



BROWN
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Benefits and Harms of Routine Preoperative Testing: A Comparative Effectiveness Review

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Background

- Preoperative testing is commonly ordered for patients undergoing procedures requiring anesthesia. Includes
 - Routine preoperative testing
 - Panel of tests used for all patients undergoing procedure
 - Per protocol preoperative testing
 - Tests are used in defined subsets of patients
 - Eg, ECG if ≥ 50 yo
- The alternatives are
 - Ad hoc preoperative testing
 - Testing done at clinician's discretion, based on H&P
 - No preoperative testing

Background

- Perceived benefits
 - Find correctable latent abnormalities that may impact surgical or anesthesia risk
 - Find abnormalities that may alter surgical or anesthesia procedures
 - Gather baseline data for possible post-op comparison
 - Predict likelihood of post-op complications

Background

- Possible harms
 - False positive tests
 - Delay surgery unnecessarily
 - Unnecessary treatments
 - Resultant complications
 - Additional testing
 - Resultant complications (eg, bleed from biopsy)
 - Psychological distress / anxiety
 - Increased resource utilization / costs
- Balance of benefits and harms unclear

Background

- Reasons why preoperative testing may not be of value in the real world
 - False positive tests
 - May not affect surgical course
 - May not improve outcomes (and any delay may worsen underlying condition)
 - Poor or variable implementation
 - Test results might not be acted on
 - Test results may not be available to surgical team when “needed” peri- and post-operatively
 - Responses to abnormal tests may vary

Key Questions

Key Question 1: How do routine or per protocol preoperative testing strategies compare to no testing or alternative testing strategies with respect to outcomes—including perioperative **clinical outcomes, quality of life or satisfaction, periprocedural patient management decisions, and resource utilization**—among patients undergoing elective surgical procedures?

How do outcomes vary by:

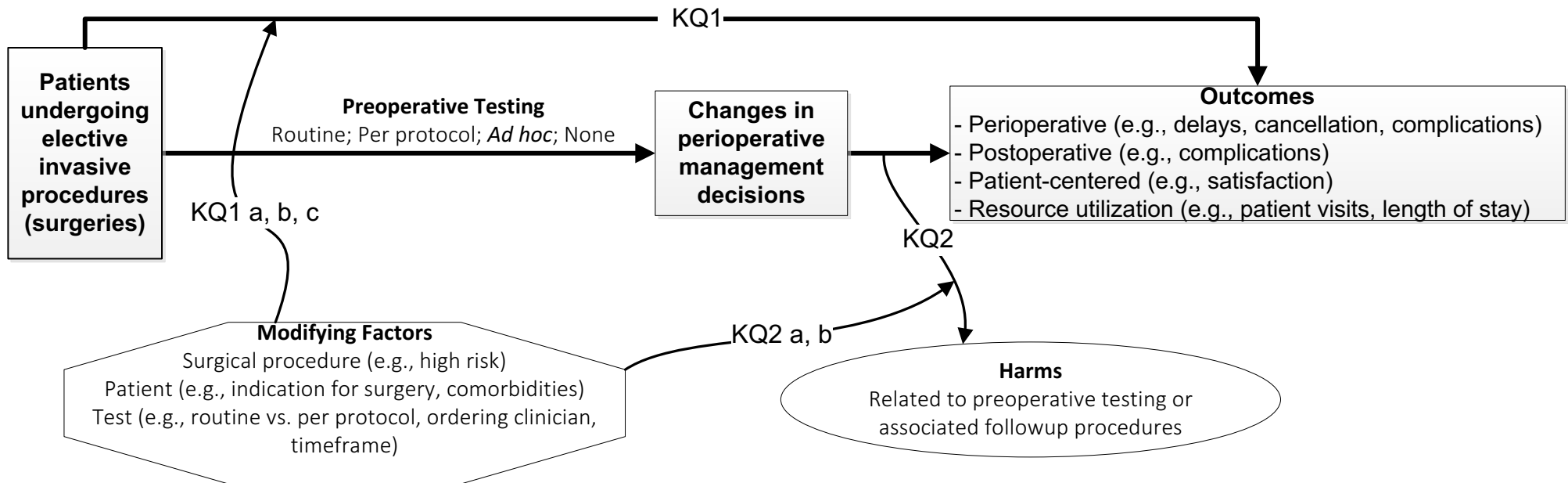
- the risk of the surgical procedure, the type of anesthesia planned, the indication for surgery, comorbidities, or other patient characteristics
- the structure of testing (e.g., routine for everyone vs. per protocol, whether testing is conducted in a specialized preoperative clinic) or by who orders the tests (e.g., surgeon vs. anesthesiologist vs. primary care physician)
- the length of time prior to the procedure that the tests are conducted

Key Question 2: What are the **harms** of routine or per protocol preoperative testing strategies compared to no testing or to an alternative testing strategies?

