The Orderly and Effective Visit: Impact of the Electronic Health Record on Modes of Cognitive Control

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OVERVIEW

- Joint Cognitive Systems
- Contextual Control Model
- Concepts of effectiveness
- Aims of the Study
- Methods
- Results
- Conclusion

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Overarching Goal

- Medical care is information intensive
- Current user interfaces are hard and unpleasant to use
- Must develop user information environments that improve efficiency and quality of care.
  - Efficiency measured in time (easy)
  - Quality measured in patient outcomes (hard)
- Need model to predict and measure effects of user interfaces on quality of reasoning

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Joint Cognitive Systems

- ***An*** interdependent emergent system
- "***Cognition***" is distributed across system
  - computers, people, data, displays
- Dimensions of a joint cognitive system:
  - ***Goal-orientation*** – increase order/alignment
  - ***Orderly/ Under <u>Control</u>*** – a cycle that detects deviations from goal and institutes adaptive actions
  - ***Co-agency*** – Collective energy of the system

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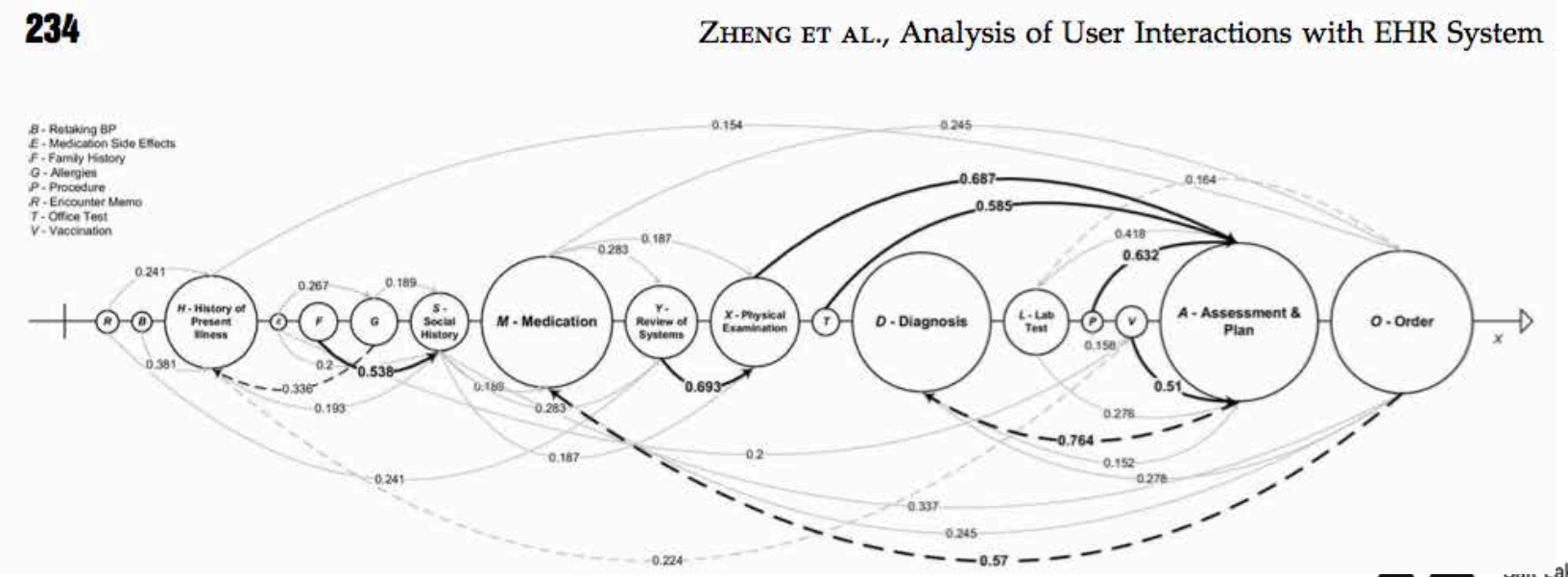
As-is EHR

- Building blocks of EHR are data domains
  - Meds, Labs, Rad, Notes, Diagnoses, etc.
- Results in bad thought-flow and workflow



Contrasts with Usual Approaches

- Cognitive support not decision support
  - quality of reasoning not right answer
- Joint not separate systems
  - Joint best not human best and computer best
- Cognitive-social psychology not ergonomics
  - Thought cycles over seconds to minutes not ms

