Decision support based on AI in medical imaging

AI in medical imaging (AIBIA) parallel session

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Outline

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1. different uses of AI in medical imaging

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2. using AI for treatment effect estimation

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3. warning: harmful self-fulfilling prophecies

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4. prognosis ($X \to Y$, Y in the future)

Uses of AI in medical imaging

1. Acquisition ($S \to X$)
2. detection / segmentation ($X \to X$)
3. inference / diagnosis ($X \to D$, both at prediction time)
4. prognosis ($X \to Y$, Y in the future)
5. treatment effect (X determines effect of a treatment)

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- some characteristics may be well captured in medical imaging:
  - T-cell distributions around tumors related to effect of immunotherapy in cancer

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What if you cannot do a (big enough) RCT?

Emulate / approximate the ideal trial in observational data you do have, using **causal inference** techniques

(which rely on untestable assumptions)

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TRIPOD+AI on prediction models (Collins et al. 2024)

"Their primary use is to support clinical decision making, such as … **initiate treatment or lifestyle changes.**"

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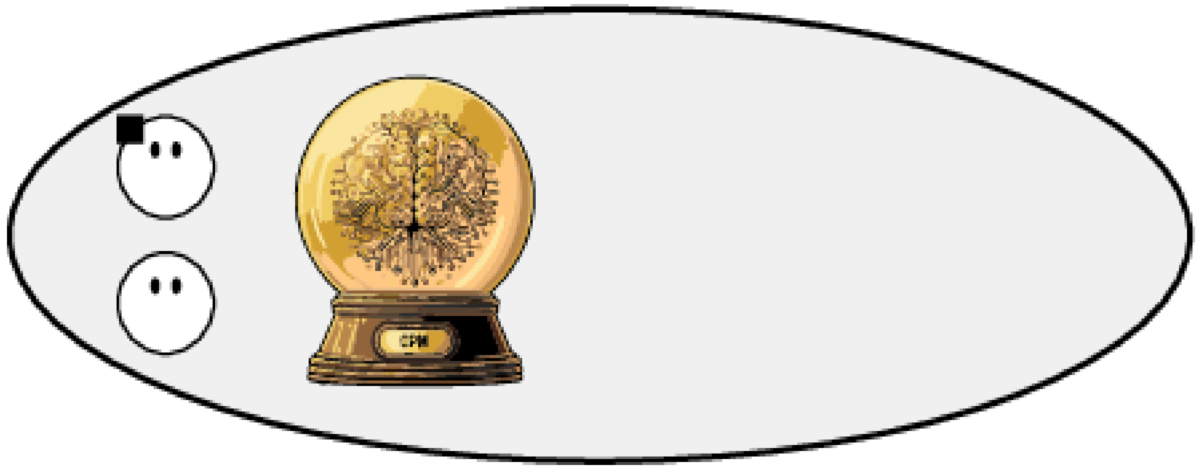
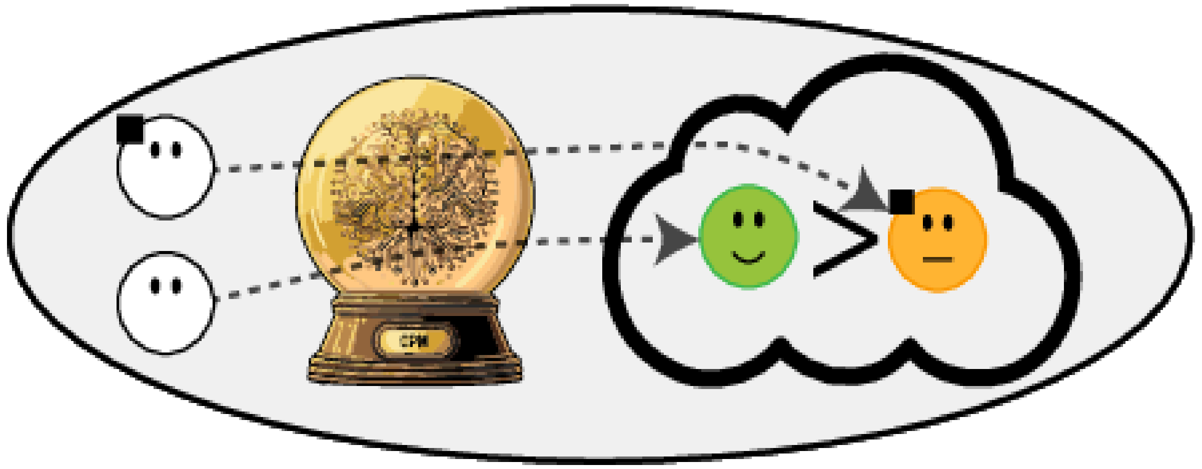
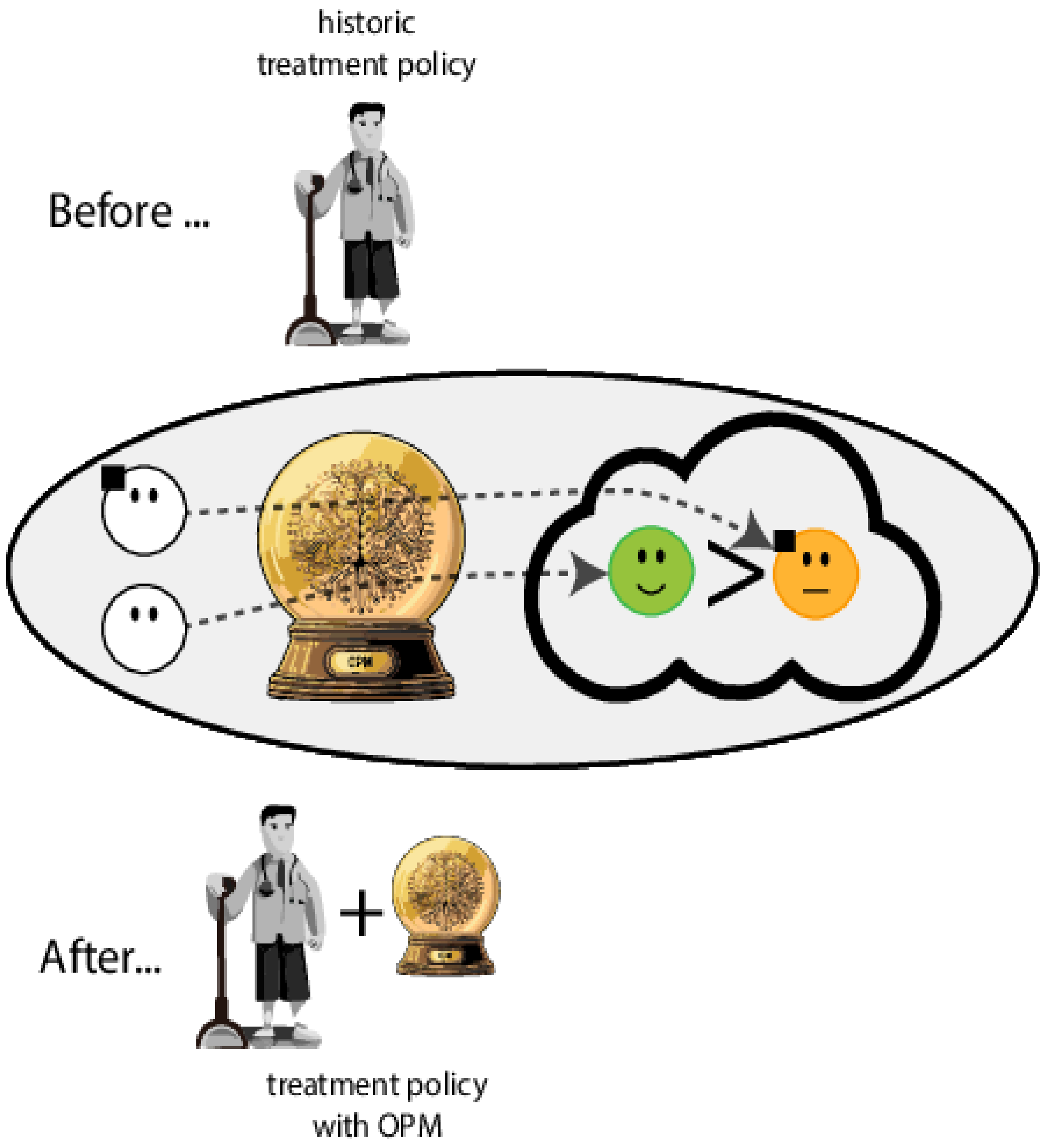
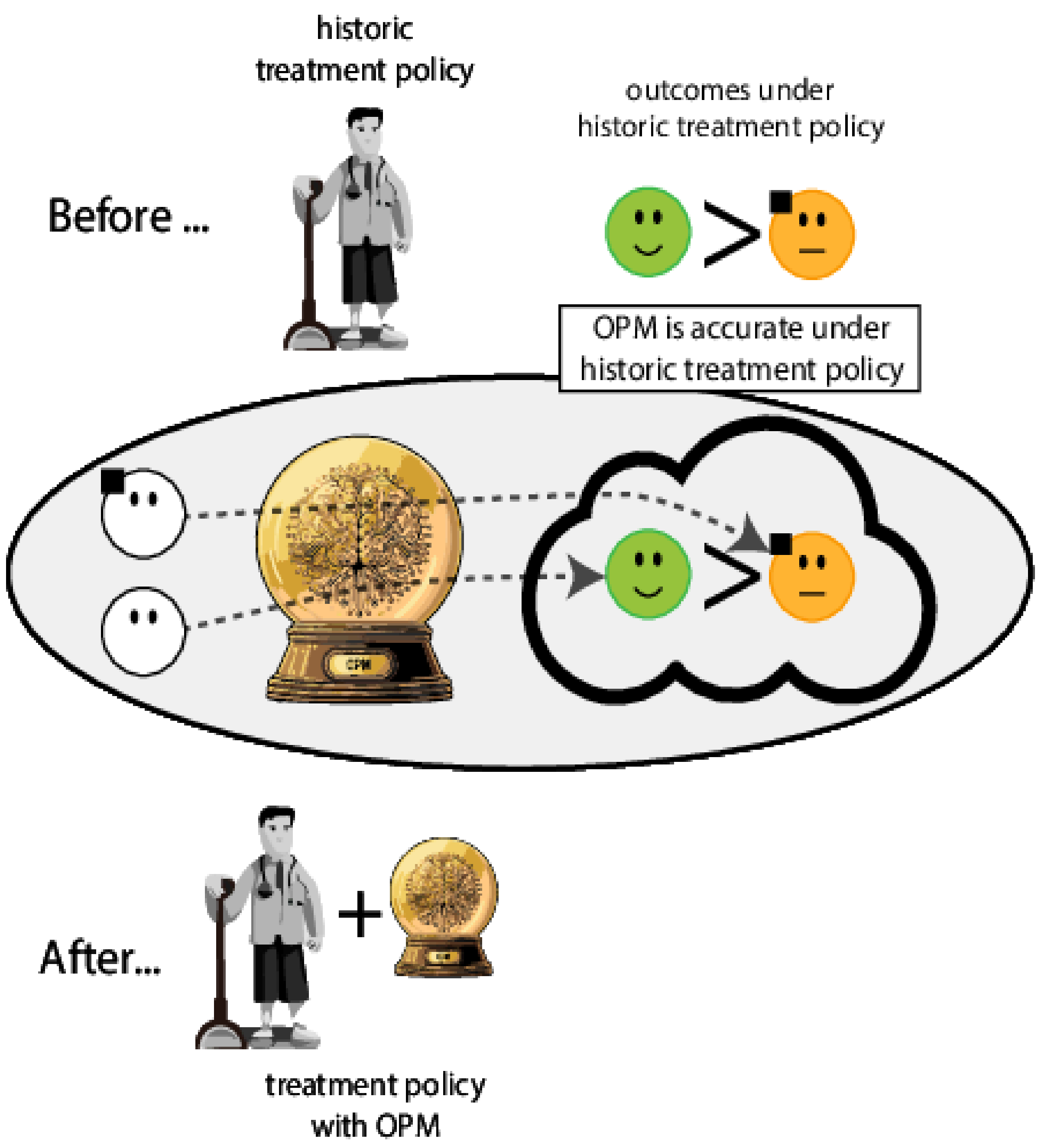
1. ignoring the treatments patients may have had during training / validation
2. only considering measures of predictive accuracy as sufficient evidence for safe deployment
3. predictive accuracy (AUC) may be measured pre- or post-deployment of the model

