, PhD, MBA, * and Franklin Dexter, MD, PhD*†

Anesthesia & Analgesia 2013;117:1460-79
Most Typical Method to Identify Evidence-Based Practice

- We performed a systematic literature review
- Finding
  - Most people seeking assistance with medical or computer-related issues rely on colleagues
Using **Technologies** to Help Anesthesiologists with Managerial Decisions

Meetings and Asking Colleagues

Franklin Dexter, M.D., Ph.D.
Director, Division of Management Consulting
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www.FranklinDexter.net
Meetings and Asking Colleagues

• Poorly posed (insufficiently worded) question
  – Need to know conditions when such communication results, at least on average, in evidence-based management decisions
Meetings and Asking Colleagues

Review of Experimental Studies in Social Psychology of Small Groups When an Optimal Choice Exists and Application to Operating Room Management Decision-Making

Andrew Prahl,* Franklin Dexter, MD, PhD,† Michael T. Braun, MA,* and Lyn Van Swol, PhD†
Meetings and Asking Colleagues

Review of Experimental Studies in Social Psychology of Small Groups When an Optimal Choice Exists and Application to Operating Room Management Decision-Making

Andrew Prahl,* Franklin Dexter, MD, PhD, † Michael T. Braun, MA,* and Lyn Van Swol, PhD†

Anesthesia & Analgesia 2013;117:1221-9
Decision Quality With or Without Unshared Information

Odds Ratio of a Quality Decision
Decision Quality With or Without Unshared Information

- **Control group**
  - Information needed to make correct decision provided to all members before discussion

- **“Real world” condition**
  - Information to make correct decision provided to one group member ahead
  - This is from managerial perspective the one person who knows the operations research, informatics, engineering, analytics, etc.
Effect size is odds ratio

Odds ratio of 107 implies that the control group’s odds of producing a correct decision was 107 times odds of “real world” group

- Correct decision by 89% of control groups
- Correct decision by 7% “real world” groups

Odds ratio 107 =

\[
\frac{(89\% / [100\% - 89\%])}{(7\% / [100\% - 7\%])}
\]
Decision Quality With or Without Unshared Information

Odds Ratio of a Quality Decision

- Minimum effect size = 18 > 0
- Minimum effect size $= 18 > 0$
- For problems with correct answers, but fact there is a correct answer is not discernible without study, the odds that a group will make the correct decision is very low.
Shared information is information that group members all know before group discussion.

- Example is that surgeons differ in case durations (OR times) for the same procedure.

Unshared information is known only to one group member before discussion and becomes known to others during the discussion.
Shared and Unshared Information

- Shared information is information that group members all know before group discussion
  - Example is that surgeons differ in case durations (OR times) for the same procedure

- Unshared information is known only to one group member before discussion and becomes known to others during the discussion
  - Example is that extra time attributable to the primary surgeon when averaged over all cases at a hospital ≈ 0.4 minutes (SE 0.1)

Shared and Unshared Information

- Effect size is the standardized mean difference
  - Groups discussed mean 10.72 items of shared information versus 7.05 items unshared information, with pooled SD of 0.96 items
  - Standardized mean difference is effect size
    - $3.84 = (10.72 - 7.05) / 0.96$
Shared and Unshared Information

More Use of Unshared Information

More Use of Shared Information
Shared and Unshared Information

- Minimum effect size = 1.25 > 0
• Minimum effect size = 1.25 > 0

- Shared information is more influential during group discussions than is unshared information.
Shared and Unshared Information

- Shared information is discussed earlier than unshared information ($P < 0.001$).\textsuperscript{18,21}
- Shared information is repeated in discussion more than unshared information ($P < 0.001$).\textsuperscript{20}
- Group members with primarily shared information take more speaking turns than members with primarily unshared information ($P < 0.005$).\textsuperscript{31}
Meetings and Asking Colleagues

- Meetings are ineffective for these problems when used for group level decision-making (i.e., consensus) or consultative type level 2 decision-making (i.e., peer discussion)
Meetings and Asking Colleagues

- Meetings are ineffective for these problems when used for group level decision-making (i.e., consensus) or consultative type level 2 decision-making (i.e., peer discussion)

  - Technologies to assist leader in obtaining solutions from outside his/her department
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Literature Search

Franklin Dexter, M.D., Ph.D.
Director, Division of Management Consulting
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University of Iowa
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www.FranklinDexter.net
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Ruth E. Wachtel, PhD, MBA,* and Franklin Dexter, MD, PhD*†