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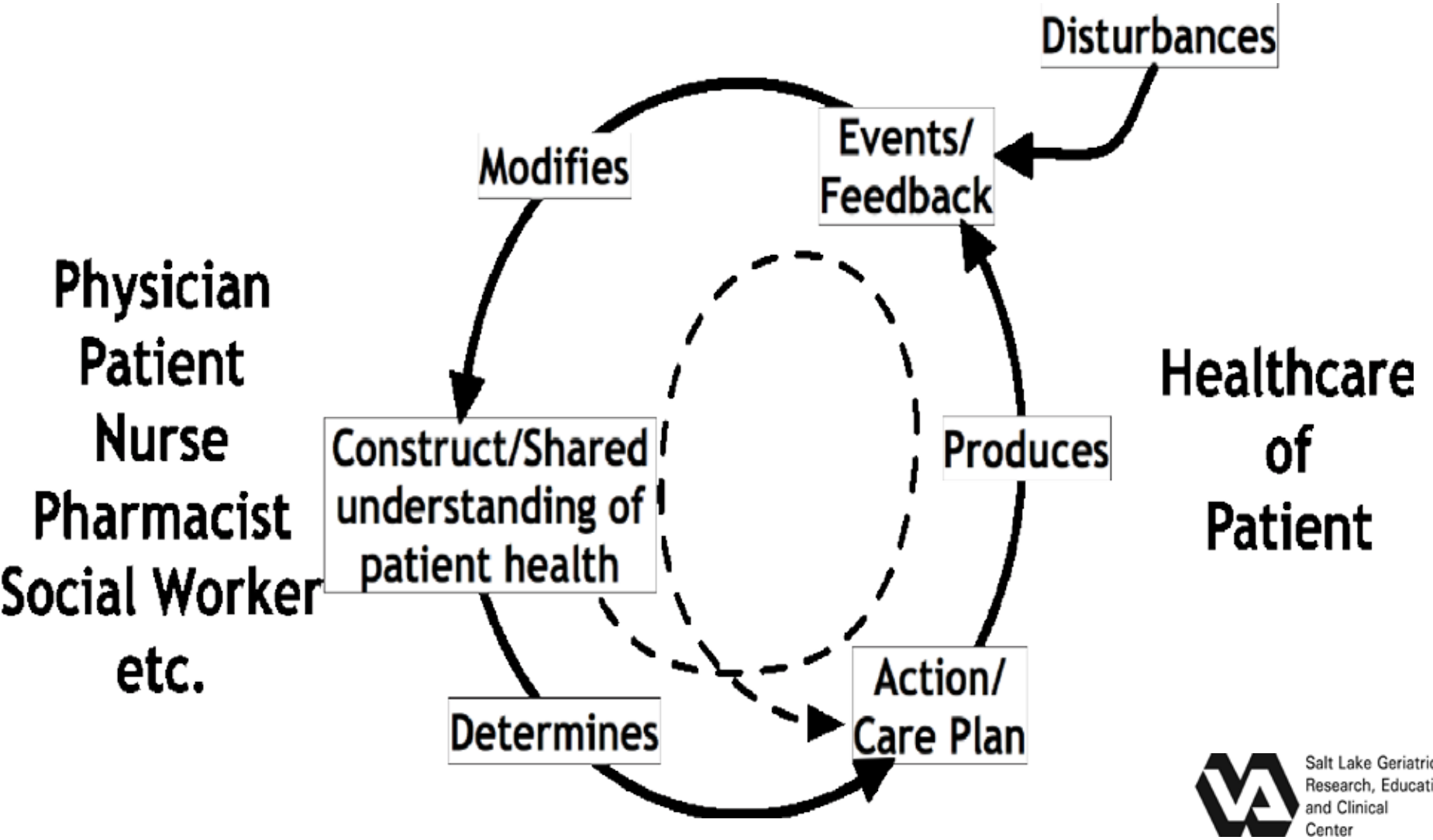
Contextual Control Cycle



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Contextual Control Components

- ***Goal Interactions*** - the degree to which goals are defined and integrated
- ***Time Horizon*** - breadth of information, change over time and future forecasting
- ***Assessment of Uncertainty*** –Limitations of available information is identified, explained and adapted to
- ***Decision heuristics*** - Action plan is customized to the current situation

