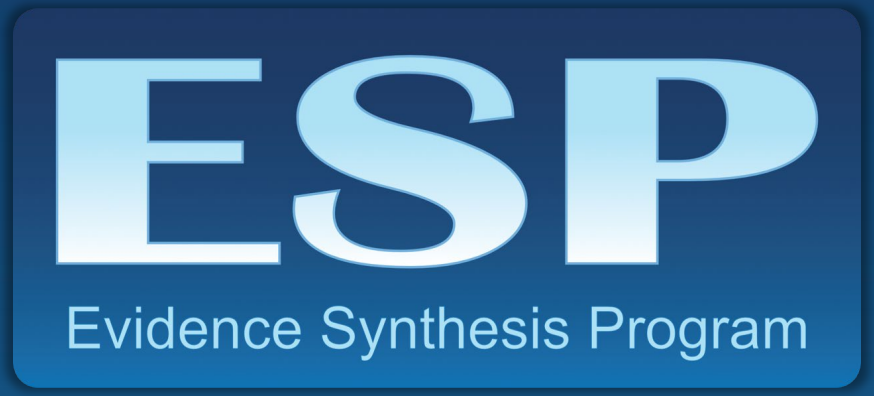

Evidence Brief: Detection and Treatment of Dental Problems on Chronic Disease Outcomes

Stephanie Veazie, MPH
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ESP Coordinating Center
Portland VA Medical Center

April 5, 2021

Acknowledgements

The review team developed the report's scope, study questions, and methodology in consultation with the Operational Partners *(ie*, topic nominators). Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

The authors gratefully acknowledge the following individuals for their contributions to this project:

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Kathryn Vela, MLIS
Information Specialist
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Operational Partner

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Associate Director, PEPReC
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Disclosure

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This report is based on research conducted by the Evidence Synthesis Program (ESP) Center located at the **VA Portland Health Care System** funded by the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (*eg*, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

VA Evidence Synthesis Program Overview

ESP
Evidence Synthesis Program

- Established in 2007
- Provides tailored, timely, and accurate evidence syntheses of VA-relevant, Veteran-focused healthcare topics. These reports help:
  - Develop clinical policies informed by evidence;
  - Implement effective services and support VA clinical practice guidelines and performance measures; and
  - Set the direction for future research to address gaps in clinical knowledge.
- Three ESP Centers across the US:
  - Directors are VA clinicians, recognized leaders in the field of evidence synthesis, and have close ties to the AHRQ Evidence-based Practice Center Program and Cochrane Collaboration
- ESP Coordinating Center in Portland:
  - Manages national program operations and interfaces with stakeholders
  - Produces rapid products to inform more urgent policy and program decisions

To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee comprised of health system leadership and researchers.

The program solicits nominations for review topics several times a year via the program website.

ESP Center Locations

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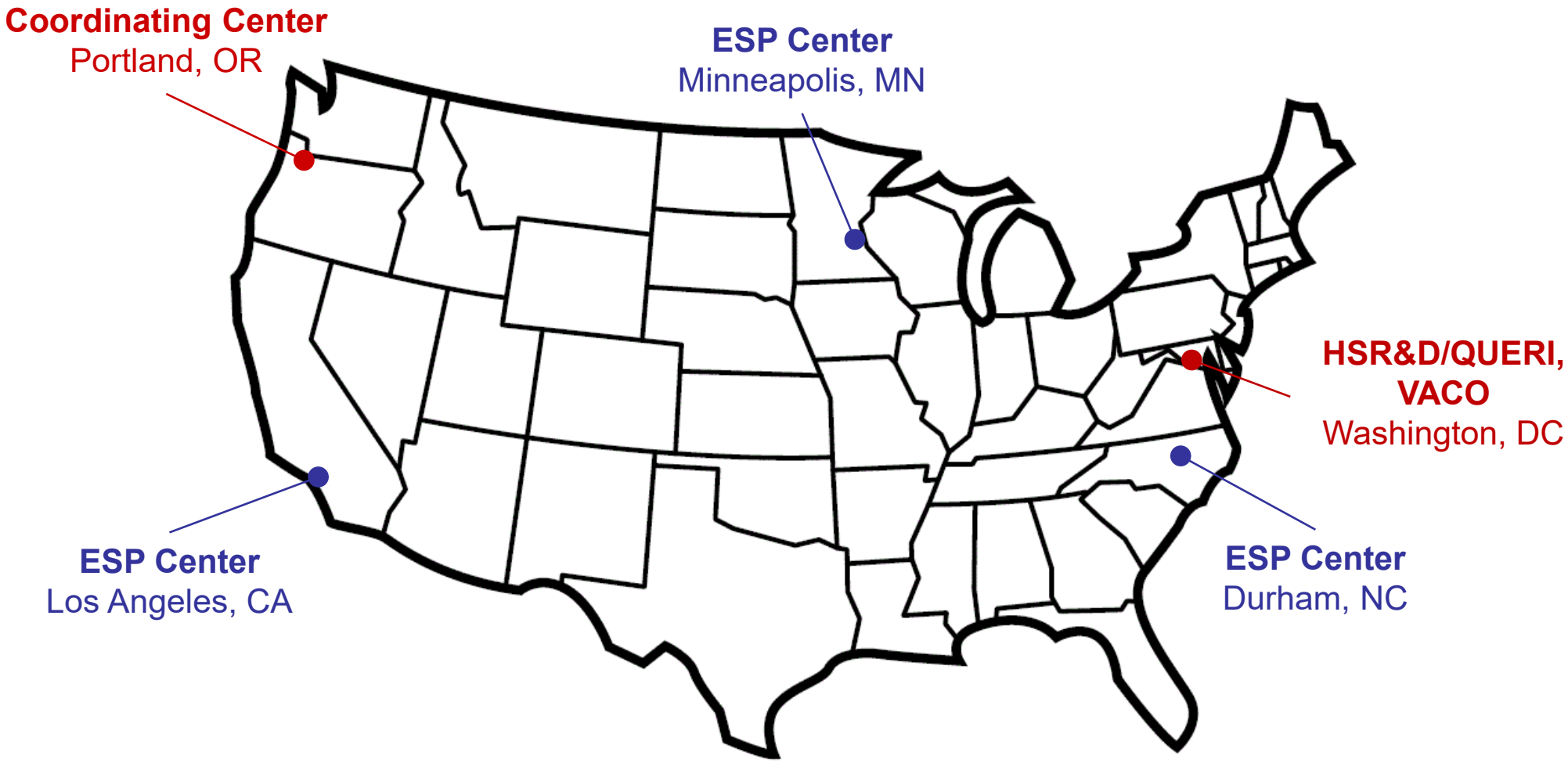

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Current Report

ESP
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Evidence Brief: Detection and Treatment of Dental Problems on Chronic Disease Outcomes

February 2021

Full-length report available on ESP website:
http://www.hsrd.research.va.gov/publications/esp/reports.cfm

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Background on VIC Care Coordination for Dental Benefits Program

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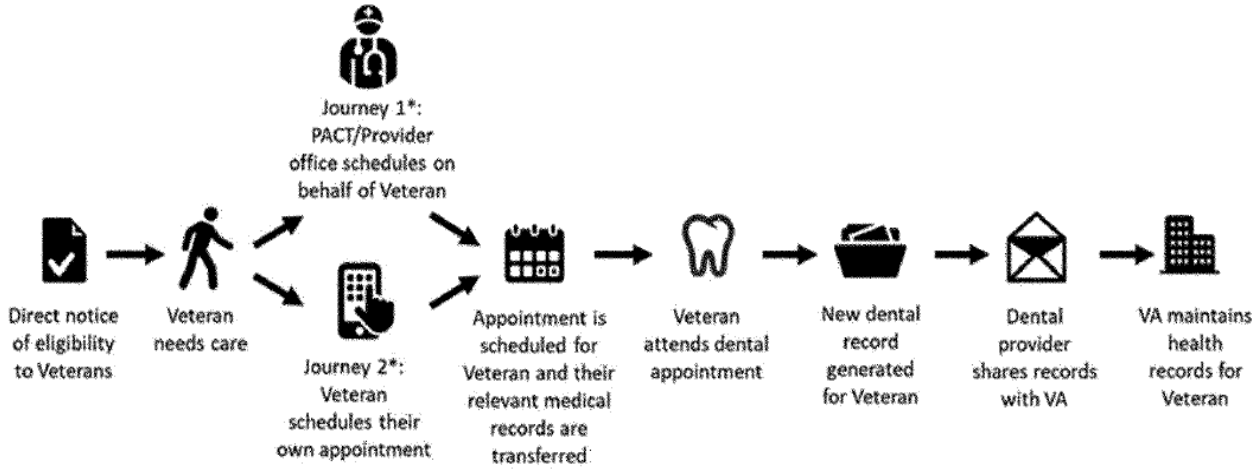
- Only 8% of Veterans have a dental issue that is service-connected or meet other criteria required to receive dental care through the VA.
- In 2019, VA initiated the Veterans Innovation Center (VIC) Care Coordination for Dental Benefits program.
- Through this program, administrative staff are empowered to coordinate care for Veterans who need dental services.
- Goal is to increase Veteran access to dental health care by connecting them with community-based, pro bono, or discounted dental service providers.