Anesthesia & Analgesia 2013;117:1460-79
Literature Search Depends on Knowledge of the Vocabulary

Difficulties and Challenges Associated with Literature Searches in Operating Room Management, Complete with Recommendations

Ruth E. Wachtel, PhD, MBA,* and Franklin Dexter, MD, PhD*†

Anesthesia & Analgesia 2013;117:1460-79
Literature Search Depends on Knowledge of the Vocabulary

- **Experiments**
  - Using PubMed, could not create protocols to identify [known] article(s) with solutions to problems (decisions) without using the precise vocabulary

- **Experiments explain observational studies**
  - Frustration with search to find solutions arises from having to know vocabulary before search
Literature Search Depends on Knowledge of the Vocabulary

• Experiments
  – Using PubMed, could not create protocols to identify [known] article(s) with solutions to problems (decisions) without using the precise vocabulary

• Experiments explain observational studies
  – Frustration with search to find solutions arises from having to know vocabulary before search

➢ Search is effective technological tool once one knows vocabulary and/or one relevant article
Literature Search Depends on Knowledge of the Vocabulary

- Experiments
  - Using PubMed, could not create protocols to identify [known] article(s) with solutions to problems (decisions) without using the precise vocabulary
- Experiments explain observational studies
  - Frustration with search to find solutions arises from having to know vocabulary before search
- Search is effective technological tool once one knows vocabulary and/or one relevant article
  - Web site or communicate with advisor
Literature Search Depends on Knowledge of the Vocabulary

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  – Using PubMed, could not create protocols to identify articles with solutions to problems (decisions) without using the precise vocabulary
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Education in Operating Room Management

An intensive course with CME credit is given at the University of Iowa in Iowa City, at hosted sites, and online; specific dates are listed on the registration pages. The course is based on these case studies and the lectures below:

- **Statistics for anesthesia**
- **Anesthesia preoperative evaluation clinics** webinar
- **Decision-making on the day of surgery** webinar
  Includes scenarios to train for decisions on afternoon, evenings, and weekends
- **Service-specific operating room staffing**
- **Operating room financial assessment for tactical decision-making**
- **Economics of reducing turnover times** webinar
- **Economics of anesthetic agents** webinar
- **Strategic planning: financial impact of different types of surgery**
- **Anesthesiologist and nurse anesthetist staffing**
- **Physician agreements – Anesthesia support & surgeon blocks**
- **Showing differences among hospitals and their surgical practices**
Click here for an annotated bibliography of the AIMS articles below, arranged by topic.

2014


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*(Web Sites for Vocabulary)*

Franklin Dexter, M.D., Ph.D.
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Vocabulary and Search

- Experiments
  - Using PubMed, could not create protocols to identify [known] article(s) with solutions to problems (decisions) without using the precise vocabulary
- Experiments explain observational studies
  - Frustration with search to find solutions arises from having to know vocabulary before search
- Search is effective technological tool once one knows vocabulary and/or one relevant article
  - Web site or communicate with advisor
E-mail as the Appropriate Method of Communication for the Decision-Maker When Soliciting Advice for an Intellective Decision Task

Andrew Prahl,* Franklin Dexter, MD, PhD,† Lyn Van Swol, PhD,* Michael T. Braun, PhD,‡ and Richard H. Epstein, MD, CPHIMS§
Communication with Advisor

E-mail as the Appropriate Method of Communication for the Decision-Maker When Soliciting Advice for an Intellective Decision Task

Andrew Prahl,*, Franklin Dexter, MD, PhD,† Lyn Van Swol, PhD,*, Michael T. Braun, PhD,‡ and Richard H. Epstein, MD, CPHIMS§

Anesthesia & Analgesia 2015;121:669-71
Communication with Advisor

E-mail as the Appropriate Method of Communication for the Decision-Maker When Soliciting Advice for an Intellective Decision Task

Andrew Prahl,* Franklin Dexter, MD, PhD,† Lyn Van Swol, PhD,* Michael T. Braun, PhD,‡ and Richard H. Epstein, MD, CPHIMS§

Anesthesia & Analgesia 2015;121:669-71

Narrative review of technologies to communicate with advisors for engineering type problems
Communication with Advisor

- Experimental and some observational studies of the different communication technologies
  - Face to face meeting
  - Video (web) conference
  - Animated computer agents (avatars)
  - Telephone (audio)
  - Live electronic chat
  - E-mail (asynchronous 1:1 written)
  - Discussion forum (listserv, social media)
Advantages of E-mail for Communication with Advisor