Dependent Variables – Control Mode

Characteristics of Control Modes

Control Mode	Goal interactions	Time horizon considered	Assessment of uncertainty	Decision heuristics
Strategic	Higher-level goals and interactions considered	Broad into past and future (feed forward)	Recognition and explanation of uncertainty	Adaptation of guidelines to situation, planning, consideration of dependencies
Tactical	Focus on defined, individual goals	Broad into past, minimal projections	Recognition	Guidelines, limited planning
Opportunistic	Poorly defined goals	Present	Limited recognition	Habits, pattern recognition
Scrambled	Lack of consideration	Immediate	None	Random

Description of Study

Aims / Hypotheses

- Aim 1: The intensity of pre-visit planning would differ performance level

- Aim 2: Higher level of performance associated with lower frequency of searching during visit.

METHODS

- ***Design***: Correlational
- ***Settings***: 5 VA hospitals
- ***Participants***: 45 primary care providers (35 MDs, 10 mid-levels)

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METHODS

Procedures

- 3 phases (audio-taped)
  - ***Phase 1:*** Interview prior to visit / prep
  - ***Phase 2:*** Interviews in person (audio-tapes); screen shots captured manually (notes, orders, medications, consults, and labs/procedure results).
  - ***Phase 3***: Post-visit interview

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Dependent Variables

- **Control Mode** (coded orderliness) (IRR > 0.80)
  - Strategic – highest level of control/orderliness
  - Tactical – structured, but rigid, guideline based
  - Opportunistic – scattered, bouncing from highly salient
  - Scrambled – very unstructured and chaotic
- **Pre-planning intensity**: coded on a 1 (low) to 7 (high) scale. Independent of Mode
- **Searching Activity**: the proportion of overall screen changes dedicated to searching alone

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Measurement Codes for Control Modes

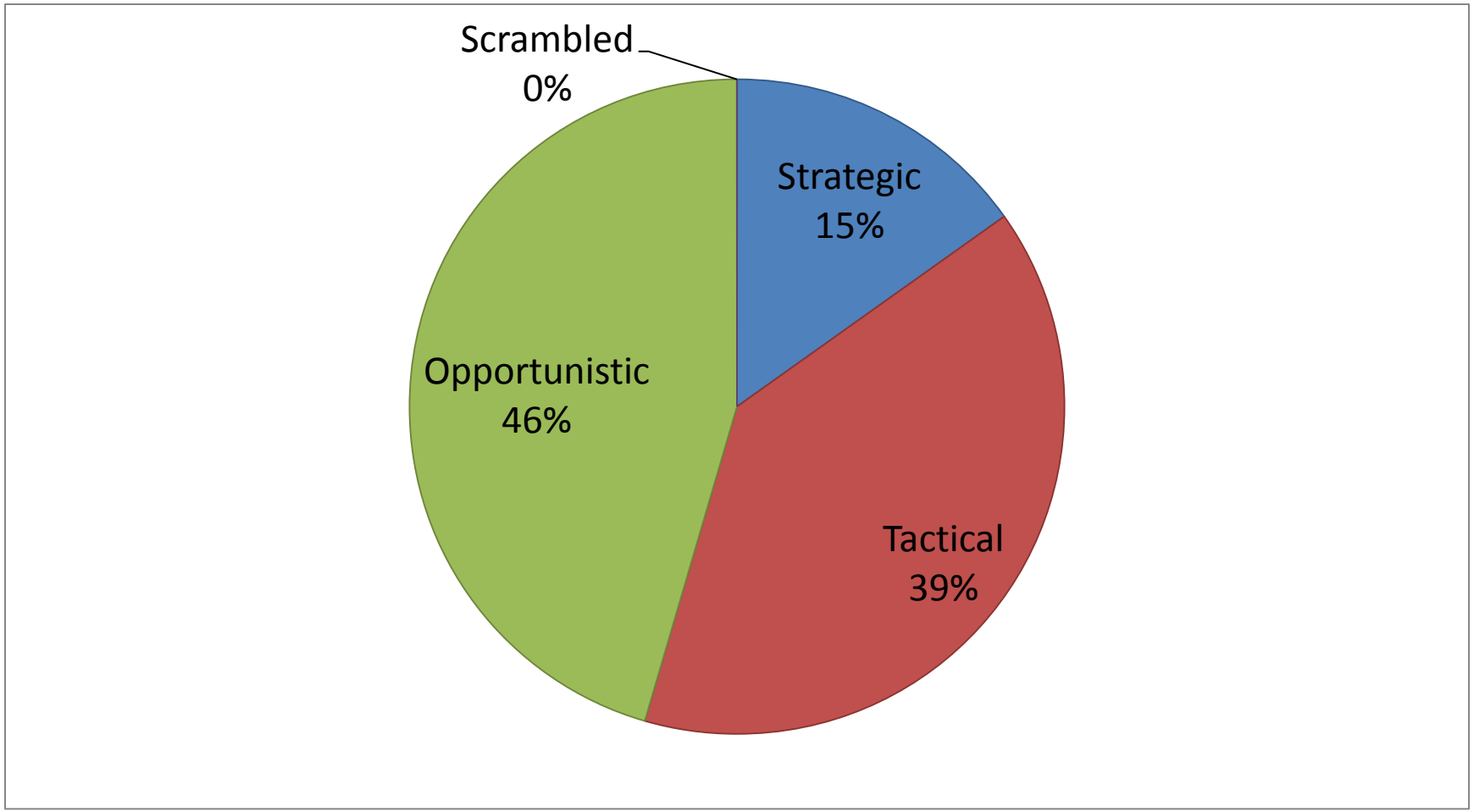
Coded by 2 independent raters using strict rules