Figure 1: Care Coordination for Dental Benefits (CCDB) Journey Map



**Scheduling to be performed via connecting with a call center or online portal*

https://www.govinfo.gov/content/pkg/FR-2019-12-13/pdf/2019-26901.pdf

Background on Dental Health & Chronic Disease

Image from: https://www.niddk.nih.gov/health-information/diabetes/overview/preventing-problems/gum-disease-dental-problems

- Periodontal disease (PD) is a gum infection typically caused by poor dental hygiene.
- Half of US adults over 30 years old have periodontal disease.
- There is an established relationship between PD and chronic disease.
  - PD linked to higher risk of coronary heart disease, coronary artery disease, stroke, and mortality due to atherosclerotic vascular disease-causes.
  - PD also linked to worse glycemic control, diabetes complications, and development of type 2 diabetes.

Background on Dental Health & Chronic Disease

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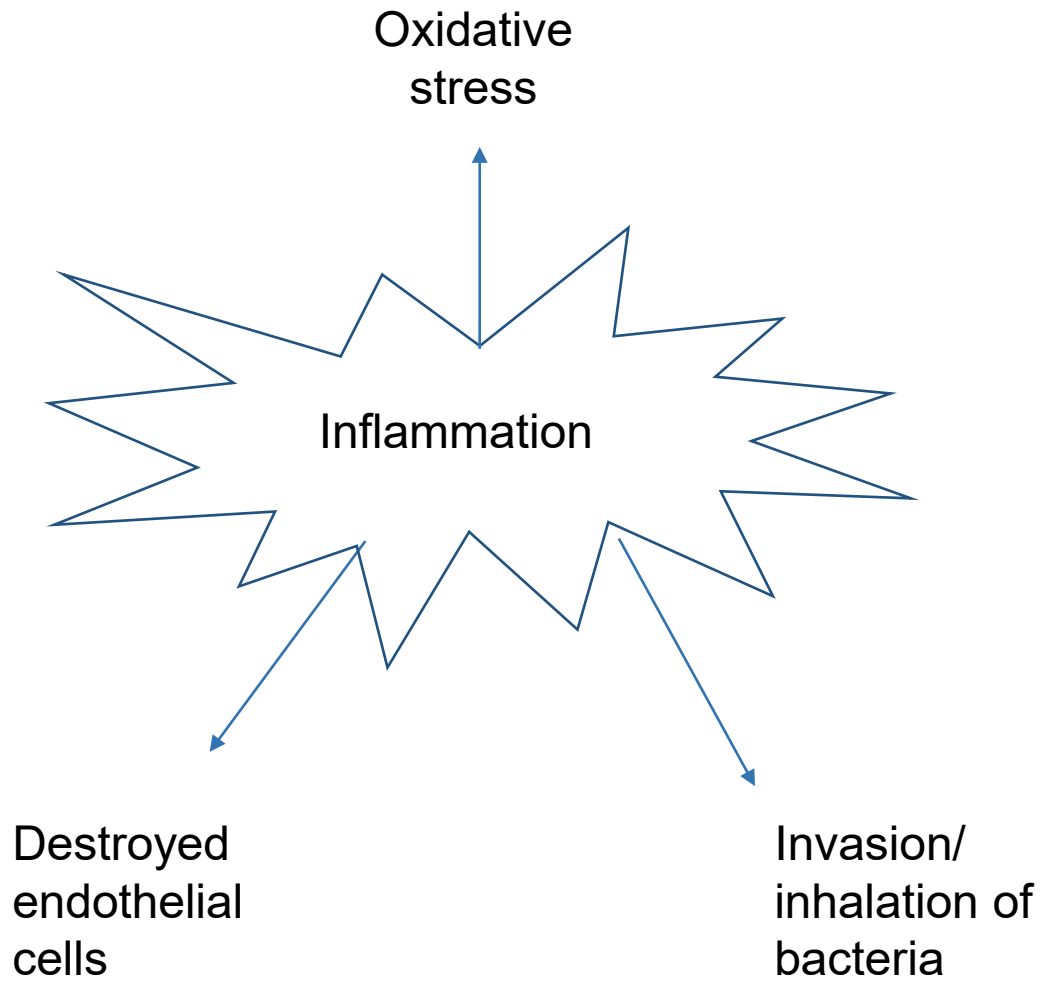
- Biological pathway between PD and chronic disease is not well understood and may vary by chronic disease.
- There are several possible pathways involving inflammatory responses.
- Relationship is bi-directional- PD is known as the “sixth complication of diabetes.”



Key Questions

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Key question 1: Among adults with cardiovascular disease (CVD), cerebrovascular disease, type 2 diabetes (T2D), and/or chronic obstructive pulmonary disease (COPD), does detection and treatment of dental problems improve patient-reported symptoms and other complications of chronic disease?

Key question 2: Among adults with CVD, cerebrovascular disease, T2D, and/or COPD, does detection and treatment of dental problems improve indicators of chronic disease management (eg, HbA1c, blood pressure, cholesterol) and patient quality of life?

Key question 3: Among adults with CVD, cerebrovascular disease, T2D, and/or COPD, does detection and treatment of dental problems decrease health care utilization and costs?

Key question 4: Among adults with CVD, cerebrovascular disease, T2D, and/or COPD, what are the possible harms of detection and treatment of dental problems?

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Key Questions

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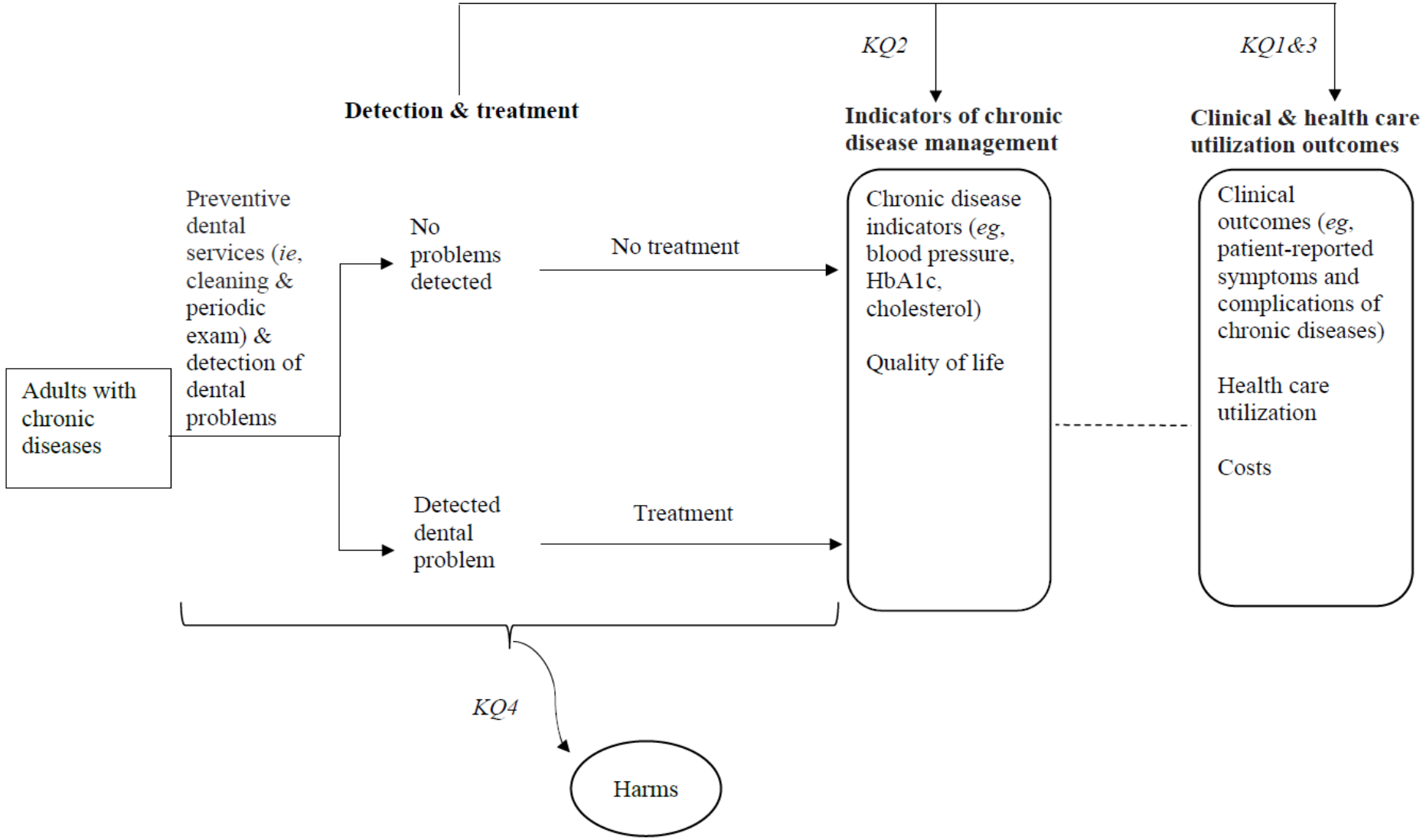
Analytic Framework



