

Status of Understanding Environmental Health Impact of Dental Materials

¹ Division of Health Policy and Administration UIC School of Public Health ² Department of Pediatric Dentistry UIC College of Dentistry, ³ Division of Epidemiology and Biostatistics, UIC School of Public Health ⁴Department of Oral Biology, UIC College of Dentistry, Chicago, IL

Background

Dental restorations are

- replacement for carious or damaged tooth structure
- most typically amalgam (“silver fillings”) and resin-based composites (“white fillings” or “RBCs”)
- possible environmental pollutants

The Association of State and Territorial Dental Directors (ASTDD) creates policy statements to:

- assist evidence-based decision making on oral health and dental public health issues
- inform strategies to improve healthcare decisions

Aims

Goal: Development of a **policy statement** for **ASTDD** using available literature on the environmental effects of restorative materials

H_0 : There is no difference in the environmental impact by any type of direct dental restorative material used in dental offices

H_a : The environmental waste generated by resin composite use in dental offices has less environmental impact as compared to amalgam use

Methods

Conduct a **Rapid Review** of the literature using relevant search terms to develop a Knowledge-to-Action Evidence Summary

1st: Peer-Reviewed Journals: PubMed, Scopus, Web of Science GeoRef, Google Scholar

2nd: White papers and grey literature identified via professional organizations and use of UIC library guides

	Rapid review	Systematic review
Timeframe ^b	≤ 5 weeks	6 months to 2 years
Question	Question specified <i>a priori</i> (may include broad PICOS)	Often a focused clinical question (focused PICOS)
Sources and searches	Sources may be limited but sources/strategies made explicit	Comprehensive sources searched and explicit strategies
Selection	Criterion-based; uniformly applied	Criterion-based
Appraisal	Rigorous; critical appraisal (SRs only)	Rigorous; critical appraisal
Synthesis	Descriptive summary/categorization of the data	Qualitative summary +/- meta-analysis
Inferences	Limited/cautious interpretation of the findings	Evidence-based

^aSpecific to the KTA program - other groups have experimented with other approaches of rapid review and will therefore have other differences; ^bPrimary difference; other potentially important differences are noted in the cells. PICOS = population, interventions, comparators, outcomes and study designs; SR = systematic review.

Figure 1: Rapid Review Process

Results of Rapid Review

The literature shows:

- Dental amalgam has **negative environmental impacts**, including building up in sedimentary form of mercury in municipal water systems
- Following the Minamata Convention guidelines, mitigation strategies of mercury pollution strategies have been highly effective.
- RBCs contain complex chemical components that can breakdown into monomer components, Bisphenol A (BPA), and micro- and nano-particles which poses a **pollution risk**

Authors	Year	Location	Outcome Metric	Environmental Impact
Al Shatrat et al	2013	Jordan	Mitigation Strategy	NEGATIVE
Taut	2013	US	Environmental Impact	NEUTRAL
Olivera et al	2014	US	Environmental Impact	NEGATIVE
Rani et al	2015	US	Environmental Impact	NEGATIVE
Jamil et al	2017	Pakistan	Mitigation Strategy	NEGATIVE
Cataldi et al	2017	Italy	Mitigation Strategy	POSITIVE
Sadasiva et al	2017	India	Mitigation Strategy	POSITIVE
Momeni et al	2018	Iran	Environmental Impact	NEGATIVE
Mulligan et al	2018	UK	Environmental Impact	NEGATIVE
Tibau and Grube	2019	US	Environmental Impact	NEGATIVE
Olivera et al	2020	US	Environmental Impact	NEGATIVE
Manyani et al	2020	Morocco	Mitigation Strategy	NEGATIVE
Benaissa et al	2020	France	Environmental Impact	NEGATIVE
Fairbanks et al	2021	UK	Environmental Impact	NEGATIVE
Schmalz and Widbill	2021	Europe	Mitigation Strategy	POSITIVE
Binner et al	2022	Europe	Environmental Impact	NEGATIVE
Khan et al	2022	Pakistan	Environmental Impact	NEGATIVE
Harding et al	2022	Ireland	Environmental Impact	NEGATIVE

Table 1: Rapid Review Literature Analysis for Dental Amalgam

Authors	Year	Location	Outcome Metric	Environmental Impact
Lynch and Wilson	2013	Norway	Mitigation Strategies	NEUTRAL
Van Landuyt et al	2014	Belgium	Environmental Impact	NEGATIVE
Atabek et al	2014	Turkey	Environmental Impact	NEUTRAL
Luo et al	2016	China	Mitigation Strategy	NEUTRAL
Nilsen et al	2019	Europe	Environmental Impact	NEUTRAL
Paula et al	2019	Portugal	Mitigation Strategy	NEUTRAL
Marzouk et al	2019	US	Environmental Impact	NEGATIVE
Polydorou	2020	Germany	Mitigation Strategy	NEUTRAL
Kechagias et al	2020	Europe	Environmental Impact	NEUTRAL
Honarmand et al	2020	Iran	Mitigation Strategy	NEUTRAL
Chandran et al	2021	Singapore	Environmental Impact	NEGATIVE
Schmalz and Widbill	2021	Europe	Environmental Impact	NEGATIVE
Reidelbach et al	2021	Germany	Environmental Impact	NEGATIVE
Binner et al	2022	Europe	Environmental Impact	NEGATIVE
Mulligan et al	2022	UK	Environmental Impact	NEGATIVE
Sun et al	2022	China	Environmental Impact	NEGATIVE
Sun et al	2022	China	Mitigation Strategy	NEUTRAL
Mulligan et al	2022	UK	Environmental Impact	NEGATIVE
Lopes-Rocha et al	2022	Portugal	Environmental Impact	NEGATIVE
Mourouzis et al	2022	US	Environmental Impact	NEGATIVE