How do outcomes vary by:

- the risk of the surgical procedure, the type of anesthesia planned, the indication for surgery, comorbidities, or other patient characteristics
- the structure of testing (e.g., routine for everyone vs. per protocol, whether testing is conducted in a specialized preoperative clinic) or by who orders the tests (e.g., surgeon vs. anesthesiologist vs. primary care physician)

Analytic Framework



KQ = Key Question

Systematic Review Methods

- Technical Expert Panel to refine questions and scope
 - Anesthesia, General surgery, Urology, Cardiology, Internal medicine, Family medicine
- Literature search July 2013
 - Medline, Cochrane databases, existing systematic reviews
- Double screening of abstracts and full-text articles
- Extracted into standardized forms (<http://srdr.ahrq.gov>)
- Assessment of study quality / risk of bias
- Grading of strength of body of evidence

Study Eligibility Criteria

Population

- Adults or children undergoing elective surgical procedures requiring anesthesia or sedation
 - Including cataract surgery, regardless of anesthesia technique
- Any setting (inpatient, outpatient, office-based)
- Any patient or surgery risk category
- *Exclude*: Non-surgical diagnostic procedures (eg, colonoscopy)

Study Eligibility Criteria

Intervention

- Any preoperative test commonly conducted routinely (or per protocol)
- Test conducted preoperatively to assess patient's risk and health status
- *Exclude* tests to diagnose or stage disease
- *Exclude* non-test factors (eg, H&P, demographics)

Specific Preoperative Tests

- Electrolytes
- Kidney function tests
- Liver function tests
- Glycemia measures
- Blood counts
- Bleeding and coagulation tests
- Hemoglobinopathy tests
- Urinalysis
- Pregnancy tests
- Chest radiography
- Electrocardiography
- Cardiac stress tests
- Basic echocardiogram
- Pulmonary function tests

Exclude costly or invasive tests, eg,

- CT and MRI
- Tests requiring markers or dyes (eg, thallium stress test)
- Invasive tests (eg, angiography)

Study Eligibility Criteria

Outcomes

- Clinical and patient-centered outcomes
 - Perioperative morbidity, mortality, complications
 - Procedure delay or cancellation
 - Quality of life, patient satisfaction
 - Unplanned hospital admission / readmission
 - Change in disposition of care (eg, unplanned ICU)
 - Length of hospital stay
 - Patient resources (including time and work loss)
 - Healthcare system resources / utilization

 - Unnecessary or inappropriate procedure delays or cancellation
 - Harms from testing or from subsequent workup
 - Unnecessary follow-up tests of procedures

Study Eligibility Criteria

Study Design

- Published peer reviewed articles
- Longitudinal design (from pre- to post-op)
- Comparative studies (different testing protocols)

- Noncomparative (single group) studies
 - Only for “process” outcomes where the process of care was altered due to testing

Study Flow Chart

4581 Abstracts

Citations retrieved from MEDLINE (through July 22, 2013), Cochrane Central Register of Controlled Trials (2nd Quarter 2013), Cochrane Database of Systematic Reviews (2nd Quarter 2013), and HealthStar (through July 22, 2013)
(n=4,581)

Excluded (n=4,361)
-- Did not meet broad eligibility criteria per title and abstract

220 Full Text

Articles identified for full-text retrieval
(n=220)

162 Excluded

Excluded (n=162)
-- only ad hoc testing (n=41)
-- not English language (n=26)
-- noncomparative and no process outcome* (n=25)
-- not primary study (n=21)
-- not anesthesia-involved procedure (n=12)
-- not a preoperative test of interest† (n=13)
-- no outcome of interest (n=9)
-- other‡ (n=15)

