

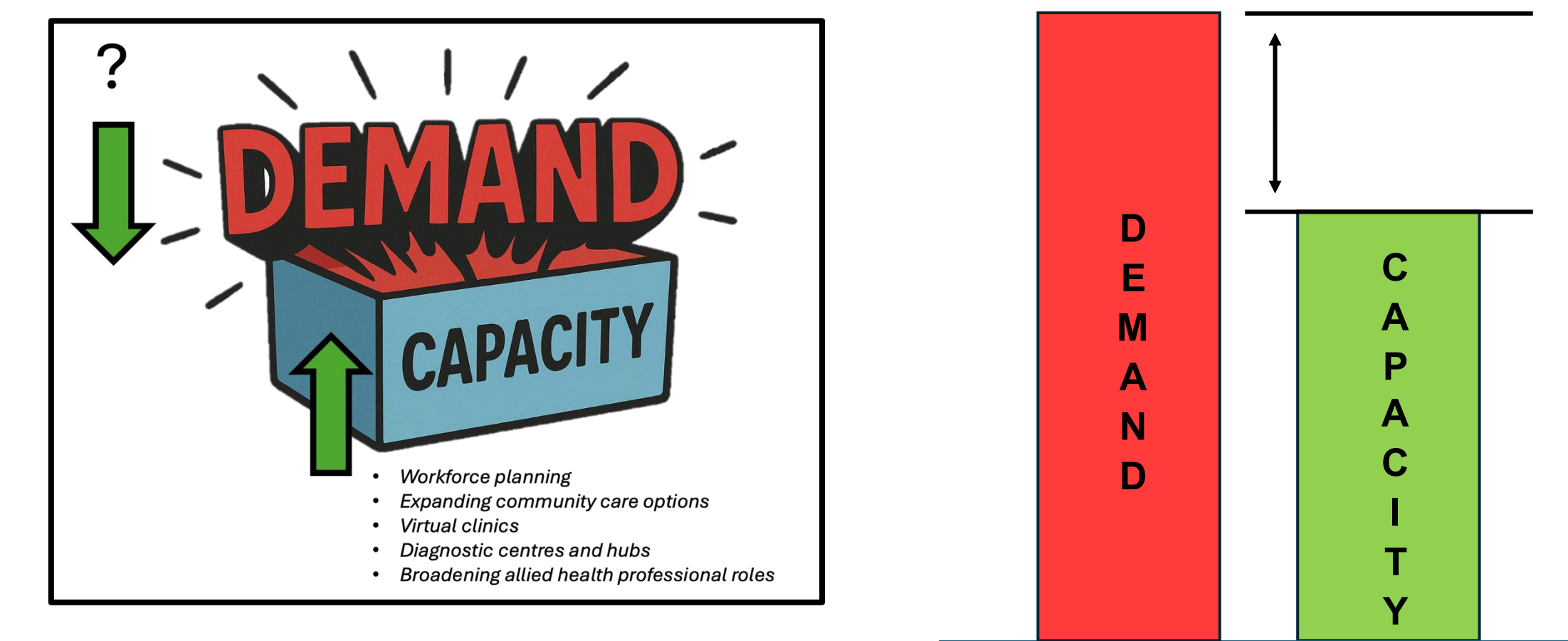
The NHS does not have a capacity problem

It has a demand:capacity mismatch — and follow-up interval is a modifiable lever to close the gap

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The problem: too many patients, too few appointments

Outpatient pressure is usually framed as a capacity problem.



Much of the focus in outpatient transformation plans has been in methods to increase capacity. Reframing it as a demand:capacity mismatch expands the solution space: capacity can be increased, but demand can also be modified.

