The Relationship Between Compliance and Blindness Prevention in Economic Models for Diabetic Retinopathy Screening

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OBJECTIVE

- To quantify the relationship between improvements in diabetic retinopathy (DR) screening compliance and reductions in blindness outcomes in published economic modeling studies evaluating new DR screening programs or technologies.

BACKGROUND

- DR is a leading cause of blindness in the United States and globally despite annual DR screening recommendations and the availability of effective treatments.[1]
- Compliance with DR screening recommendations has remained between 40% and 60% in recent decades,[2,3] motivating policy initiatives and technological innovations seeking to improve access to and compliance with DR screening.[4,5]
- Relating DR screening compliance to long-term blindness outcomes depends on a complex interaction of population characteristics, DR progression, screening accuracy, and treatment effectiveness.
- Acknowledging this complexity, studies estimating the impact of improvements in compliance on reductions in blindness tend to rely on modeled analyses such as those conducted for economic evaluations of DR screening policies or technologies.
- Published economic models for DR screening represent a unique resource to investigate the relationship between screening compliance and blindness across a variety of populations, settings, and comparators.

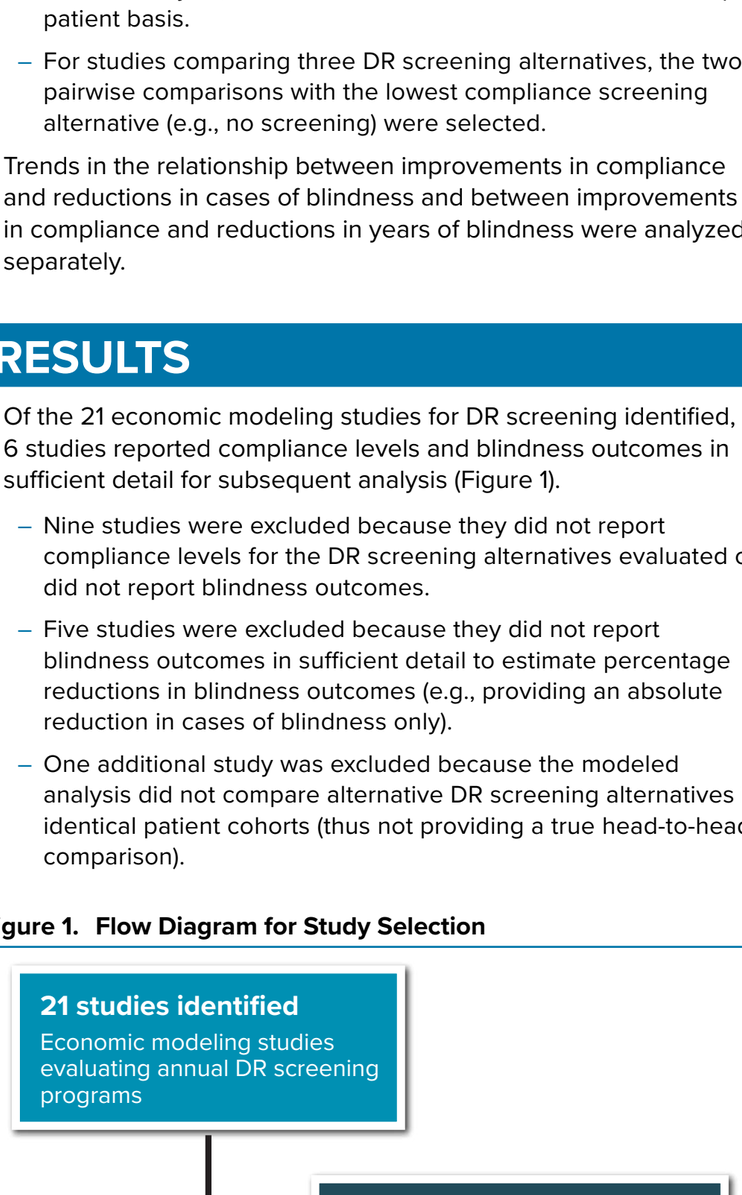
METHODS

- Recently published systematic literature reviews of economic models for DR screening were supplemented with a targeted PubMed search to identify studies for this analysis.[6,7]
- To be considered for this analysis, the identified studies were required to meet the following criteria:
  - Use an economic model to compare two annual DR screening programs or to compare an annual DR screening program with no screening
  - Report on compliance with annual DR screenings and on blindness outcomes (cases of blindness or years of blindness)