Included studies
(n=57, In 58 publications):
6 randomized controlled trials
1 prospective nonrandomized comparative study
6 retrospective nonrandomized comparative studies
1 prospective/retrospective nonrandomized comparative study
22 prospective cohort studies
21 retrospective cohort studies

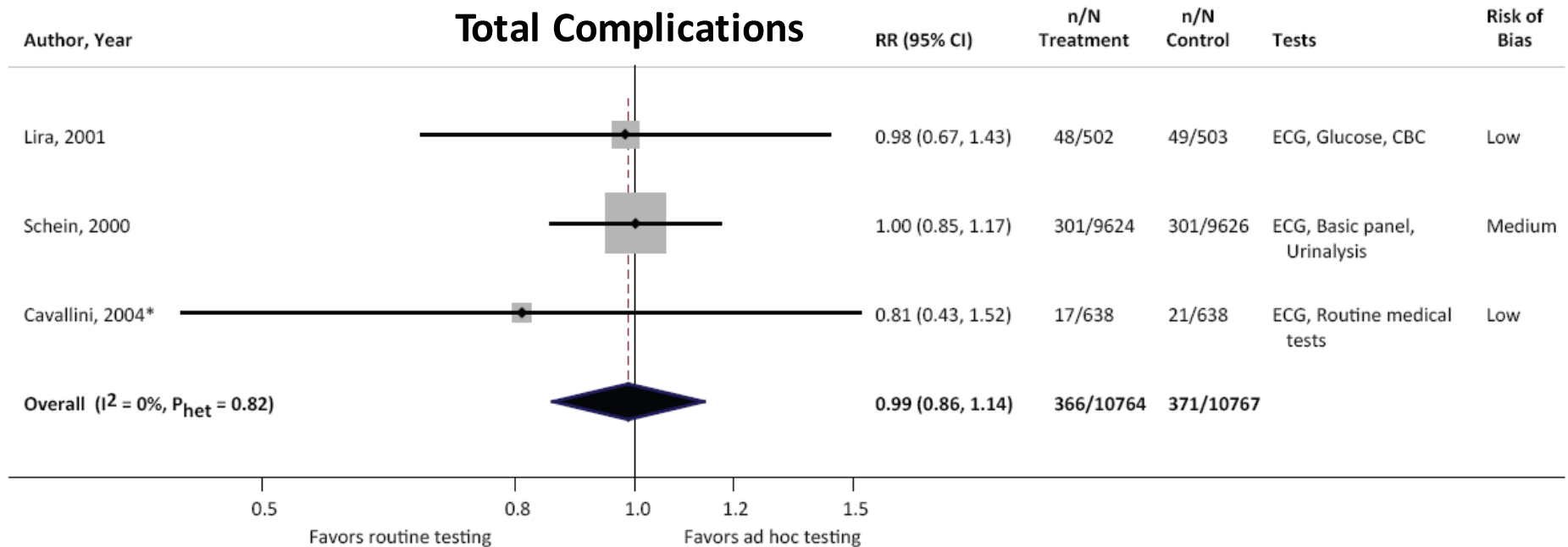
57 Included

- **6 Randomized (RCT)**
- **1 Prospective nonrandomized (nRCS)**
- **6 Retrospective nonrandomized (nRCS)**
- **1 Prosp-Retro nonrandomized (nRCS)**
- **22 Prospective single group (Cohort)**
- **21 Retrospective single group (Cohort)**

Cataract Surgery

3 RCTs (Low risk of bias-2, Medium risk of bias-1)

| Study | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemo-stasis | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|----------------------------|------------|-----|-----|-----------------|--------------------|-----|-------------|------------|----------------|-------------|------|-------------------------|
| Cavallini 2004 15506597 | Routine | Yes | | | | | | | | | | "Routine medical tests" |
| | No testing | | | | | | | | | | | |
| Lira 2001 11558245 | Routine | Yes | | Glucose | | Yes | | | | | | |
| | No testing | | | | | | | | | | | |
| Schein 2000 10639542 | Routine | Yes | | Panel-7 | | Yes | | Yes | | | | |
| | No testing | | | | | | | | | | | |