Table 2: Rapid Review Literature Analysis for RBCs

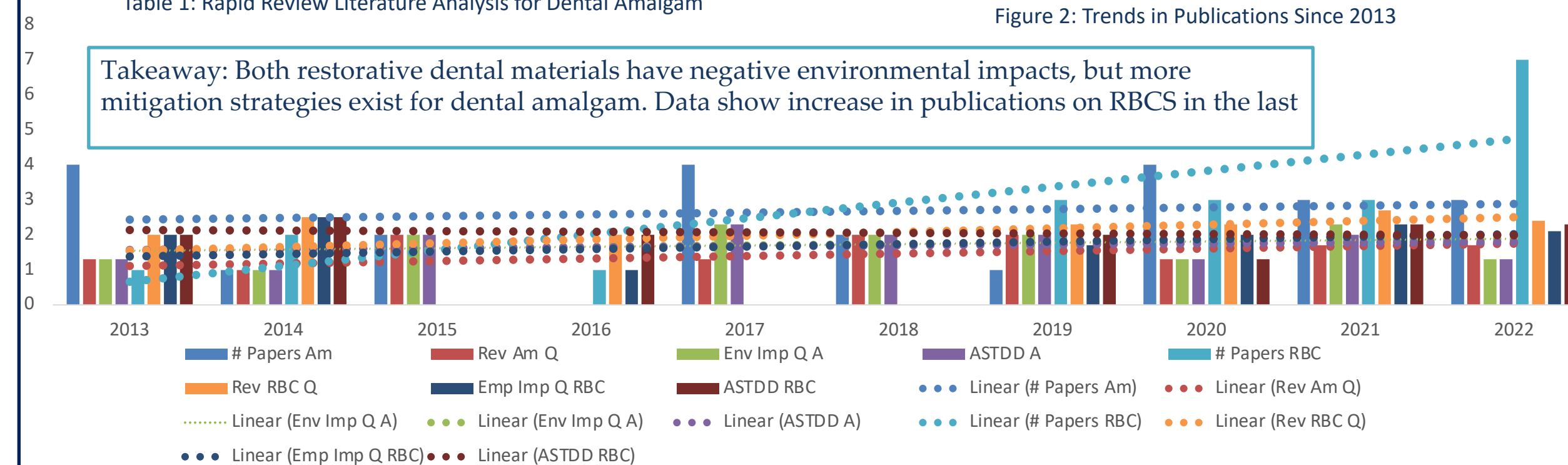


Figure 2: Trends in Publications Since 2013

Policy Implications

- The mercury present in dental amalgam is minimal and has been shown to be mitigated through use of in-office separators and filter traps.
- Due to this, the ASTDD recommends use of amalgam, when clinically appropriate, due to limited environmental contamination.
- RBCs have emerging literature showing complex chemical byproducts, including monomers and Bisphenol A.
 - This is shown to have possible detrimental environmental effects, with fewer known mitigation strategies.
- Due to this, the **ASTDD** is recommending using RBCs when appropriate, but focusing on **(1) prevention of dental caries** and **(2) development of new dental materials** that minimize environmental hazards.

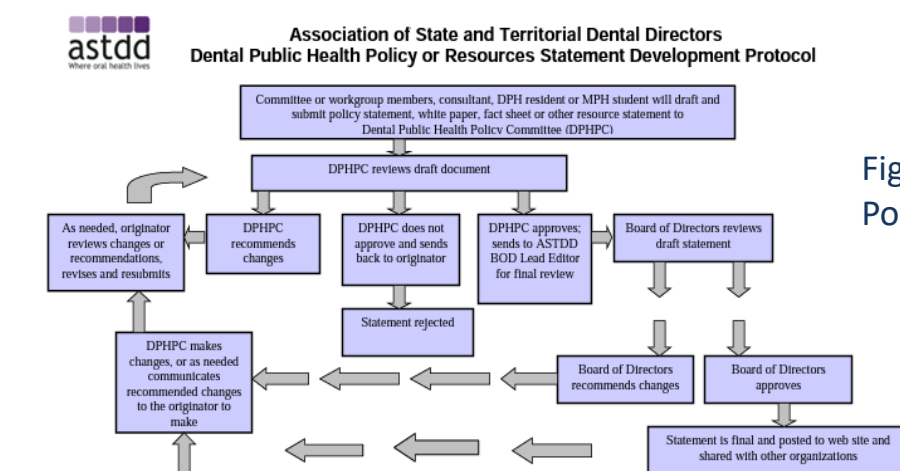
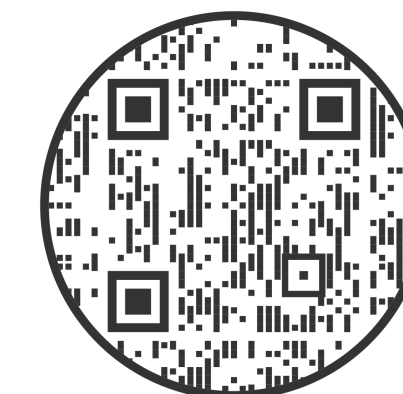


Figure 3: Flowchart of Policymaking Process

References and Acknowledgments



I would like to thank Harry Goodman DMD, MPH, Judith Feinstein MSPH for their feedback as knowledge users and ASTDD consultants. They have been instrumental in connecting me to this project and providing feedback about the policy process.