Eligibility Criteria

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Population: Adults with CVD, cerebrovascular disease, T2D, and/or COPD

Intervention: Detection and treatment of dental problems (*ie*, use of preventive dental services such as regular oral exams, detection of dental problems, and treatment of dental problems detected during exams) - *Limited to periodontal treatment after SR search*

Comparator: No detection or treatment of dental problems

Outcomes:

- Clinical outcomes (*eg*, patient-reported symptoms, complications)
- Chronic disease indicators (*eg*, HbA1c, blood pressure, cholesterol)
- Quality of life (*eg*, oral health-related quality of life)
- Healthcare utilization (*eg*, ED visits for non-dental conditions, health care visits associated with chronic disease management, direct costs)
- Harms

Evidence Brief Methods

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- **Search:** 2-stage search-
  - Search #1: SRs indexed in MEDLINE, CDSR, & other SR databases
  - Search #2: Primary studies indexed in MEDLINE or CENTRAL that addressed gaps in SR evidence or were published after SRs
- **Study selection:** Based on eligibility criteria
- **Data abstraction:** Study characteristics (PICOs) and results
- **Critical appraisal:** Use of standardized tools
- **Quality control:** Assessments first completed by one reviewer and checked by one additional reviewer. Disagreements resolved by consensus.
- **Peer review:** Topic and methodological experts commented, responses are publicly available

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Criteria for Assessing Quality of Systematic Reviews

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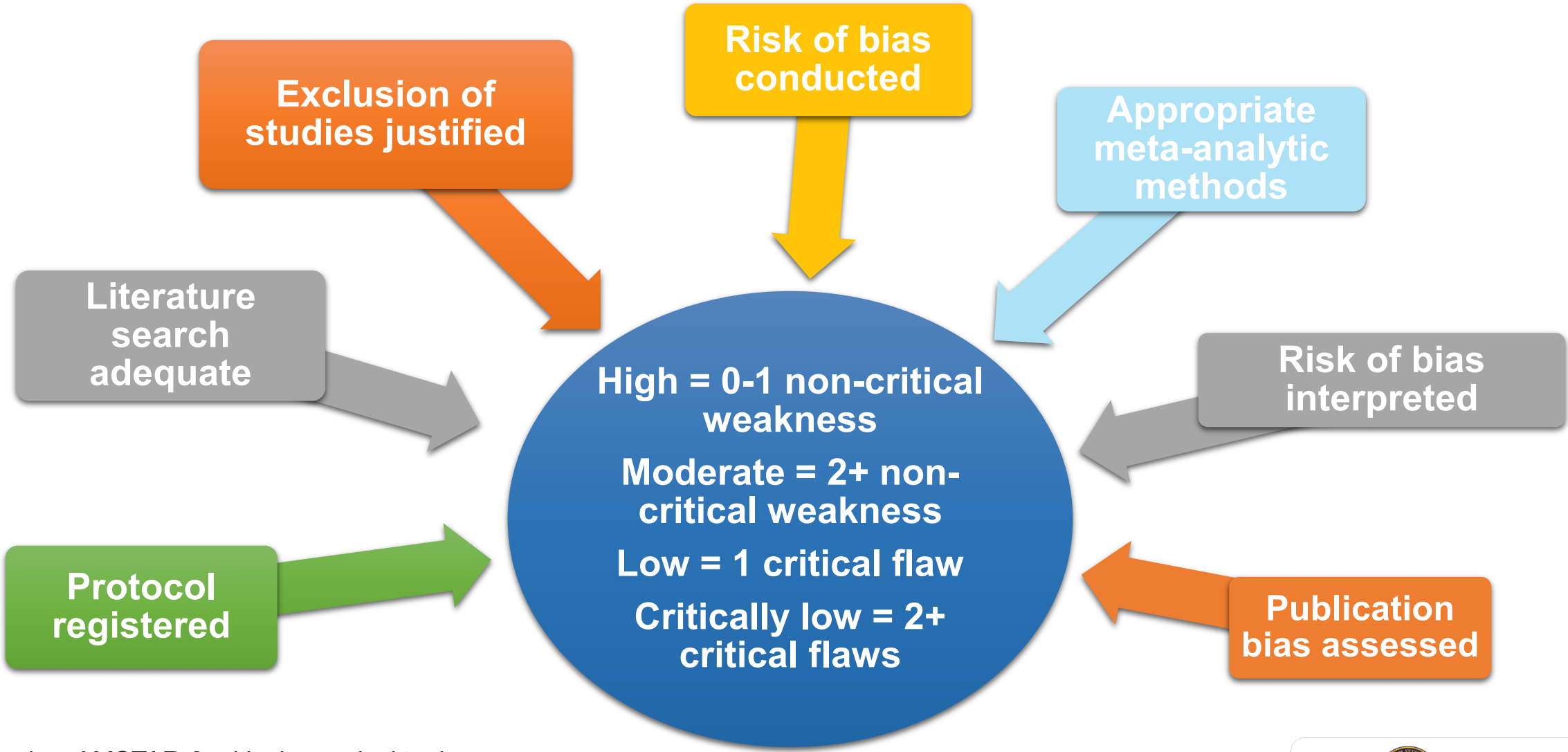

*Based on AMSTAR-2 critical appraisal tool

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Criteria for Assessing Risk of Bias of Primary Studies

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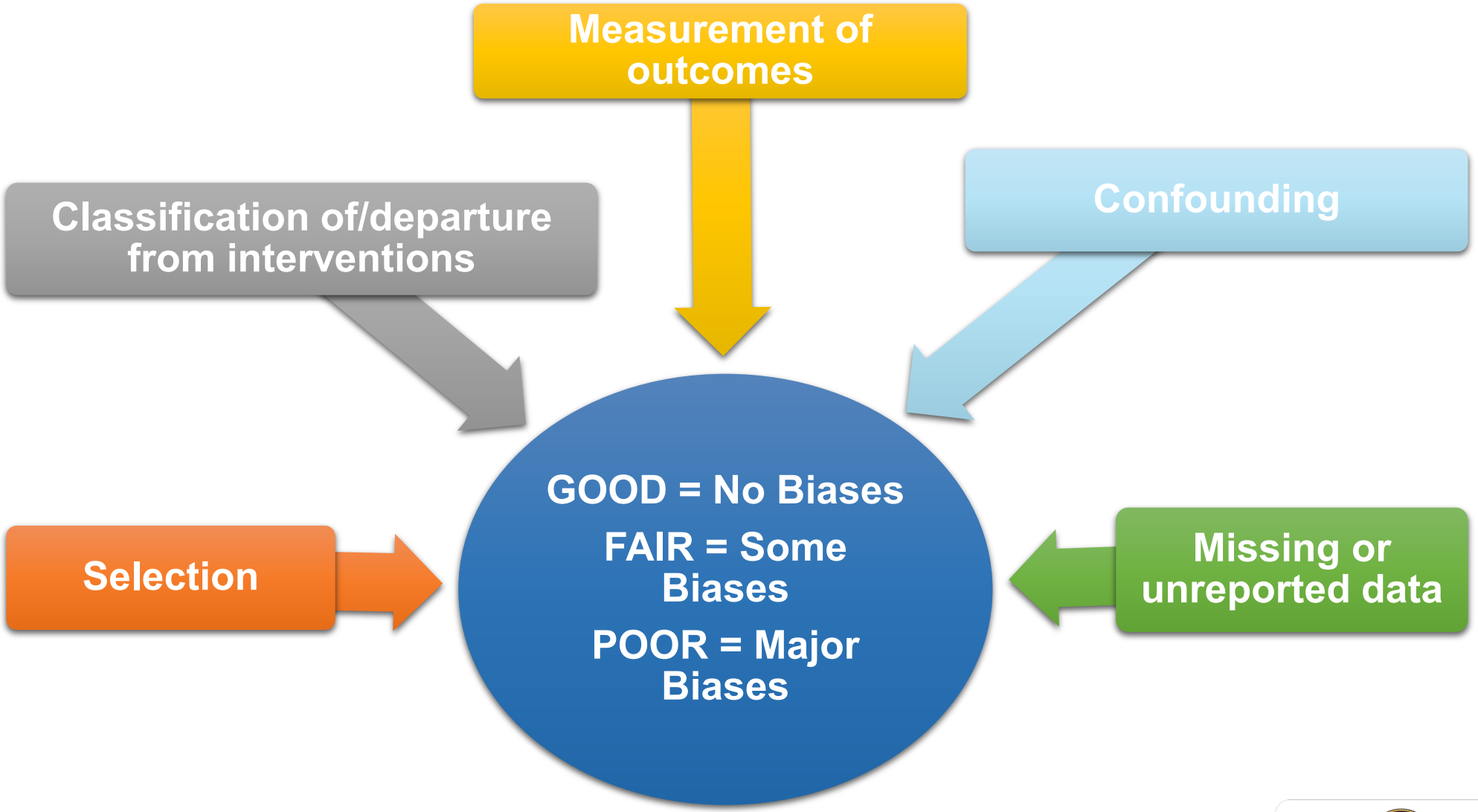