Cataract Surgery, Summary

- **High strength of evidence** of no clinically important difference in complication rates
- **High strength of evidence** to suggest that routine testing does not affect rates of procedure cancellation
- **Insufficient evidence** to evaluate potential differences based on subgroups
- **No study** evaluated harms

General (or Various) Surgery, Adults

1 RCT, 1 Prosp nRCS, 3 Retro nRCS, 1 Mixed nRCS

General, orthopedic, urologic, neurologic, and other surgeries; elective noncardiac surgeries; cataract surgery, transurethral resection of the prostate, laparoscopic cholecystectomy, hip arthroplasty, abdominal hysterectomy, breast reduction, radical neck dissection, any cardiovascular surgery, and any thoracic surgery surgeries; and “ambulatory” surgery

| Study | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemo-stasis | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|----------------------------|--------------|-----------------|------------|-----------------|--------------------|-------------|-------------|------------|----------------|-----------------|-----------------|-------------------------|
| Almanaser 2005 15528897 | Per protocol | ACC/AHA Class I | | | | | | | | ACC/AHA Class I | ACC/AHA Class I | Cardiac workup |
| | Ad hoc | Yes | | | | | | | | | ACC/AHA Class I | |
| Chung 2009 19151274 | Per protocol | >45 yo, etc. | Indication | Indication | | >60 yo etc. | Indication | | | | | Sickle cell (ethnicity) |
| | No testing | | | Glucose (DM) | | | | | | | | |
| Finegan 2005 15983141 | Routine | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | |
| | Ad hoc | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | |
| Larocque 1994 7922901 | Per protocol | 77% | 45% | ~70% | 6% | Yes | 23% | 93% | | | | |
| | Ad hoc | 75% | 57% | ~96% | 11% | Yes | 26% | 97% | | | | |
| Mignonsin, 1996 8762245 | Routine | 67% | 71% | ~90% | | 95% | ~50% | 58% | | | | Electrophoresis (12%) |
| | Per protocol | 47% | 37% | ~30% | | 59% | 100% | 0.5% | | | | (27%) |
| Wyatt 1989 2729769 | Per protocol | ≥40 yo | ≥50 yo | Yes | Yes | Yes | Yes | Yes | | | | |
| | Ad hoc | Yes | Yes | Yes | Yes | Yes | Yes | | | | | EtOH, Cardiac enzymes |

Yes = test included in protocol or analyzed ad hoc; Percentages refer to the percent of study participants who had test; Other text provides details about who or what test was included.

General Surgery, Adults, Summary

- RCT underpowered, Nonrandomized studies unadjusted for baseline differences,
- Overall, high risk of bias
- **Insufficient evidence** regarding perioperative death or complications
- **Insufficient evidence** regarding other outcomes
- **Insufficient evidence** to evaluate potential differences based on subgroups
- **No study** evaluated harms, quality of life

Orthopedic / Vascular Surgery, Adults

Orthopedic: 1 Retro nRCS

| Author Year PMID | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemostas is tests | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|-----------------------------|-----------------|--------|-----|--------------------|-----------------------|-----|----------------------|------------|-------------------|----------------|------|-------|
| Mancuso 1999 10203622 | Routine | Yes | Yes | Yes | Yes | Yes | PT, PTT, ESR | Yes | | | | RPR |
| | Per protocol | ≥50 yo | | | | Yes | | | | | | |

Vascular: 1 RCT

| Author Year PMID | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemostasis tests | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|-----------------------------|------------|-----|-----|--------------------|-----------------------|-----|---------------------|------------|-------------------|----------------|------|-------|
| Falcone 2003 14689407 | Routine | | | | | | | | | | Yes | |
| | No testing | | | | | | | | | | | |

Both surgeries:

- High risk of bias, no adjustment for baseline differences
- **Insufficient evidence** regarding differences in unplanned hospital admissions (only outcome reported)
- **No study** evaluated complications, harms, other outcomes
- **No study** subgroup differences

Pediatric Surgery

Tonsillectomy /Adenoidectomy: 1 Retro nRCS

| Author Year PMID | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemostas is tests | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|--------------------------|-----------------|-----|-----|--------------------|-----------------------|-----|----------------------|------------|-------------------|----------------|------|-------|
| Zwack 1997 9051441 | Routine | | | | | Yes | Yes | | | | | |
| | Per protocol | | | | | Yes | Indicated | | | | | |