	Strategic	**Tactical**	**Opportunistic**	***Scrambled***
Goals:	High-level goals/interactions	Specific, lower level goals	Little mention of goals of care	*No goals mentioned*
Time Horizon	Broad/Future and past trending	Broad view into past; little future trending	Present focus; little trending	*Immediate only*
Uncertainty	Recognition / Attempt to Explain	Recognition but no attempt to explain	Little recognition	*None*
Heuristics	Guidelines / Planning/ Considerations of dependencies	Heavy use of guidelines and rules; little adaptation to individual	Habits/ guidelines and pattern recognition	*Random*

RESULTS - *Descriptives*

	Opportunistic	Tactical	Strategic
Years*	16	18	10
Role*	11	9	11
Work Pressure*	4.9	4.3	3.0
Time*	27. 4	26.3	28.7

% Cognitive Mode



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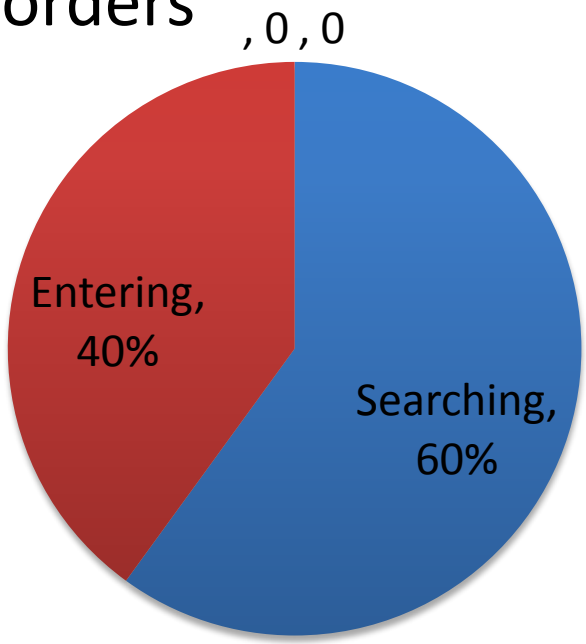
Screen Changes

- Mean # of screen changes = 18.5 per visit
  - 60% searching
  - 40% entering notes or orders



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- **Control mode** NOT related to years since graduation, familiarity with the patient, ratings of levels of mental stress, and overall time of the visit.

Pre-planning Measurement: CTA

"Please think aloud what is in your mind while you do this task. Please indicate what you are trying to do. There are no right or wrong things to say."

"Please tell me what you're doing explicitly during the preparation templating and updating process. You're doing this in order to do what? And you're doing that by doing what?"

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Intensity of Preparation Coding

- 1 (not well) to 7 (very-well) scale
- 2 independent coders, (R>0.80)

  - Medication review
  - Pre-review of prior visits and intervening events (reading progress notes)
  - Review by problems/associated labs
  - Establishment of goals of visit

Aim 1: The intensity of pre-visit planning would differ across mode

- Mean = 4.9
- ANOVA ($F_{2,23}$=5.64; p=0.01).
- Statistical significance remained after controlling for years of experience ($F_{2,23}$ = 6.62; p=0.01).