When accurate prediction models yield harmful self-fulfilling prophecies




CPM


historic
treatment policy
Before ...
After...
treatment policy
with OPM


historic
treatment policy
outcomes under
historic treatment policy
Before ...
OPM is accurate under
historic treatment policy
After...
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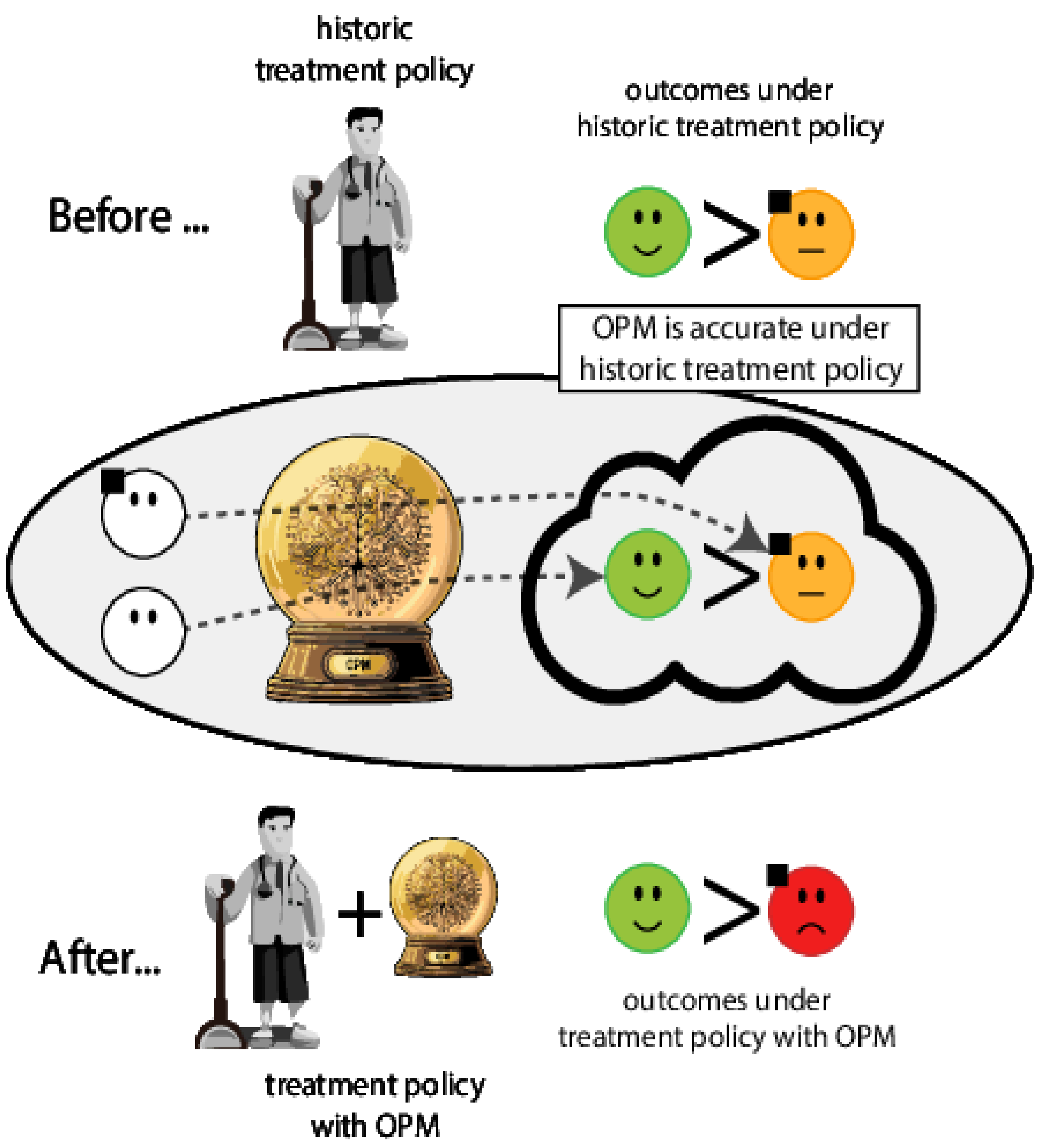
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OPM is accurate under
historic treatment policy
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treatment policy