1. Follow-up interval is a powerful, modifiable determinant of demand that we control at the point of care

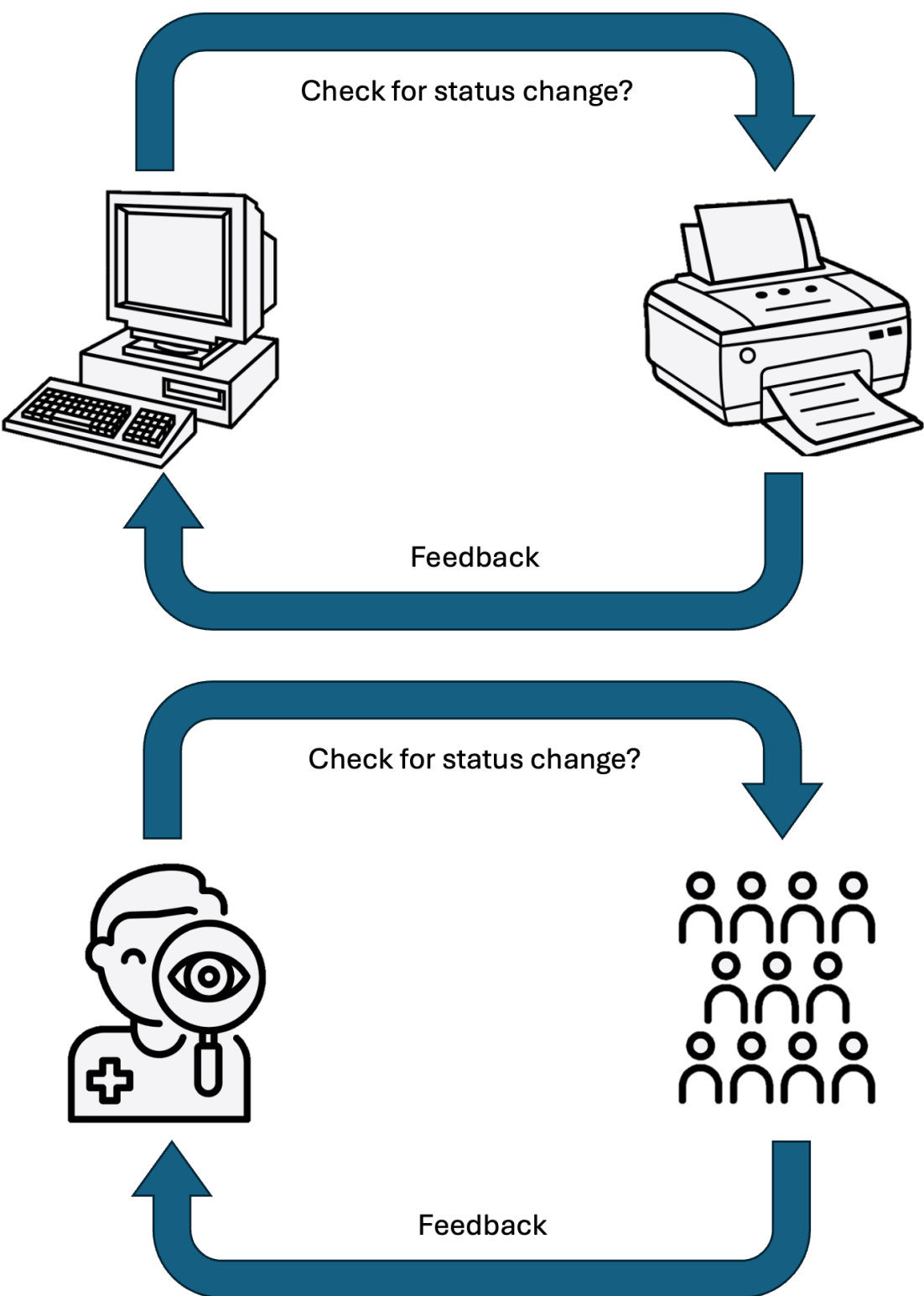
Many factors affecting demand, such as an ageing population and the increasing prevalence of chronic disease, are beyond our control. A large proportion of ophthalmology outpatient demand is generated by follow-up scheduling decisions. An important modifiable factor determining outpatient clinic demand is the choice of follow-up interval.

2. Monitoring asymptomatic disease and the “polling problem” analogy

When monitoring asymptomatic chronic disease, follow-up must be frequent enough to detect clinically meaningful change, but not so frequent as to overwhelm system capacity.

This trade-off corresponds to a periodic inspection (polling) model in computer science, in which a system is reviewed at fixed intervals rather than continuously monitored.

The mathematics of this framework provides a quantitative basis for estimating outpatient demand and expected detection delay as functions of follow-up interval.