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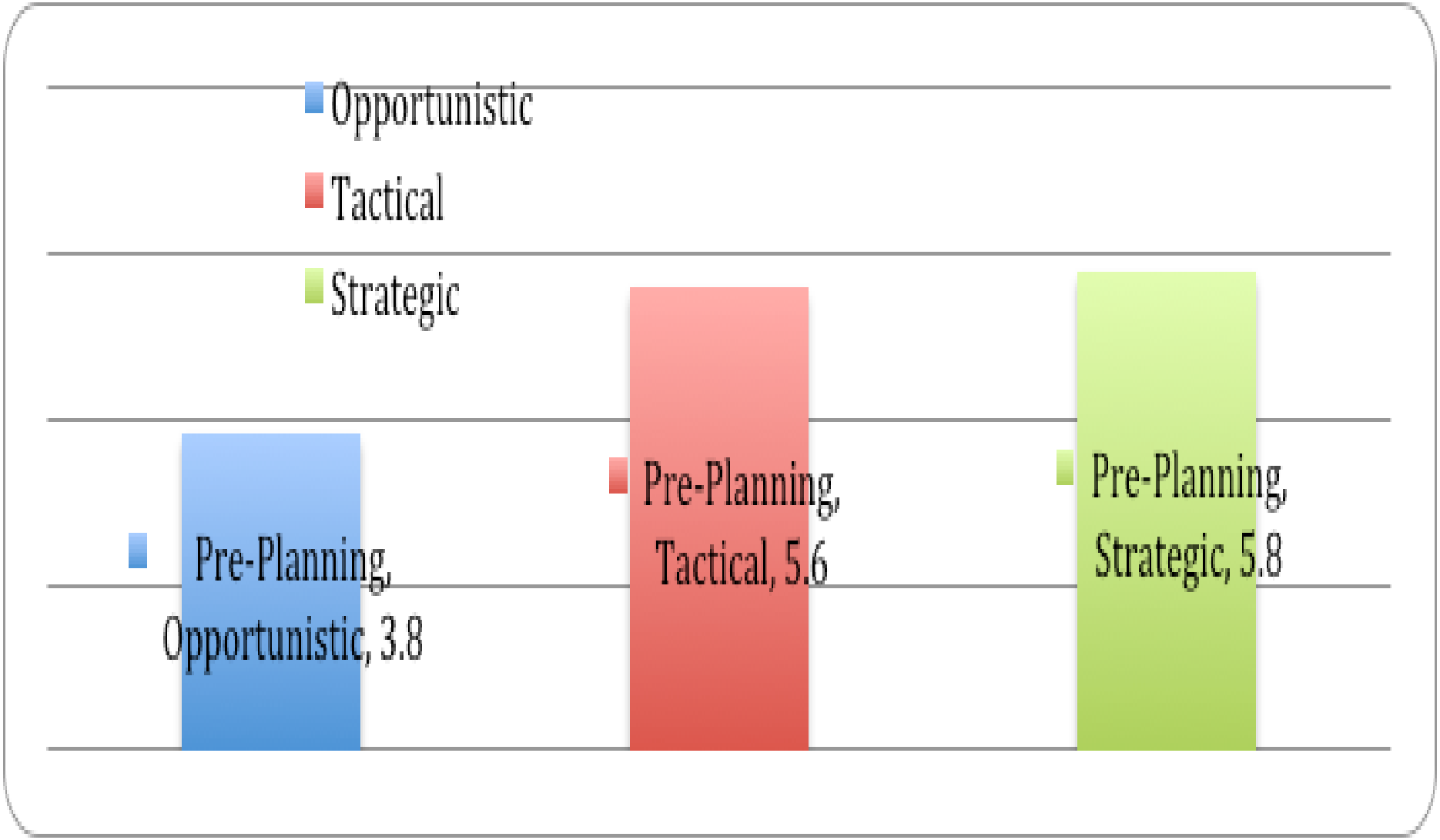
RESULTS – *Pre-Planning (1 to 7)*



Aim 2: Higher level of performance associated with lower frequency of searching during visit

- Higher levels of performance associated with lower incidence of search activities

  ($F_{2,30} = 6.54$; $p=0.004$)

- After controlling for pre-planning:

  ($F_{2,22} = 4.2$; $p=0.03$)