  - Provide sufficient detail on compliance input parameters and on blindness outcomes to calculate percentage-point increases in compliance and percentage reductions in blindness outcomes
- Data extraction for studies meeting these criteria captured the country and year of the analysis, target population, time horizon, screening technologies compared, compliance levels, and blindness outcomes.
- For each pair of DR screening alternatives compared, the difference in compliance and the percentage reduction in blindness outcomes were calculated.
  - Prior to analysis, all blindness outcomes were converted to a per-patient basis.
  - For studies comparing three DR screening alternatives, the two pairwise comparisons with the lowest compliance screening alternative (e.g., no screening) were selected.
- Trends in the relationship between improvements in compliance and reductions in cases of blindness and between improvements in compliance and reductions in years of blindness were analyzed separately.

RESULTS

- Of the 21 economic modeling studies for DR screening identified, 6 studies reported compliance levels and blindness outcomes in sufficient detail for subsequent analysis (Figure 1).
  - Nine studies were excluded because they did not report compliance levels for the DR screening alternatives evaluated or did not report blindness outcomes.
  - Five studies were excluded because they did not report blindness outcomes in sufficient detail to estimate percentage reductions in blindness outcomes (e.g., providing an absolute reduction in cases of blindness only).
  - One additional study was excluded because the modeled analysis did not compare alternative DR screening alternatives in identical patient cohorts (thus not providing a true head-to-head comparison).

Figure 1. Flow Diagram for Study Selection



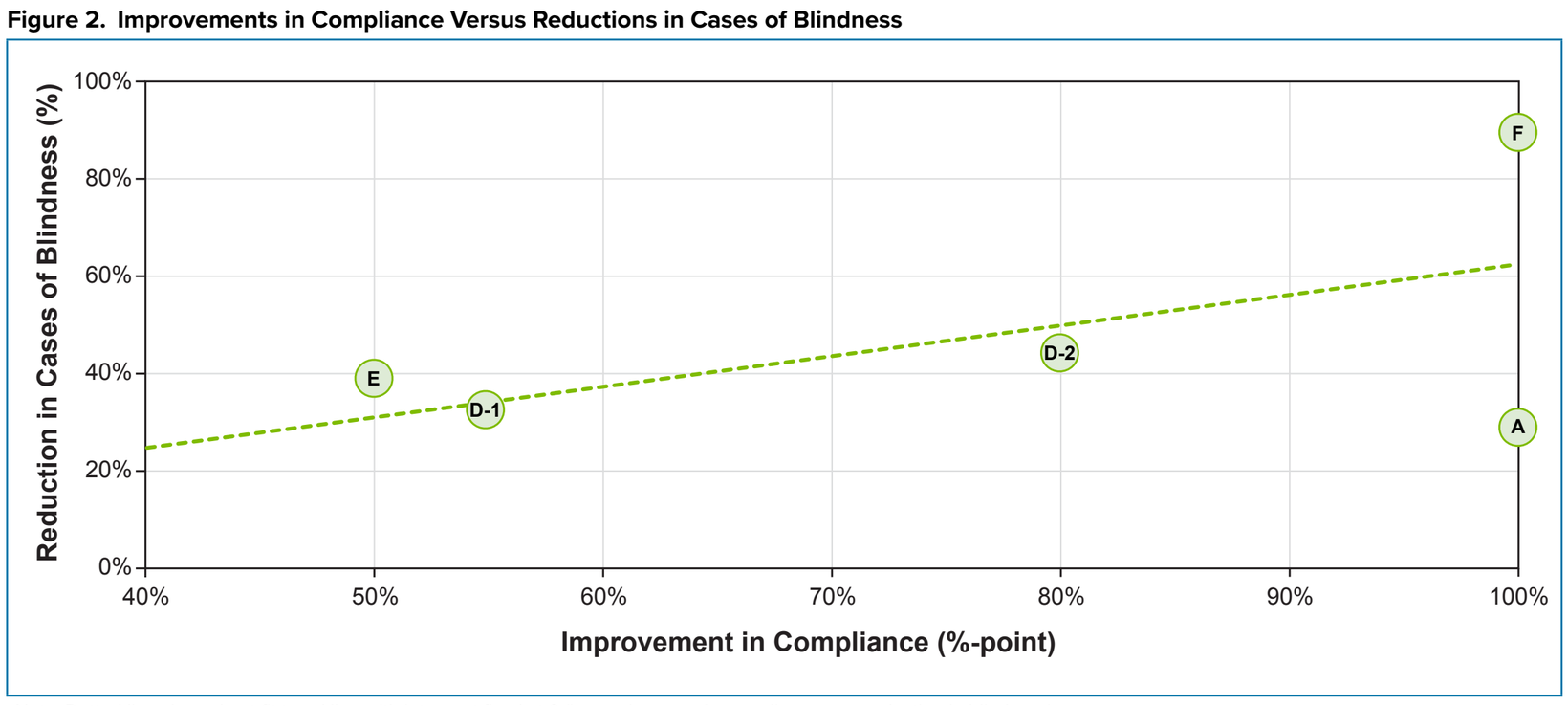
[a] The accepted abstract for this study reported 7 studies included in the analysis, but one of these studies was later excluded because it failed to report sufficient detail on blindness outcomes.