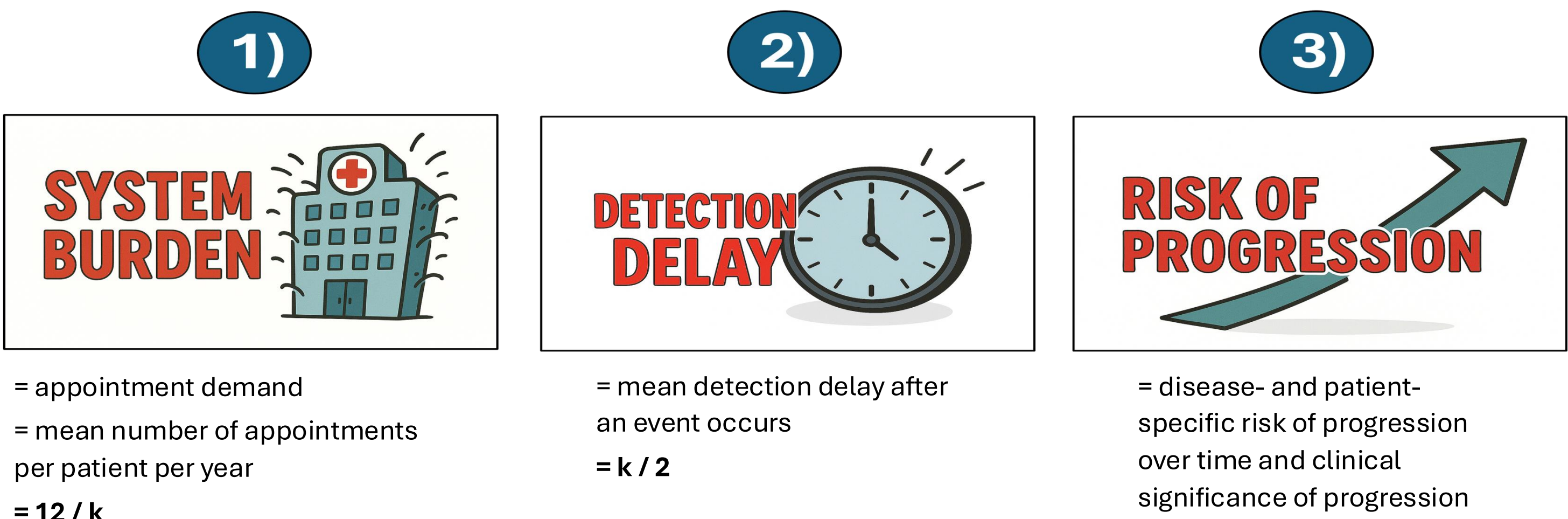


Aim

- 1) Quantify the effect of follow-up interval on outpatient demand
- 2) Develop a framework for optimising follow-up interval decisions, balancing detection delay against system burden.

Methods

Follow-up scheduling can be viewed as a three-way trade-off between:



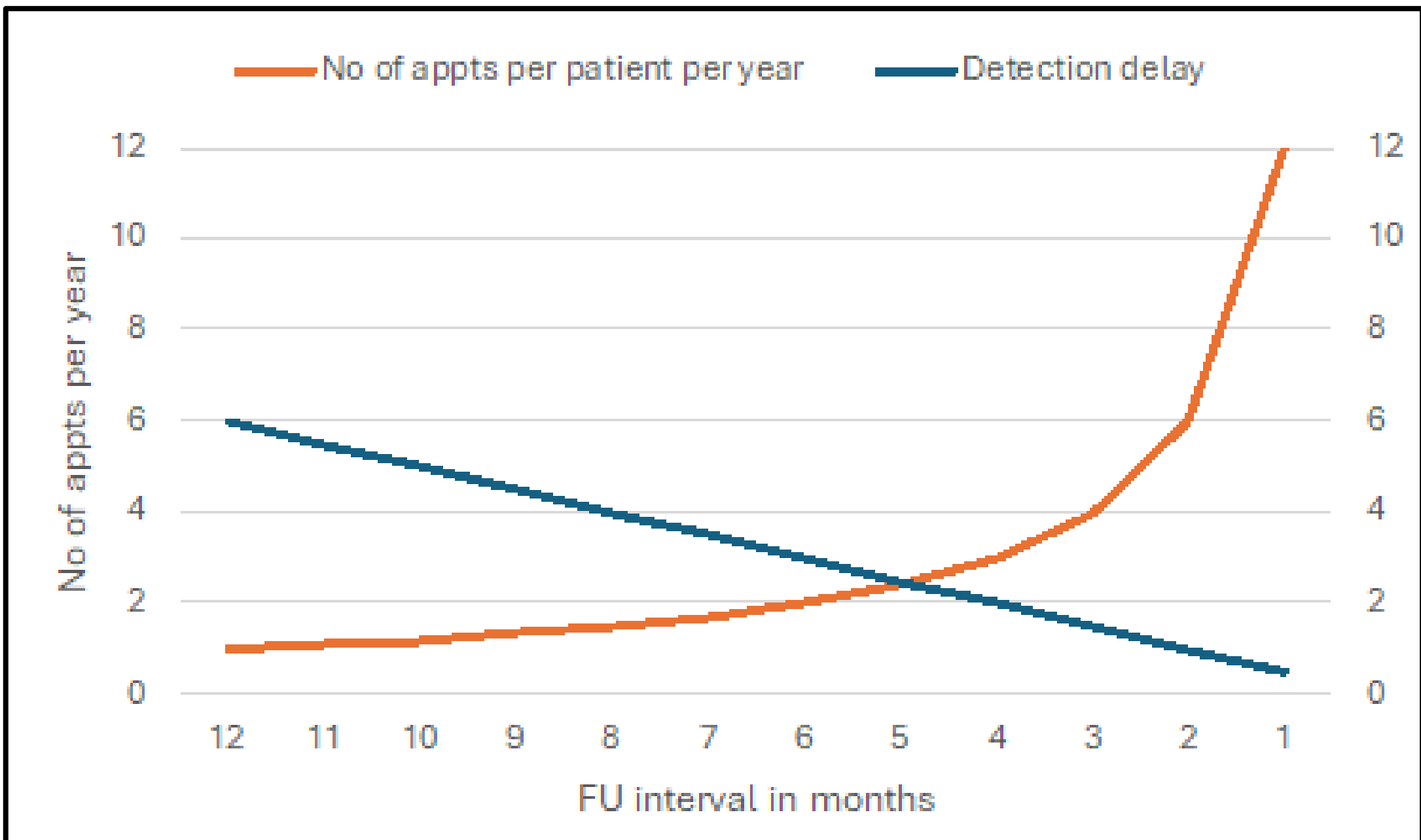
where k = mean follow-up interval in months