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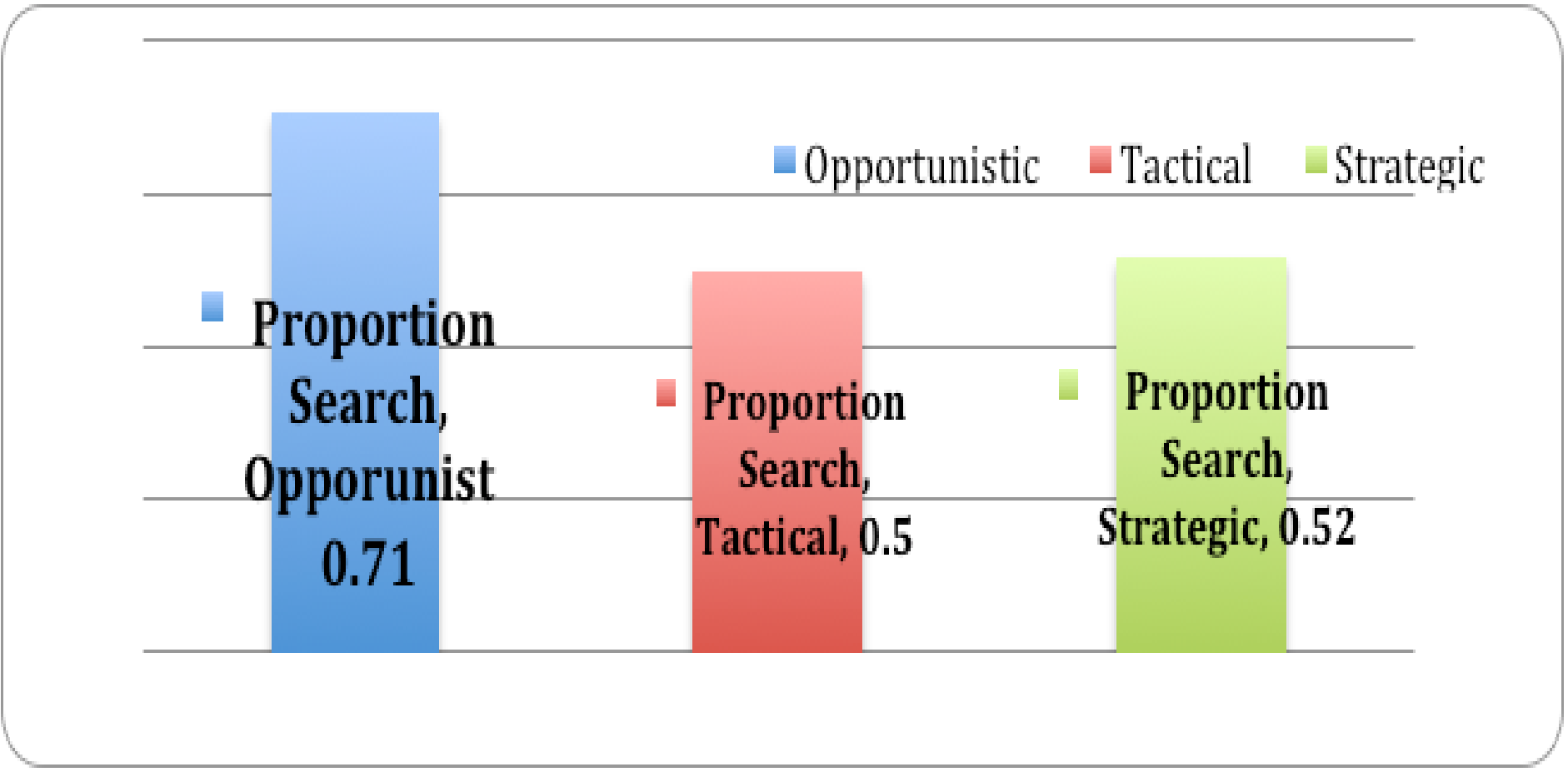
Measurement of Search Activity

- Research assistants in room with patient and provider
- Used tablet with time-stamped software
- Tape-recorded visit
- Noted every change of screen

RESULTS – *Search Activity*



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Entering Screens

- Visits rated at a higher level of control had higher proportion of computer interactions involving ordering.

  ANOVA, ($F_{2,22} = 9.26$; $p=0.001$)

- After controlling for pre-visit planning:

  ($F_{2,22} = 4.9$; $p=0.02$).