Note: This diagram describes the inclusion and exclusion of DR screening economic modeling studies. Studies reporting on more than two DR screening alternatives or reporting both blindness outcomes were permitted to contribute multiple data points to the subsequent analysis.

Table 1. Summary of Study Details, Compliance Levels, and Blindness Outcomes for Included Studies

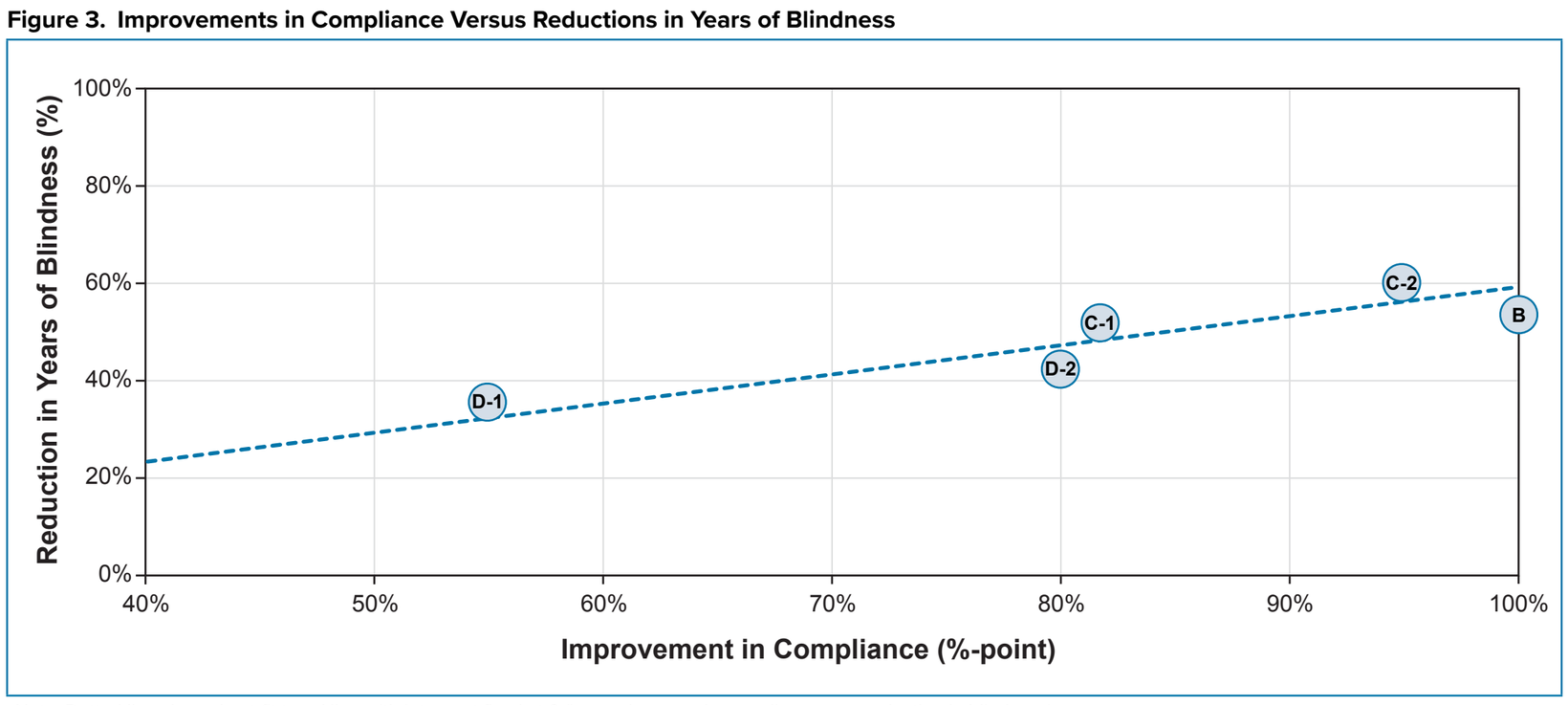
Study	Country; Horizon	Screening Alternatives (% Compliance)	Cases of Blindness (% Reduction)	Years of Blindness (% Reduction)
Crijns et al., 1999[8]	Netherlands; Lifetime	A: Dilated eye exam (100%) vs. no screening (0%)	0.232 vs. 0.327 (29.0%)	
Vijan et al., 2000[9]	United States; Lifetime	B: Dilated eye exam (100%) vs. no screening (0%)		0.041 vs. 0.089 (53.7%)
Davies et al., 2002[10]	United Kingdom; 25 years	C-1: Dilated eye exam (82%) vs. no screening (0%)		0.0003 vs. 0.0006 (51.3%)
		C-2: Office-based photography (95%) vs. no screening (0%)		0.0002 vs. 0.0006 (60.1%)
Maberley et al., 2003[11]	Canada; 10 years	D-1: Dilated eye exam (55%) vs. no screening (0%)	0.006 vs. 0.009 (33.3%)	0.036 vs. 0.055 (34.8%)
		D-2: Mobile photography (80%) vs. no screening (0%)	0.005 vs. 0.009 (44.4%)	0.032 vs. 0.055 (42.2%)
Aoki et al., 2004[12]	United States; Lifetime	E: Mobile photography (75%) vs. dilated eye exam (25%)	0.124 vs. 0.205 (39.5%)	
Tung et al., 2008[13]	Taiwan; 10 years	F: Dilated eye exam + office-based photography (100%) vs. no screening (0%)	0.066 vs. 0.597 (89.0%)	