*Based on Cochrane's ROB 2.0 and ROBINS-I quality assessment tool

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Study Selection

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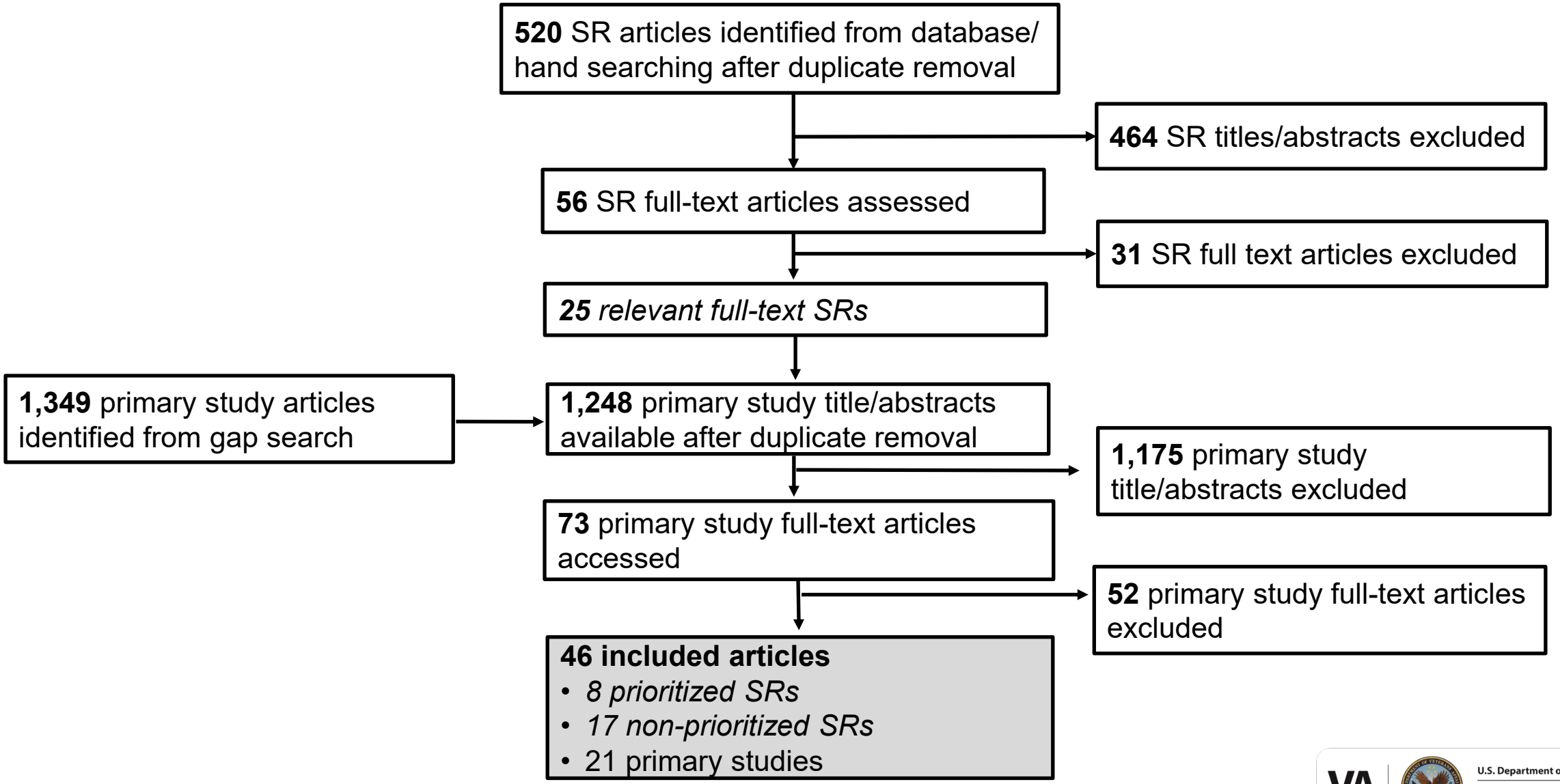

Included Study Characteristics

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- **Study design:** Variable study designs-
  - 8 prioritized SRs
  - 8 RCTs
  - 1 non-randomized controlled trial
  - 8 retrospective cohort study
  - 1 case-control study
  - 2 modeling studies
  - 1 self-controlled case series
- **Population:** All 4 populations assessed
  - Type 2 diabetes (6 SRs + 17 primary studies)
  - Cardiovascular disease (2 SRs + 5 primary studies)
  - COPD (4 primary studies)
  - Cerebrovascular disease (3 primary studies)
- **Interventions:** Primarily non-surgical periodontal treatment (scaling and root planing)
- **Comparators:** Primarily no periodontal treatment, delayed treatment, or oral health education
- **Outcomes:** All 4 categories of outcomes assessed
- **Study quality:**
  - 8 prioritized SRs: 2 high quality, 4 moderate quality, 1 low quality, and 1 critically-low quality
  - 21 primary studies: 13 fair-quality, 5 poor-quality, 3 not assessed (either modeling study or case series)

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Type 2 Diabetes: Overall Results