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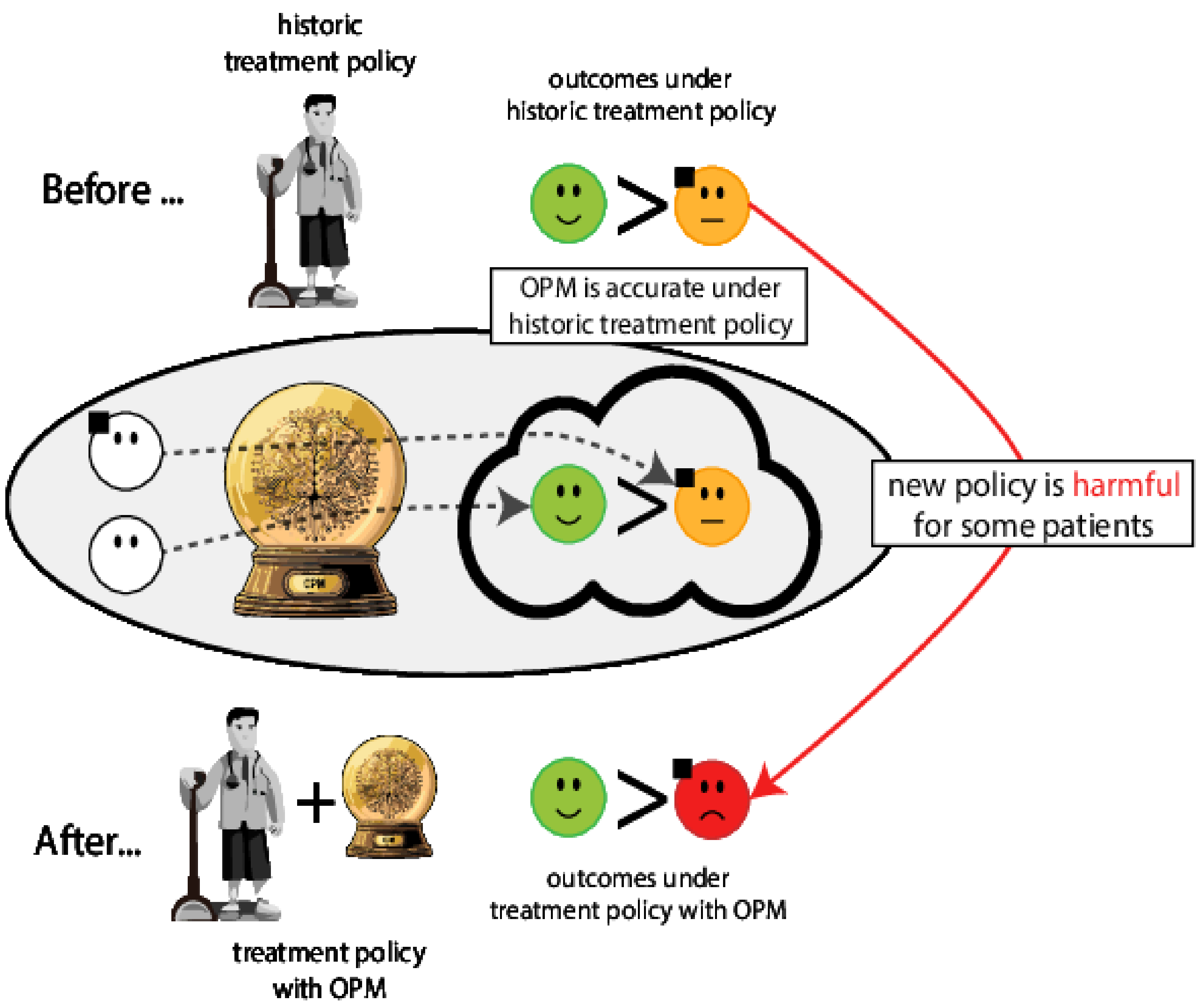
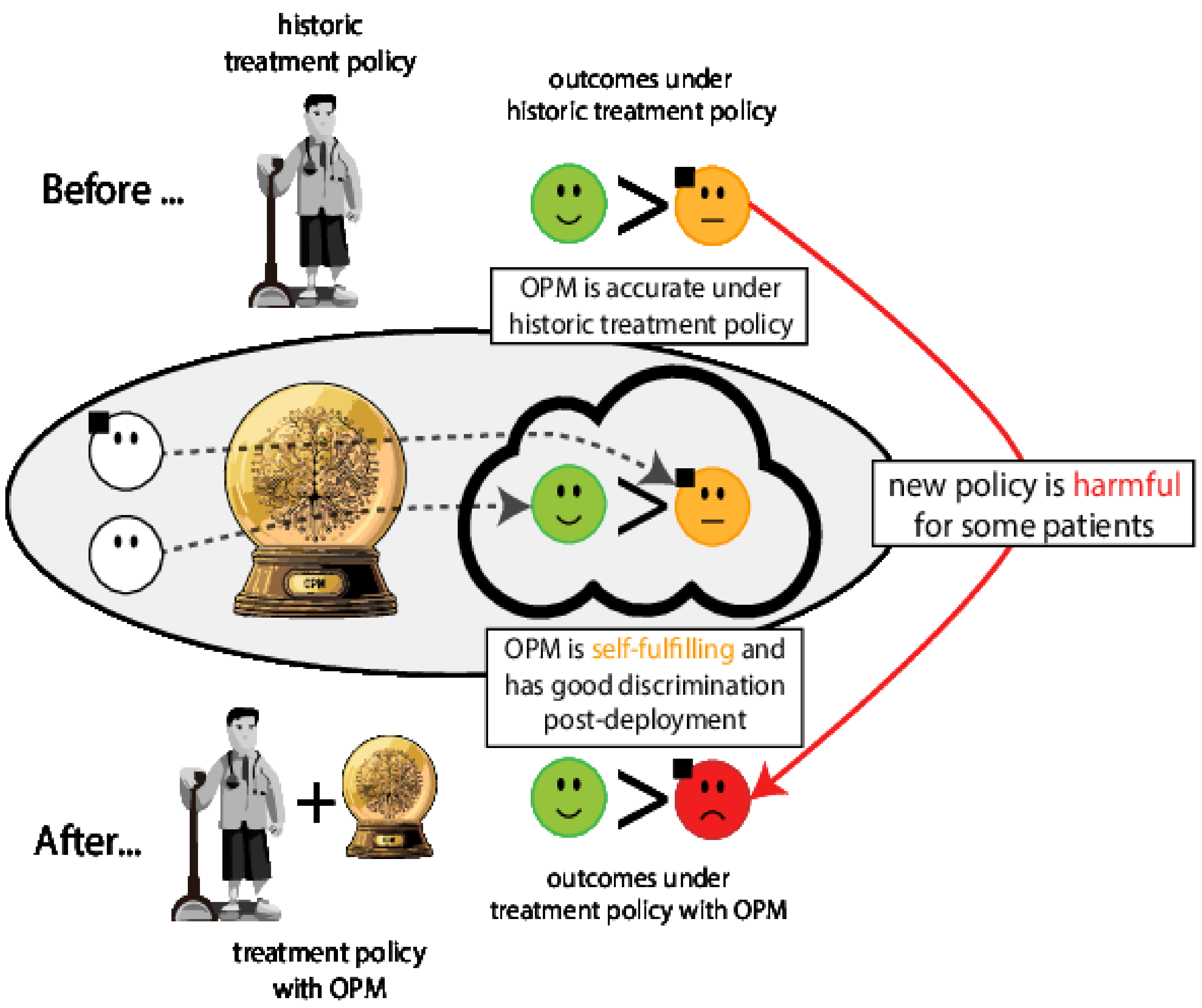

historic
treatment policy
Before ...
outcomes under
historic treatment policy
OPM is accurate under
historic treatment policy
new policy is harmful
for some patients
After...
treatment policy
with OPM
outcomes under
treatment policy with OPM


historic
treatment policy
Before ...
outcomes under
historic treatment policy
OPM is accurate under
historic treatment policy
new policy is harmful
for some patients
OPM is self-fulfilling and
has good discrimination
post-deployment
After...
outcomes under
treatment policy with OPM
treatment policy
with OPM

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From algorithms to action: improving patient care requires causality (W. A. C. van Amsterdam et al. 2024b)

When accurate prediction models yield harmful sel-fulfilling prophecies (W. A. C. van Amsterdam et al. 2024a)

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