With asymptomatic disease, an event that occurs between two scheduled visits can only be detected when the patient is next reviewed. The detection delay depends on when within that follow-up interval an event occurs. If an event occurs just after an appointment, detection is delayed to the next visit (approximately k months). If it occurs just before the next appointment, the delay is close to zero. Assuming events occur uniformly within the interval, the mean detection delay is therefore $k/2$.

This is a simplifying approximation used to illustrate the relationship between follow-up interval and detection delay. In reality, risk may be back-loaded (i.e. closer to the next review), so the true average detection delay may be $< k/2$. Using $k/2$ is therefore a reasonable and conservative approximation.

3. Small changes at a patient level can translate into large effects at a service level

- 1) Simple arithmetic: small change x large number of patients = large effect
- 2) The relationship between follow-up interval and demand is hyperbolic. Small changes in follow-up interval, especially in the steep section of the graph, can result in substantial reductions in appointment demand.



The mathematics of this framework show that increasing follow-up interval **increases detection delay linearly**, but **reduces demand for appointments hyperbolically**.

Results

Optimal follow-up interval is a choice that balances expected harms vs system load.

Clinical risk

Increasing follow-up interval increases expected detection delay. However, the clinical significance of this delay depends on disease, severity, prior stability and consequence of progression. A small increase in expected delay may be justified in lower-risk groups if it substantially reduces system overload and the risk of delayed appointments for all patients.

Examples

Diabetic retinopathy (DR) example: retrospective analysis of our DR service.
Glaucoma example: modelled estimate from current service capacity data.
Intravitreal injection example: mathematical modelling only.

Diabetic Retinopathy

- Previous mean follow-up interval 4.7 months = mean 2.55 appointments per person per year
- FU increase of 6 weeks to 6.2 months = mean 1.94 appointments per person per year
- Reduced clinic appointment demand by ~600 appointments per 1000 patients per year
- Mean detection delay increased by 0.75 months

Glaucoma

- A mean follow-up increase from 6.4 months to 8 months could reduce clinic appointment demand from 7000 appointments to 5500 appointments per year in our service of 3,700 follow-up patients.
- This is a 20% reduction in clinic appointments
- Mean detection delay would increase by 0.8 months

Intravitreal Injections

- One fewer injection per patient per year in a service of 1500 patients reduces annual appointment demand by 1500 appointments

We describe a mathematical framework to help quantify the trade-off between system burden, detection delay, and risk of disease progression, supporting decision making regarding follow-up interval selection.

This framework complements, rather than replaces, capacity expansion.

The benefits of this are:



- ✓ Follow-up interval optimisation is a cost-neutral demand-reduction strategy, but should be applied selectively using disease-specific risk and patient-level clinical judgement.
- ✓ Reframing the NHS capacity crisis as a demand:capacity mismatch opens the space of solutions to include those addressing demand as well as methods to increase capacity.
- ✓ For patients, this can result in reduced appointment burden and reduced likelihood of delayed follow-up clinic appointments.