Phase 1 England COVID-19 Vaccine Allocation & Delivery Strategy

“It is the greatest happiness of the greatest number that is the measure of right and wrong." – Jeremy Bentham

Prepared for: Sir Patrick Vallance

Prepared by: Linus Wössner

Where Lives, Logistics and Public Trust Converge

A highly constrained rollout with significant human impact. Our objective is to maximise national health benefit under all JCVI and operational constraints, guided by the principle that ***"the greatest happiness of the greatest number"*** must shape allocation decisions.

The Operational Challenge

- **Scarce supply and asymmetric logistics** (Pfizer/BioNTech double-boxing, AstraZeneca single-boxing)
- **Major regional differences** in cold chain capacity and population age structure
- **Strict JCVI prioritisation rules**: frontline minima and high-risk prioritisation
- **Manual planning cannot handle** the scale, urgency, & interacting constraints

Public Trust & Perception Challenges

- The rollout will be **highly visible and closely watched** by public and media
- **Perceived regional inequities** can quickly **undermine confidence** in the programme
- Communities expect a **strategy that is fair, transparent, & easy to justify**
- Ensuring **frontline worker protection** is essential for sustaining trust in NHS response

Our Objective & Approach

- Convert **clinical priorities and operational limits** into a transparent optimisation framework
- Identify the allocation that **maximises mortality-weighted public health benefit**
- **Guarantee feasibility** through strict adherence to supply, boxing, age and frontline constraints
- Compare against proportional allocation to **make fairness trade-offs explicit**

Turning Complexity Into Clarity: A Transparent Optimisation Framework

Our Utilitarian Optimisation Engine for England

Inputs

- JCVI criticality scores
- Regional population by age
- National Pfizer/BioNTech & AstraZeneca supply
- Regional boxing/cold chain limits
- Frontline worker minimums

Our Model

Linear Optimisation Model:

- **Objective:** maximise mortality-weighted health benefit
- **Constraints:** supply, boxing, population caps, frontline minima, & eligibility rules
- Fully **transparent & explainable**

Outputs

- **Optimal Allocation** by region x age x vaccine
- **Coverage patterns** for high-risk groups
- Identification of **binding constraints**
- **Insights of marginal value** of additional capacity
- **Benchmark comparison:** egalitarian proportional allocation vs. optimised utaliratian solution

This model provides a defensible, data-driven allocation plan that explains why each dose goes where it does.

Delivering Phase 1: What Optimal Looks Like

Allocation Results:

100%
Pfizer/BioNTech

83%
AstraZeneca

By Region

- London, SE and NW with highest benefit
- Shift toward older populations
- NE's boxing capacity as bottleneck

By Age Group

- *NE aside (~70% 80+), all regions achieve full coverage of 80+ and 70–79.*
- Most regions reach ~65–70% coverage of 60–69
- Younger adults receive minimal doses beyond frontline staff

Delivery Results:

25%
Conservative Model

99%
Ramp-up Model
(Complete in 18–49 working days)

> Site Type

- Mass vaccination centres – *~3,000 /day*
- Hospital hubs – *~800/day*
- GP-led sites & mobile teams – *~400/day*
- Community pharmacies – *~250/day*

> Delivery Model

Conservative: Sites vaccinate only after all are supplied
Ramp-up: Sites vaccinate immediately as sites come online

80%
Utilitarian > Proportional: ~80% higher JCVI benefit + full frontline coverage

Operational Priorities for Phase 1 and What They Mean for Phase 2

Operational Excellence in Phase 1 creates the foundation for a faster, fairer, and more resilient Phase 2.

Phase 1 Priorities

Site Types & Capacities

- Mass vaccination centres (~3,000 doses/day)
- Hospital hubs (~800 doses/day)
- GP-led sites & mobile teams (~400 doses/day)
- Community pharmacies (~250 doses/day)

Delivery Modes

- Conservative mode
- Ramp-up mode (recommended)

Operational Risks

- Cold-chain processes
- Site staffing
- Queue management
- Mobile team coordination
- Internal & external communication

Phase 2 Strategies

Use remaining AstraZeneca strategically

- Close high-risk gaps
- Donate surplus via COVAX

Expand North East capacity

- Delivers highest marginal benefit (~5x more benefit than in any other region)

Maintain Pfizer/BioNTech procurement

- Only vaccine with strong benefit in younger cohorts
- Enables efficient coverage as Phase 2 expands beyond high-risk groups

Continue ramp-up activation

- Maximises benefit delivery as Phase 2 cohorts broaden

Prepare for multi vaccine integration

- Enable smooth adoption of new vaccines should they be approved

Key Recommendation for a Successful Rollout

Ensuring a successful rollout requires coordinated action across communication, technical execution, and governance, guided by the principle of achieving the greatest good for the greatest number.

Communication

- Explain **who is prioritised and why**, highlighting the **protection of vulnerable groups and frontline staff**
- Clarify that regional **differences reflect clinical need and logistics**, not political preference
- Provide **regular public updates** to maintain transparency and reduce anxiety
- Reassure citizens that the **strategy adapts weekly** based on supply, capacity and epidemiological guidance

Technical Execution

- **Strengthen real-time data systems for stock levels**, cold-chain status, throughput and activation
- **Standardise operational protocols** for vial usage, rerouting of doses, & waste minimisation
- **Build contingency buffers** for cold-chain equipment, vehicles and dry-ice capacity

Political & Governance

- **Balance utilitarian efficiency with perceived fairness**, ensuring allocations remain explainable and defensible
- **Monitor regional vaccination rates** to avoid political backlash or perceptions of unequal treatment

Our Values: Insight | Integrity | Impact

Where rigorous insights meets principled action – guided by Bentham's aim of achieving the greatest good for the greatest number.

Proposed Fees

Phase 1	Pro bono given urgency
Phase 2	Transparent, co-designed fee model
Ongoing support	On-demand analytical support