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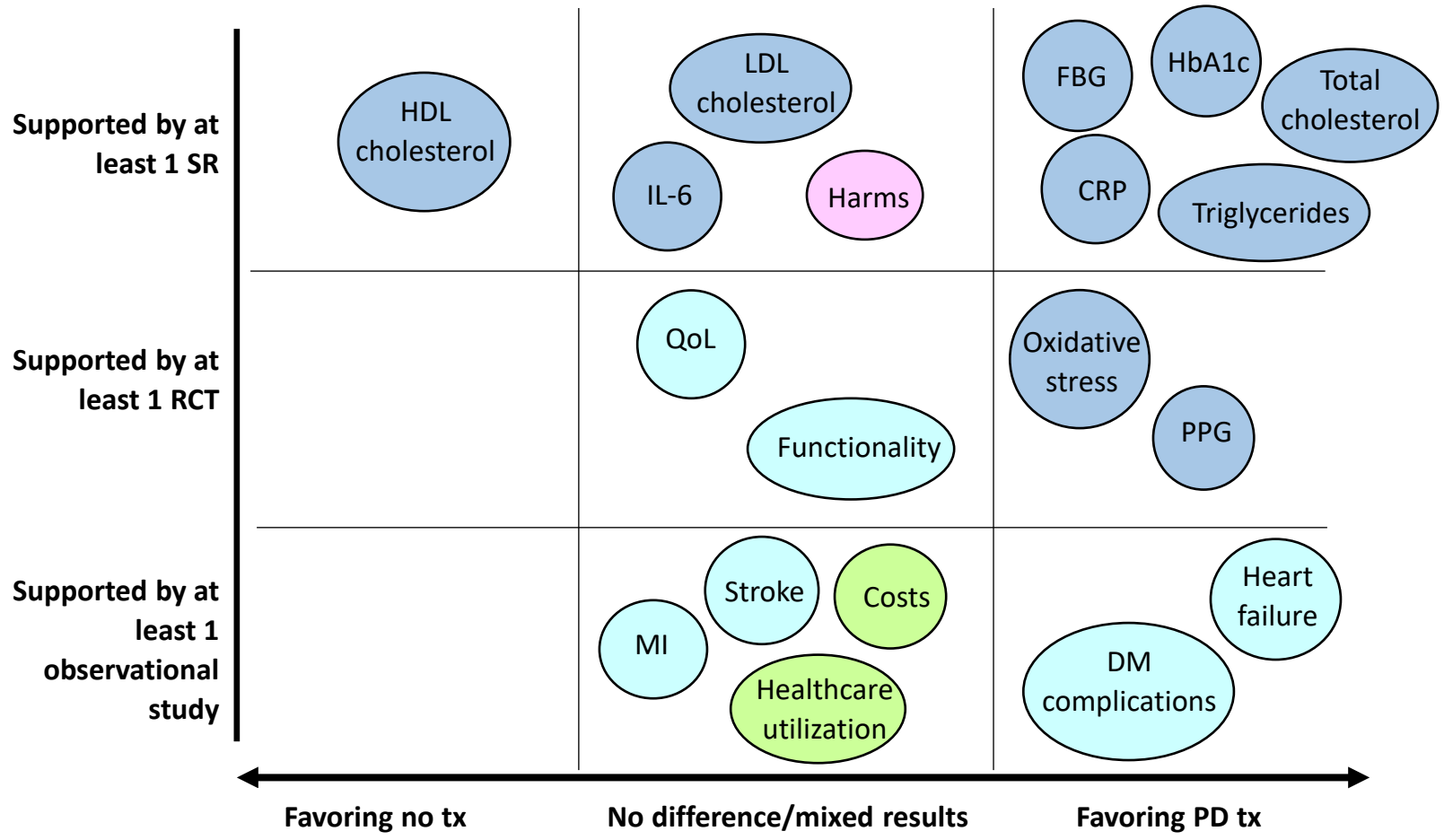
- 6 SRs + 17 primary studies
- PD tx likely improves most **measures of chronic disease severity and inflammation** with only **minor adverse events** in the short term (3-4 months). Benefits do not seem to persist beyond 6 months.
- Findings are unclear on the relation between PD tx and most **patient-reported outcomes, diabetes-related complications, healthcare utilization,** and **costs**.

Improvements in outcomes associated with PD tx vs. no tx.



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Type 2 Diabetes: Healthcare Utilization

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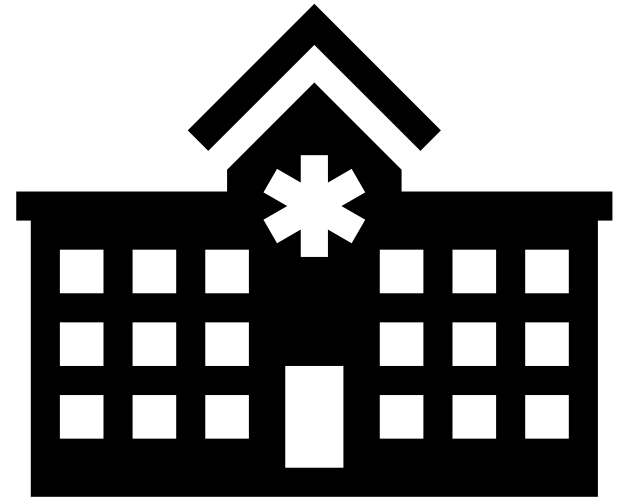
Inpatient admissions:

- ↓ rates of annual patient admissions in PD tx vs. no tx group (1 retrospective cohort study)
- ≈ probability of being hospitalized in both groups (1 retrospective cohort study)



Outpatient physician visits: ≈ outpatient physician visits in both groups (1 retrospective cohort study)

ED visits: ≈ ED visits in both groups (1 retrospective cohort study)

Type 2 Diabetes: Costs

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Author Year	Study design	Quality	Sample size	Country	Types of costs	Results
Smits 2020	Retrospective cohort	Fair	N= 41,598	Netherlands	DM-related dx, tx, rx & hospitalization	Lower costs in PD tx group
Jeffcoat 2014	Retrospective cohort	Poor	N= 338,891	U.S.	All medical costs	Lower costs in PD tx group
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Choi 2020	Modeling study	NA	N = 10,000	U.S.	All medical & dental costs	Lower costs in PD tx group
Albert 2006	Retrospective cohort	Fair	N= 116,306	U.S.	All medical costs	Higher costs in PD tx group
Solowiej-Wedderburn 2017	Modeling study	NA	NA	U.K.	Cost savings of improved HbA1c vs. costs of periodontal tx	Higher costs in PD tx group
Blaschke 2021	Retrospective cohort	Poor	N= 23,771	Germany	All medical costs	No difference between groups

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Limitations of Studies of Medical Claims Data

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vs.

Populations with periodontal disease who received treatment

Populations that did not receive periodontal treatment (who may or may not have had periodontal disease)

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A Note on Subgroups

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HbA1c level:

- Those with poorly-controlled HbA1c (≥7%) who underwent PD tx experienced improvements in oral health related QoL compared to no tx, while those with well-controlled HbA1c (<7%) did not experience these improvements (1 case-control study).
- PD tx was most cost-effective for those with higher HbA1c as they had more to to gain from PD tx-associated reductions in HbA1c (1 modeling study).

Age:

- PD tx most cost-effective for those who are older as lifetime costs of PD tx is lower (1 modeling study)

Use of medications:

- Only those who did not initiate diabetes medications experienced lower healthcare costs associated with PD tx (1 retrospective cohort study)

Cardiovascular Disease: Overall Results

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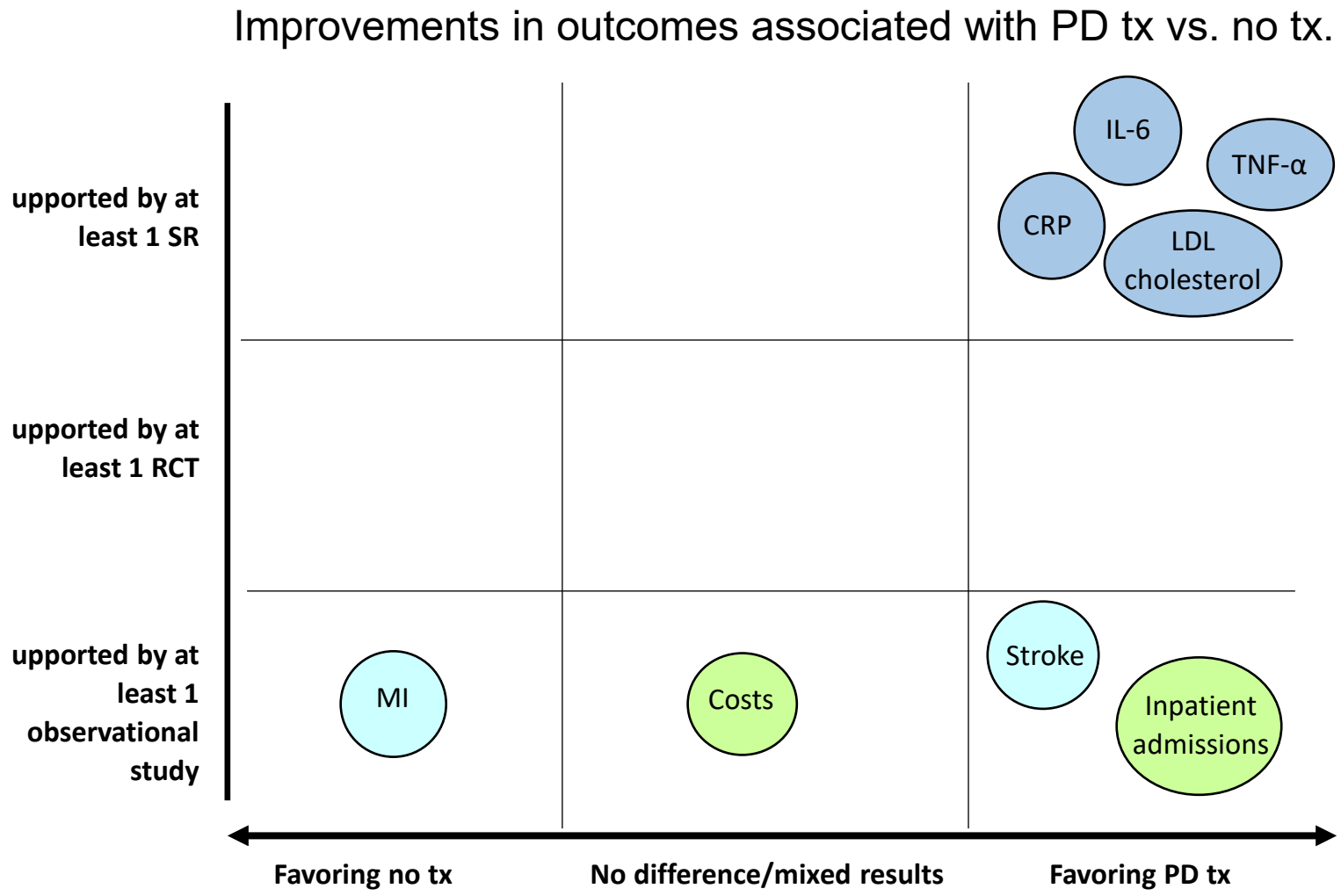
- 2 SRs + 5 primary studies
- PD tx likely improves **measures of inflammation** at 3 months; longer-term outcomes have not been evaluated.
- Findings are unclear on the relation between periodontal treatment and **cardiovascular disease-related complications, healthcare utilization and costs**.