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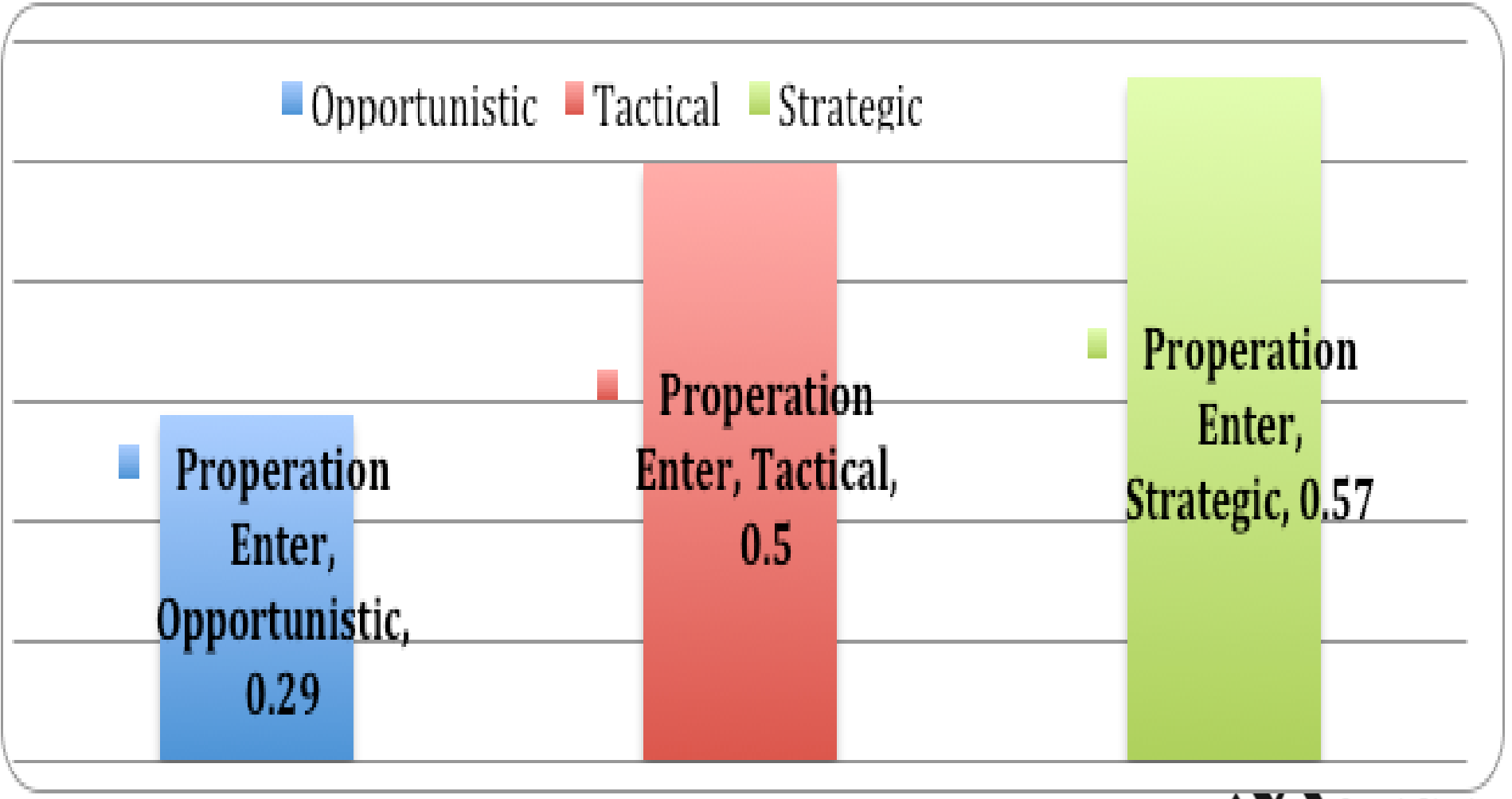
RESULTS – *Entering Notes/Orders*



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Conclusions

- Pre-visit preparation of electronic note was significantly associated with higher levels of visit control ***after controlling for years of clinical experience***.
- Searching activity significantly inversely associated with visit performance ***after controlling for degree of pre-planning efforts.***
- Implication is that the EHR is not providing adequate cognitive support for visit workflow.
  - Information has to be very organized to support a complex primary care visit.
  - Searching during a visit is very ditsracting and decreases performance

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"IT applications appear designed largely to automate tasks or business processes. They are often designed in ways that simply mimic existing paper-based forms and provide little support for the cognitive tasks of clinicians or the workflow of the people who must actually use the system." (p. 3)

Stead WW, Lin HS. Computational technology for effective health care: immediate steps and strategic directions. Washington, D.C.: National Academies Press; 2009.