• Easy to use across organizational boundaries
• Convertible to tasks (e.g., set follow-up flag)
• Asynchronous; no appointment arranged
• Absence of expectation of immediate response
  – Responsibility and reduced social loafing
• Presence of expectation of a response
• Training significantly increases productivity in use (e.g., search rather than folders)
Advantages of E-mail for Communication with Advisor

- Decision-maker can construct (frame) the message carefully to increase likelihood of receiving a useful response.
- Decision-maker can read response when least distracted and reread complicated portions.
- Decision-maker has reduced cognitive load vs. face-to-face, video conferencing, or avatar.
  - For factual material, written text consistently easier to understand and as effective or more effective at changing behavior.
Advantages of E-mail for Communication with Advisor

- Advisor can control cues to appear credible
  - Titles and degrees in signature line expected
- Advisor can focus on constructing message rather than appearance of hair, color of slides
- Advisor can include attachments with details
- Advisor can include written expression(s) of confidence in advice
  - Best predictor of usage in experimental studies
E-mail ... It’s so Old Fashioned
E-mail ... It’s so Old Fashioned

• Segment quality of the communication technology based on experimental results
  – Not good when asking someone out on a date
  – Not good when asking for a pay raise
  – Good when asking for formula to quantify each nurse anesthetist’s contribution to the department’s overall fresh gas flow
E-mail to Provide Feedback to Individuals Within Department
E-mail to Provide Feedback to Individuals Within Department

Influencing Anesthesia Provider Behavior Using Anesthesia Information Management System Data for Near Real-Time Alerts and Post Hoc Reports

Richard H. Epstein, MD,* Franklin Dexter, MD, PhD,† and Neil Patel, MD‡
E-mail to Provide Feedback to Individuals Within Department

Influencing Anesthesia Provider Behavior Using Anesthesia Information Management System Data for Near Real-Time Alerts and Post Hoc Reports

Richard H. Epstein, MD,* Franklin Dexter, MD, PhD,† and Neil Patel, MD‡

Anesthesia & Analgesia 2015;121:678-92
E-mail to Provide Feedback to Individuals Within Department

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Richard H. Epstein, MD,* Franklin Dexter, MD, PhD,† and Neil Patel, MD‡

Anesthesia & Analgesia 2015;121:678-92
E-mail to Provide Feedback to Individuals Within Department

- Departmental weighted fresh gas flow for sevoflurane calculated as:
  
  sum for each case of
  product of the duration of surgery and mean fresh gas flow for the case
  between the beginning and end of surgery
  divided by the total duration among all cases
E-mail to Provide Feedback to Individuals Within Department
E-mail to Provide Feedback to Individuals Within Department

- Individualized, automated e-mail feedback to all anesthesia providers about their fresh gas flows for each case, by volatile anesthetic
  - Sent approximately monthly
E-mail to Provide Feedback to Individuals Within Department

Sevoflurane Total Fresh Gas Flow (ml/min)

Pre-Intervention

Post-Intervention

Baseline FGF reports sent

# 4 wk intervals from baseline FGF report
E-mail to Provide Feedback to Individuals Within Department

- Using e-mail after case avoids concerns related to potential creation of medical device
  - Administrative function designed to enhance overall compliance with a departmental quality practice objective
  - Not effort to dictate care of individual patients
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(Web Sites for Vocabulary)

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Director, Division of Management Consulting Consulting
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www.FranklinDexter.net
Influence of Data and Formulas on Trust in the Information

- E-mail can include attachments, often with the expert as one of the authors.
- What type of articles should be attached?
  - Review article with text and simple figures or primary article including data?
  - With/without appendices with formulas?
Influence of Data and Formulas on Trust in Information from Journal Articles in an Operating Room Management Course

Franklin Dexter, MD, PhD,* and Lyn M. Van Swol, PhD†
Influence of Data and Formulas on Trust in Information from Journal Articles in an Operating Room Management Course

Franklin Dexter, MD, PhD,* and Lyn M. Van Swol, PhD†

A & A Case Reports 2016;6:329-34
Influence of Data and Formulas on Trust in the Information

• 50 hour OR management course
  – 15 hours for statistics review and learning the vocabulary
  – 35 hours of class over 3.5 days
  • Mostly to work in teams and complete cases
• Within a few days of finishing the course, N = 17 subjects completed a 36 item survey form, with 9 items about each of 4 readings
  – Sequences of survey items fully randomized
Influence of Data and Formulas on Trust in the Information