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Cardiovascular Disease: Costs

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Cerebrovascular disease: Overall Results

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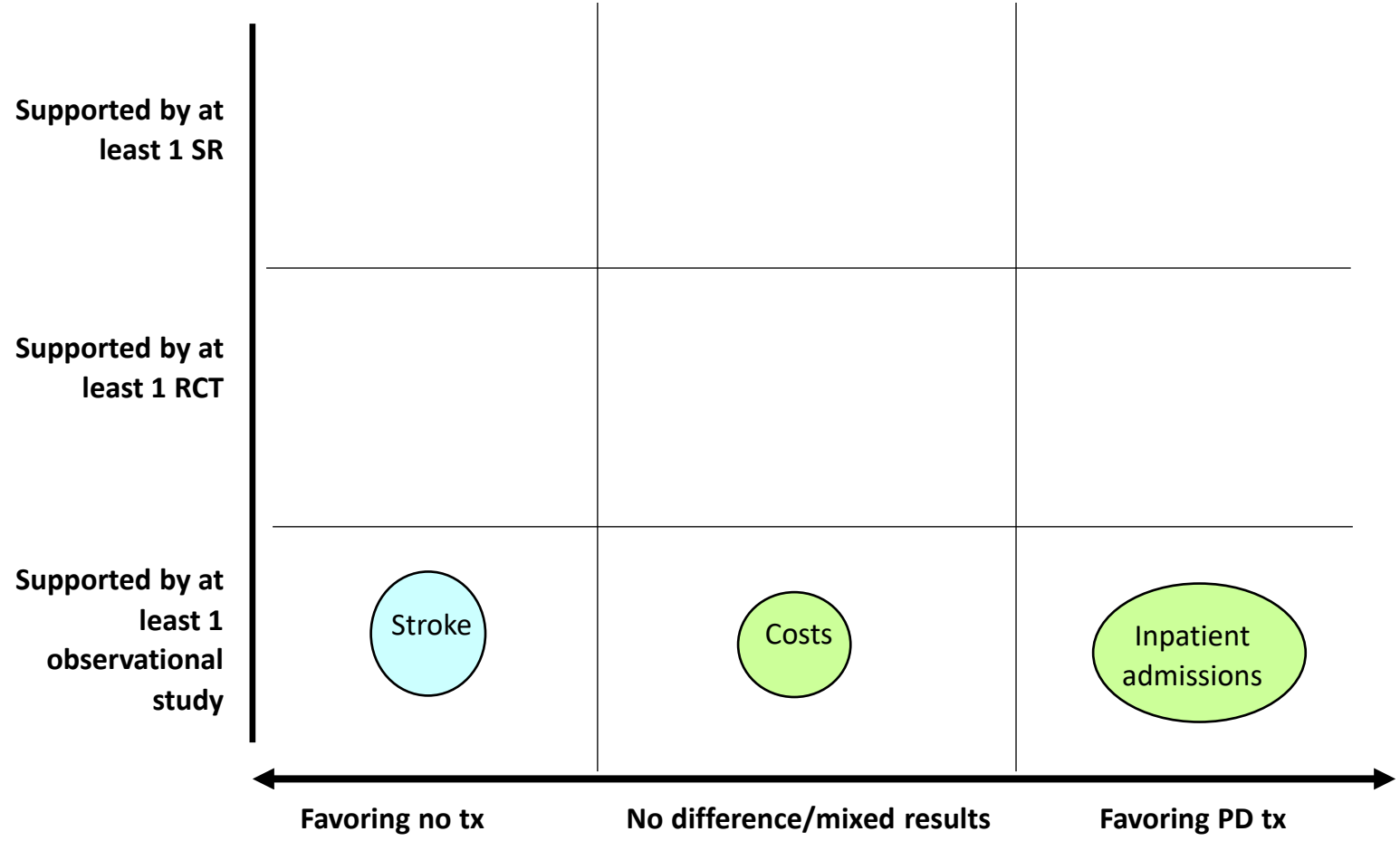
- 3 primary studies
- Studies are unclear on the relation of periodontal treatment to **complications and costs**, similar to findings for diabetes and cardiovascular disease.

Improvements in outcomes associated with PD tx vs. no tx.



Cerebrovascular disease: Costs

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A note on MI & stroke

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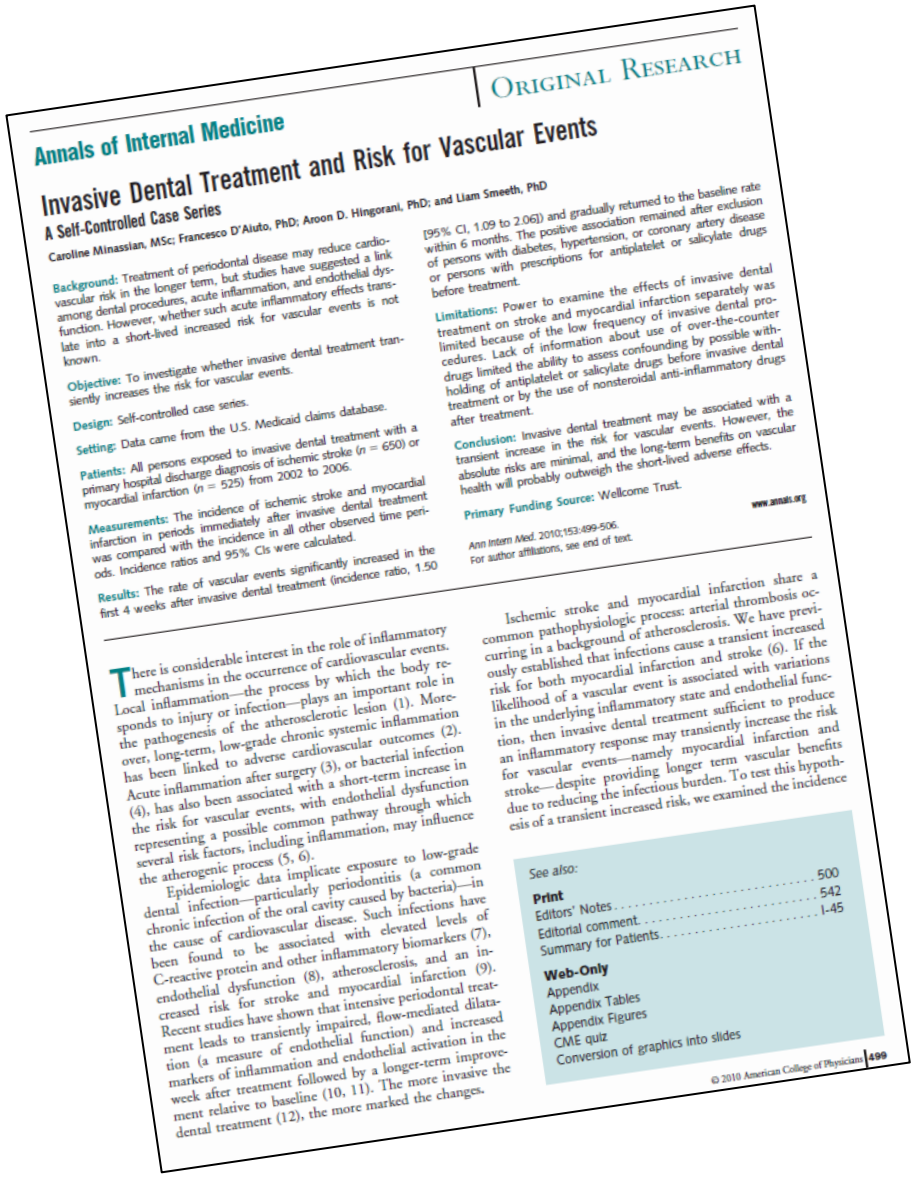

ORIGINAL RESEARCH

Annals of Internal Medicine

Invasive Dental Treatment and Risk for Vascular Events

A Self-Controlled Case Series

Caroline Minassian, MSc; Francesco D'Aiuto, PhD; Aroon D. Hingorani, PhD; and Liam Smeeth, PhD

Background: Treatment of periodontal disease may reduce cardiovascular risk in the longer term, but studies have suggested a link among dental procedures, acute inflammation, and endothelial dysfunction. However, whether such acute inflammatory effects translate into a short-lived increased risk for vascular events is not known.