Figure 2. Improvements in Compliance Versus Reductions in Cases of Blindness



Note: Dotted line shows best-fit trend line with intercept fixed at 0 (i.e., no increase in compliance = no reduction in blindness).

Figure 3. Improvements in Compliance Versus Reductions in Years of Blindness



Note: Dotted line shows best-fit trend line with intercept fixed at 0 (i.e., no increase in compliance = no reduction in blindness).

- The study details, DR screening alternative comparisons, compliance levels, and blindness outcomes for the 6 studies included in the analysis are presented in Table 1.
  - The analysis years, countries of interest, and time horizons varied widely across studies. The most recent study included in the analysis was published in 2008; more recent economic modeling studies failed to report blindness outcomes entirely or did not report enough detail to estimate percentage reductions in blindness outcomes.
  - Most of the economic models compared dilated eye exams and fundus photography (office-based or mobile) to no screening or to each other, with compliance levels assumed to range from 25% to 100% for dilated eye exams and from 75% to 100% for photography.
  - The blindness outcomes reported were balanced between cases of blindness (4 of the 6 studies) and years of blindness (3 of the 6 studies), with improvements in compliance uniformly predicted to lead to reductions in blindness outcomes across all the studies.
- For the comparisons reporting cases of blindness, the models estimated that 50- to 100-percentage-point improvements in compliance were associated with 29%-90% reductions in cases of blindness.
  - On average, a 10-percentage-point increase in compliance was associated with a 6.2% reduction in cases of blindness per patient (Figure 2).
- For the comparisons reporting years of blindness, the models estimated that 55- to 100-percentage-point improvements in compliance were associated with 35%-60% reductions in years of blindness.
  - On average, a 10-percentage-point increase in compliance was associated with a 5.9% reduction in years of blindness per patient (Figure 3).

CONCLUSIONS

- Published economic modeling studies have evaluated the health benefits associated with annual DR screening alternatives across a range of populations, health plan settings, and time horizons.
- The heterogeneity of diabetes populations and DR progression paired with advances in the provision of care over time can make the interpretation of published DR screening analyses and the cross-validation of new DR screening analyses challenging.
- Despite these factors, the analysis presented here suggests a consistent trend in the relationship between annual DR screening compliance and blindness outcomes, with each 10-percentage-point increase in compliance predicted to translate to an approximate 6% reduction in cases and years of blindness.
- This analysis provides a guide to health care decision makers evaluating new DR screening policies or technologies in their local contexts and highlights the ongoing importance of reporting detailed and transparent blindness outcomes in future DR screening economic analyses.

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