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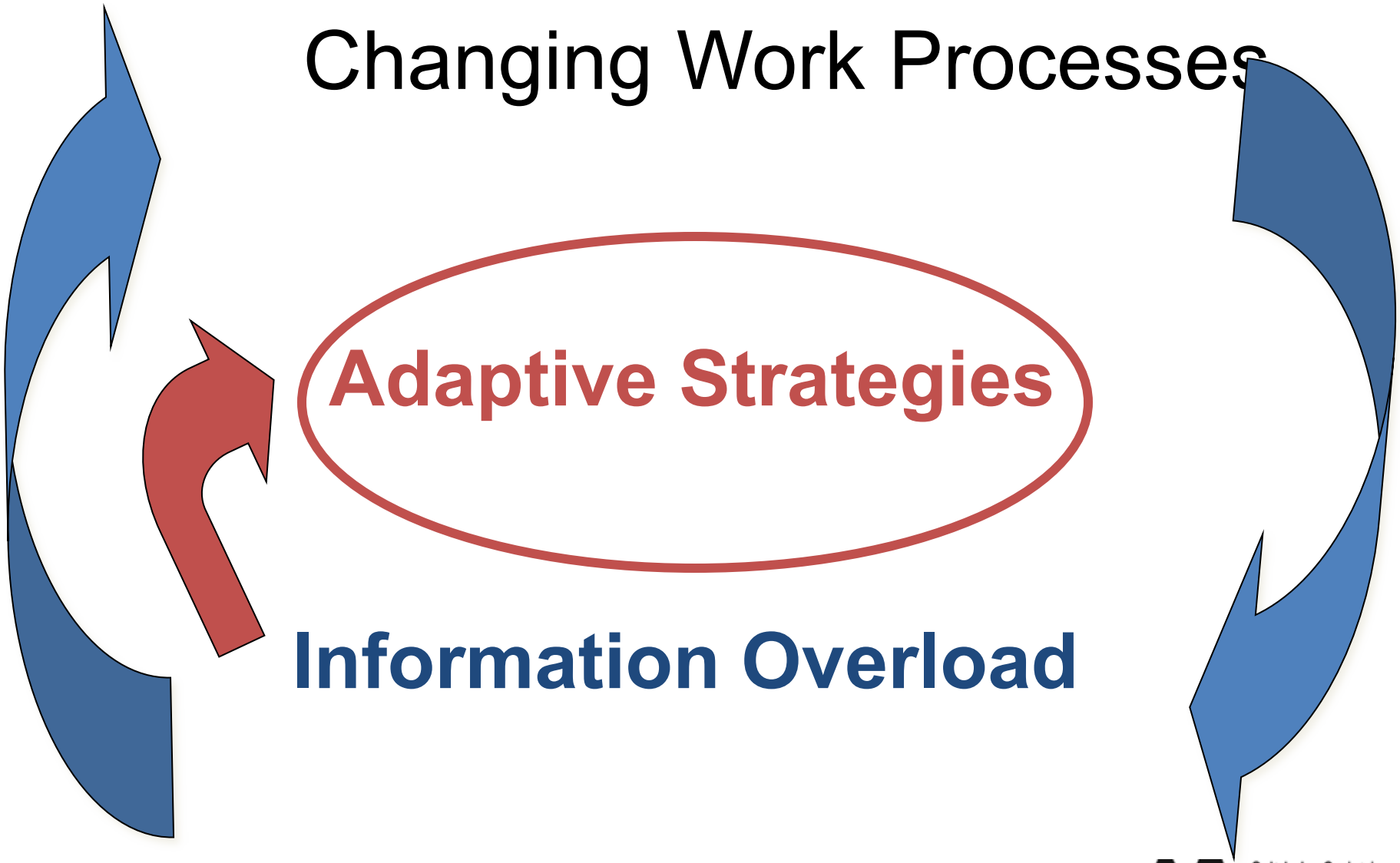
Changing Work Processes



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Limitations

- Not a randomly controlled trial
- Personality/cognitive factors may be associated with pre-planning and ALSO associated with visit performance (thus producing a confound)
- Study done in the VA which may not be generalizable

Acknowledgements

Research supported by:

AHRQ 1R18HS017168-01 (Nebeker, J)

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