- Example of one of the 4 readings
  - Reading for lecture #5
    - Formulas Yes
    - Data Yes
    - 19 references
  - Citation
    - Dexter F, Ledolter J, Wachtel RE. Tactical decision-making for selective expansion of operating room resources incorporating financial criteria & uncertainty in sub-specialties’ future workloads. Anesthesia & Analgesia 2005;100:1425-32
Influence of Data and Formulas on Trust in the Information

• Example of one of the 4 readings
  – Reading for lecture #4
    • Formulas No
    • Data No
    • 76 references
  – Citation
    • Wachtel RE, Dexter F. Tactical increases in OR block time for capacity planning should not be based on utilization. Anesthesia & Analgesia 2008;106:215-26
Influence of Data and Formulas on Trust in the Information

- Response scale for each of the 9 items
  - 1, Strongly disagree
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7, Strongly agree
### Quality of reading

<table>
<thead>
<tr>
<th>Scale</th>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality (sequence of the 3 items randomized)</td>
<td>In general, Reading #X provides me with high quality information.</td>
<td>5.93</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, I would give the information from Reading #X high marks.</td>
<td>5.90</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, I would give the information provided by Reading #X a high rating in terms of quality.</td>
<td>6.01</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pooled</td>
<td>5.95</td>
<td>0.84</td>
<td>0.95</td>
</tr>
</tbody>
</table>
## Influence of Data and Formulas on Trust in the Information

<table>
<thead>
<tr>
<th>Scale Item</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness (sequence of the 3 items randomized)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The information in Reading #X is helpful for my work.</td>
<td>5.51</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>The information in Reading #X is valuable for my work.</td>
<td>5.57</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>The information in Reading #X is informative for my work.</td>
<td>5.62</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>5.57</td>
<td>1.18</td>
<td>0.91</td>
</tr>
</tbody>
</table>

**Usefulness of reading**
<table>
<thead>
<tr>
<th>Scale</th>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability (sequence of the 3 items randomized)</td>
<td>The information in Reading #X is reliable.</td>
<td>5.97</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anyone trusting the information in Reading #X is helping himself/ herself.</td>
<td>5.94</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The information in Reading #X can be trusted; there are many certainties.</td>
<td>5.88</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pooled</td>
<td>5.93</td>
<td>0.85</td>
<td>0.96</td>
</tr>
</tbody>
</table>
Influence of Data and Formulas on Trust in the Information

- 9 item assessment of trust in the content, including quality, usefulness, and reliability
  - Overall Cronbach alpha 0.94
- 95% confidence interval 0.92 to 0.96
Influence of Data and Formulas on Trust in the Information

- 9 item assessment of trust in the content, including quality, usefulness, and reliability
  - Overall Cronbach alpha 0.94
- 95% confidence interval 0.92 to 0.96

> Quality, usefulness, and reliability are attributes of unidimensional construct: trust in the information
Influence of Data and Formulas on Trust in the Information

Mixed effects analysis of trust (9 items × 4 articles for each of N = 17 subjects)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Numerator Degrees of freedom</th>
<th>Denominator Degrees of freedom</th>
<th>F-ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data versus no data</td>
<td>1</td>
<td>49</td>
<td>2.159</td>
<td>0.148</td>
</tr>
<tr>
<td>Formula versus no formulas</td>
<td>1</td>
<td>49</td>
<td>10.778</td>
<td>0.0019</td>
</tr>
</tbody>
</table>
Influence of Data and Formulas on Trust in the Information

- Residuals normally distributed
- Interaction not significant
- Count of references not significant
- Journal not significant
Influence of Data and Formulas on Trust in the Information

- Residuals normally distributed
- Interaction not significant
- Count of references not significant
- Journal not significant

Formulas in appendices serve a role, even for reader who does not understand them
Influence of Data and Formulas on Trust in the Information

- Residuals normally distributed
- Interaction not significant
- Count of references not significant
- Journal not significant
- Formulas in appendices serve a role, even for reader who does not understand them
  - Cue that the article can be trusted
Summary

- Cost reduction achieved through management, particularly informatics
- Small groups large odds poor quality decisions
- Obtain information from outside department by literature search, once know vocabulary
  - Web site lectures and question/answers
  - Expert consultation, typically by e-mail
    - Attach articles, especially if include formulas
- Use e-mail as well for providing quantitative feedback within department