General (or Various) Surgery: 1 RCT (1975), 1 Retro nRCS

| Author Year PMID | Arm | ECG | CXR | Basic Metabolic | Extended Metabolic | CBC | Hemostas is tests | Urinalysis | Pregnancy Test | Stress Test | Echo | Other |
|-------------------------------|----------------------|-----|-----|--------------------|-----------------------|-----|----------------------|------------|-------------------|----------------|------|----------------------------|
| Leonard 1975 1095116 | Routine | | | Yes | Yes | Hb | | | | | | |
| | Routine (Hb only) | | | | | Hb | | | | | | |
| Meneghin i 1998 9483592 | Routine | | | | | Hb | | Yes | | | | CPK, cholineste rase |
| | No testing | | | | | | | | | | | |

- **Tonsillectomy:** High risk of bias (2 per protocol surgeons conducted 50% more surgeries than 9 routine surgeons combined)
- **Both:** **Insufficient evidence** regarding differences outcomes (differences in bleeding outcomes likely due to surgical experience)
- **Both:** **No study** evaluated harms, other outcomes
- **Both:** **No study** subgroup differences

Impact on Case Management

- **Change in surgical technique**
 - 4 studies (3 adult, 1 children), published prior to 1998
 - *0-0.7% changed surgical technique*
- **Change in anesthesia management**
 - 16 studies (10 adult, 6 children)
 - *Children: 0-2.3% changed anesthesia*
 - *Adults: 0-10% changed anesthesia*
 - 1977-1988: 0-10.5% (median 2.9%)
 - 1990s: 0-3.7% (median 0.1%)
 - 2002-2006: 0%
- **Changes in surgery or anesthesia may have improved, worsened, or had no effect on outcomes**

Impact on Delays/Cancellation

- **Procedure cancellation**

- 34 studies (23 adult, 11 children)
- *Adults: 0-6.4%*
- *Children: 0-0.5%*
 - 1983-1989: 0-6.4% (median 0.1%)
 - 1990s: 0-2.0% (median 0%)
 - 2002-2009: 0-2.0% (median 0%)

- **Procedure or anesthesia delay**

- 26 studies (19 adult, 7 children)
- *Adults: 0-5.1%*
- *Children: 0-2.7%*
 - 1977-1989: 0-1.2% (median 0.5%)
 - 1990s: 0-3.6% (median 0.5%)
 - 2001-2013: 0-5.1% (median 0.6%)

- **Cancellations or delays may have improved, worsened, or had no effect on outcomes**

Study Limitations

- Studies included
 - Highly **heterogeneous surgeries** (even within studies), except cataract
 - Highly **heterogeneous patients** (even within studies)
 - Highly **heterogeneous testing** (sometimes within studies)
- **No analyses of differential effects** by surgery, patient risk category, or specific tests
- **No adequate adjustment** for differences in surgery, anesthesia, patients, individual surgeons, surgical experience, or other factors between preoperative testing groups
- **Poor reporting** of other preoperative assessments (H&P), why clinicians ordered ad hoc tests, or how abnormal test results were handled
- **(Almost) no evaluation of harms**

Future Research Suggestions

- **RCTs required** for non-cataract surgeries
 - Many opportunities available to conduct trials
- Studies of different populations/surgeries needed
 - Studies of “low risk” populations can yield instances where testing does not improve outcomes
 - Studies of “high risk” populations can yield instances where testing may be of value (may improve outcomes)
- **Variability** in patients, surgeries, surgeons, anesthesiologists, etc. **needs to be accounted for** (even in RCTs)
- **Patient-centered outcomes**, including harms and patient time and resources should be investigated

Conclusions

- 57 studies
 - Only 14 comparative, only 6 RCTs (3 cataract)
- High strength of evidence routine testing does not affect outcomes with cataract surgery
 - Likely not applicable to other (more invasive) surgeries
- Insufficient (or no) evidence of the benefits and harms of any type of testing for all other surgeries
- Highly heterogeneous, flawed studies overall
- Decision- and policy-makers do not have adequate, evidence-based guidance regarding when and how to use preoperative testing
- Research in this area is both feasible and could have significant impact on healthcare outcomes and resource use