Objective: To investigate whether invasive dental treatment transiently increases the risk for vascular events.

Design: Self-controlled case series.

Setting: Data came from the U.S. Medicaid claims database.

Patients: All persons exposed to invasive dental treatment with a primary hospital discharge diagnosis of ischemic stroke (n = 650) or myocardial infarction (n = 525) from 2002 to 2006.

Measurements: The incidence of ischemic stroke and myocardial infarction in periods immediately after invasive dental treatment was compared with the incidence in all other observed time periods. Incidence ratios and 95% CIs were calculated.

Results: The rate of vascular events significantly increased in the first 4 weeks after invasive dental treatment (incidence ratio, 1.50 [95% CI, 1.09 to 2.06]) and gradually returned to the baseline rate within 6 months. The positive association remained after exclusion of persons with diabetes, hypertension, or coronary artery disease or persons with prescriptions for antiplatelet or salicylate drugs before treatment.

Limitations: Power to examine the effects of invasive dental treatment on stroke and myocardial infarction separately was limited because of the low frequency of invasive dental procedures. Lack of information about use of over-the-counter drugs limited the ability to assess confounding by possible withholding of antiplatelet or salicylate drugs before invasive dental treatment or by the use of nonsteroidal anti-inflammatory drugs after treatment.

Conclusion: Invasive dental treatment may be associated with a transient increase in the risk for vascular events. However, the absolute risks are minimal, and the long-term benefits on vascular health will probably outweigh the short-lived adverse effects.

Primary Funding Source: Wellcome Trust.

www.annals.org

Ann Intern Med. 2010;153:499-506.
For author affiliations, see end of text.

There is considerable interest in the role of inflammatory mechanisms in the occurrence of cardiovascular events. Local inflammation—the process by which the body responds to injury or infection—plays an important role in the pathogenesis of the atherosclerotic lesion (1). Moreover, long-term, low-grade chronic systemic inflammation has been linked to adverse cardiovascular outcomes (2). Acute inflammation after surgery (3), or bacterial infection (4), has also been associated with a short-term increase in the risk for vascular events, with endothelial dysfunction representing a possible common pathway through which several risk factors, including inflammation, may influence the atherogenic process (5, 6).

Epidemiologic data implicate exposure to low-grade dental infection—particularly periodontitis (a common chronic infection of the oral cavity caused by bacteria)—in the cause of cardiovascular disease. Such infections have been found to be associated with elevated levels of C-reactive protein and other inflammatory biomarkers (7), endothelial dysfunction (8), atherosclerosis, and an increased risk for stroke and myocardial infarction (9). Recent studies have shown that intensive periodontal treatment leads to transiently impaired, flow-mediated dilatation (a measure of endothelial function) and increased markers of inflammation and endothelial activation in the week after treatment followed by a longer-term improvement relative to baseline (10, 11). The more invasive the dental treatment (12), the more marked the changes.

Ischemic stroke and myocardial infarction share a common pathophysiologic process: arterial thrombosis occurring in a background of atherosclerosis. We have previously established that infections cause a transient increased risk for both myocardial infarction and stroke (6). If the likelihood of a vascular event is associated with variations in the underlying inflammatory state and endothelial function, then invasive dental treatment sufficient to produce an inflammatory response may transiently increase the risk for vascular events—namely myocardial infarction and stroke—despite providing longer term vascular benefits due to reducing the infectious burden. To test this hypothesis of a transient increased risk, we examined the incidence

- Self-controlled case series (N=1,175) of pts from a US Medicaid claims database who underwent an invasive dental procedure and were hospitalized for stroke or MI.
- Higher incidence of MI in 4 weeks after invasive dental tx than baseline period (Incidence ratio= 1.56, 95% CI [0.98, 2.47]). Ratio decreased over the next 20 weeks.
- Higher incidence of stroke in 4 weeks after invasive dental tx than baseline period (IR = 1.39, 95% CI [0.89, 2.15]). Unclear pattern of resolution.
- Limitations:
  - No separate control group
  - Possibility for confounding (discontinuing use of NSAIDS, blood thinners, or antiplatelet medications)

COPD: Overall Results

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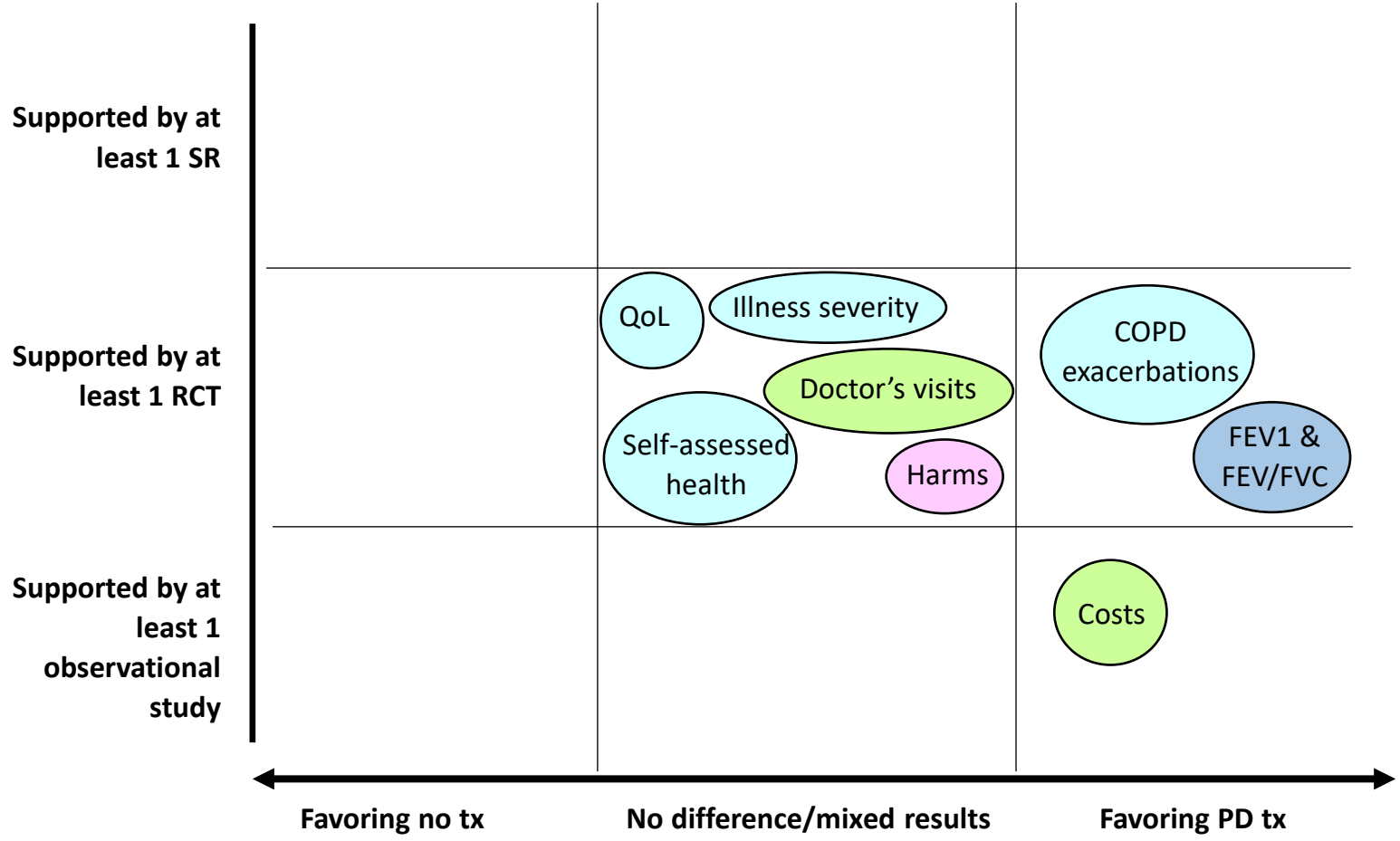
- 4 primary studies
- PD tx may improve **lung function** and reduce the frequency of **exacerbations** at 1 and 2 years compared to no treatment.
- Periodontal tx may also contribute to **lower annual medical costs**.

Improvements in outcomes associated with PD tx vs. no tx.



Limitations- Included SRs & Primary Studies

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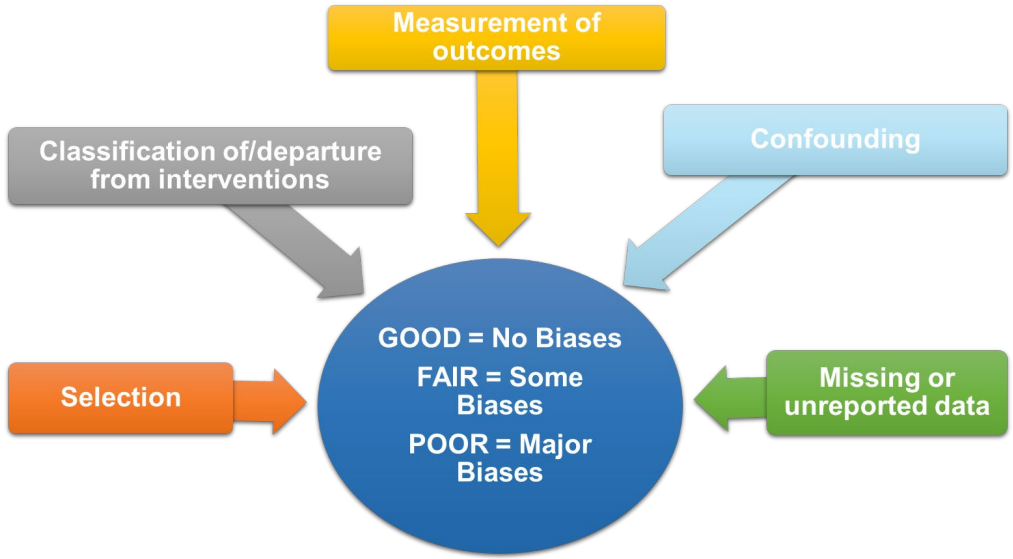
- **SRs:** common limitations were not searching for grey literature, absence of a publicly available review protocol, and failure to discuss individual studies' risks of bias when interpreting results.

- **RCTs:** common limitations were lack of publicly available protocol, pts & providers aware of group assignment, lack of information of cointerventions (*eg*, tooth-brushing)

- **Non-randomized controlled studies**: common limitations were poorly defined tx & control groups, inadequate control for differences between groups at baseline, high likelihood of confounding



Limitations- Rapid Review Methods

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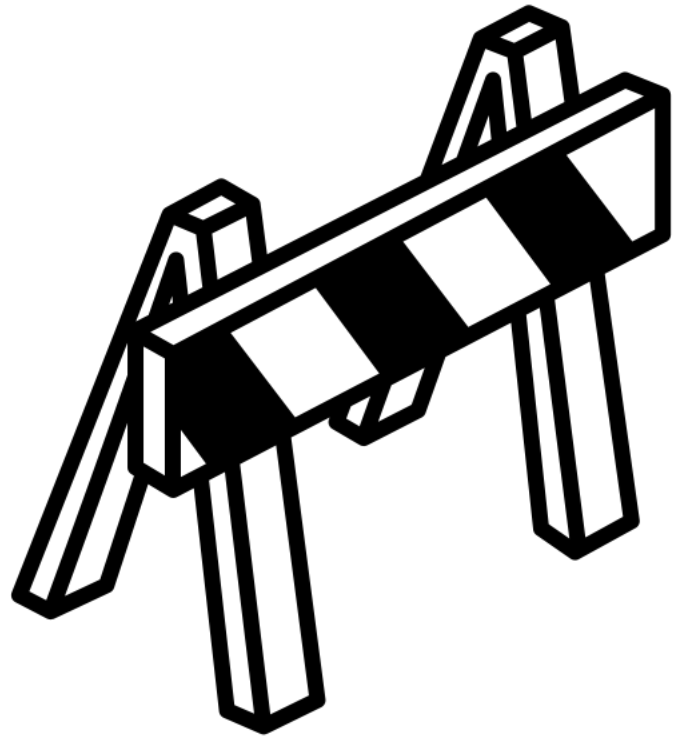
- Synthesized **best available evidence** rather than all available evidence (*ie*, prioritized 8 SRs, searched for primary studies that addressed gaps in SRs).

- Had **a single reviewer** assess study eligibility, study quality, and strength of evidence with second reviewer checking.



barrier by Andy Ivandikov from the Noun Project

Evidence Gaps: Future Research

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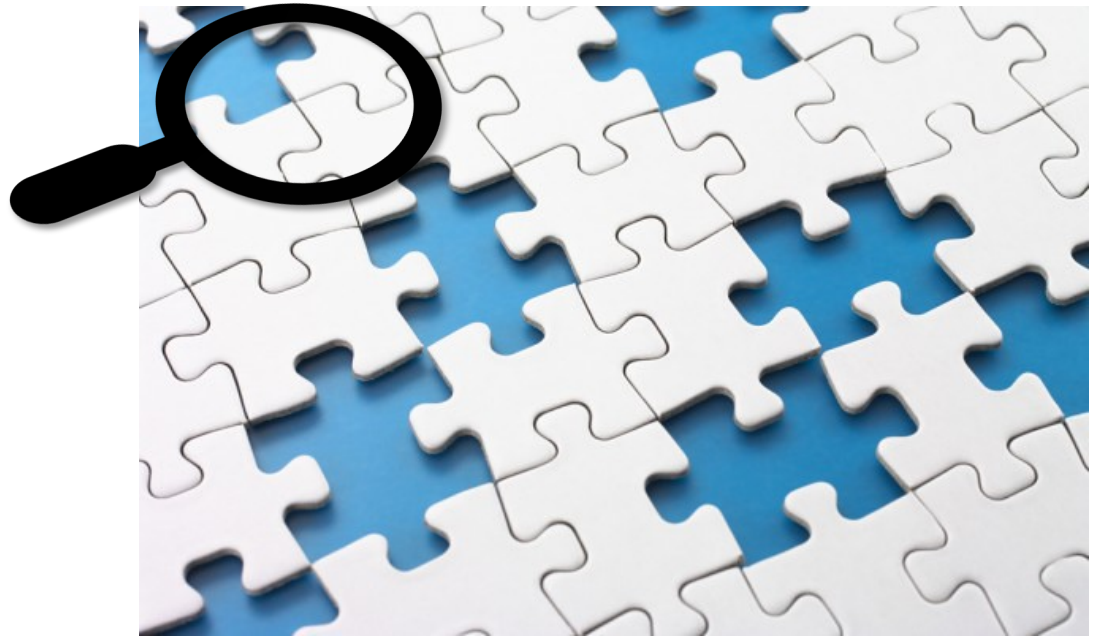
- More research on people with **cerebrovascular disease**. Also consider **evaluating whether outcomes vary by patient characteristics** (e.g., age, sex, race/ethnicity), **disease severity**, and **single versus multiple chronic diseases**.

- Because of unclear evidence on the impact of periodontal treatment on **chronic disease-related complications, healthcare utilization, and costs**, these outcomes should be evaluated in future research.

- In the context of the VA, evaluate whether **referral to dental care** improves outcomes. Important to measure whether referral leads to receipt of dental services, what kinds of services are delivered, and whether participants continue to receive services.



Conclusions

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- Among people with **COPD**, periodontal treatment may improve lung function and reduce exacerbations at 1-2 years, as well as reduce annual medical costs.
- Among people with **diabetes or cardiovascular disease**, periodontal treatment likely leads to improvements in some measures of chronic disease severity and inflammation at 3-4 months, but benefits do not seem to persist beyond 6 months.
- Results are unclear on the relation between periodontal treatment and chronic disease outcomes for those with **cerebrovascular disease**.
- Results are also unclear on the relation between periodontal treatment and medical costs and risk of chronic disease complications among those with **diabetes, cardiovascular disease, or cerebrovascular disease**.

Questions?

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If you have further questions, please feel free to contact:

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Full-length report available on ESP website:

http://www.hsrd.research.va.gov/publications/esp/

VA
U.S. Department of Veterans Affairs
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