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CAREVAX

# Digital Integration Between Hospitals and Local Health Authorities for Enhanced Vaccination Coverage among Frail Patients

CareVax Study Protocol

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# Adult Immunization: Still a Missed Opportunity

Vaccine-preventable diseases remain a major burden in terms of mortality, morbidity, and healthcare costs — with frail patients bearing the highest risk. Yet coverage remains persistently suboptimal.

## Vaccine-Preventable Diseases

Major burden of mortality, morbidity, and direct healthcare costs across all adult age groups

## Frail Patients = Highest Risk

Multi-morbid, immunocompromised, and elderly patients face the greatest risk yet are the least reliably reached

## Coverage Still Suboptimal

Influenza, pneumococcus, herpes zoster, HBV — all with documented gaps in adult vaccination uptake

"The problem is not availability of vaccines — it's identification and delivery"

# Where Are We Failing?



## No Automated Identification

Eligible patients are not systematically identified — eligibility assessment depends entirely on clinician initiative and memory



## Fragmentation Between Hospital and Territory

Hospital records and regional vaccine registries operate in silos, with no structured data exchange



## Missed Opportunities at Every Contact

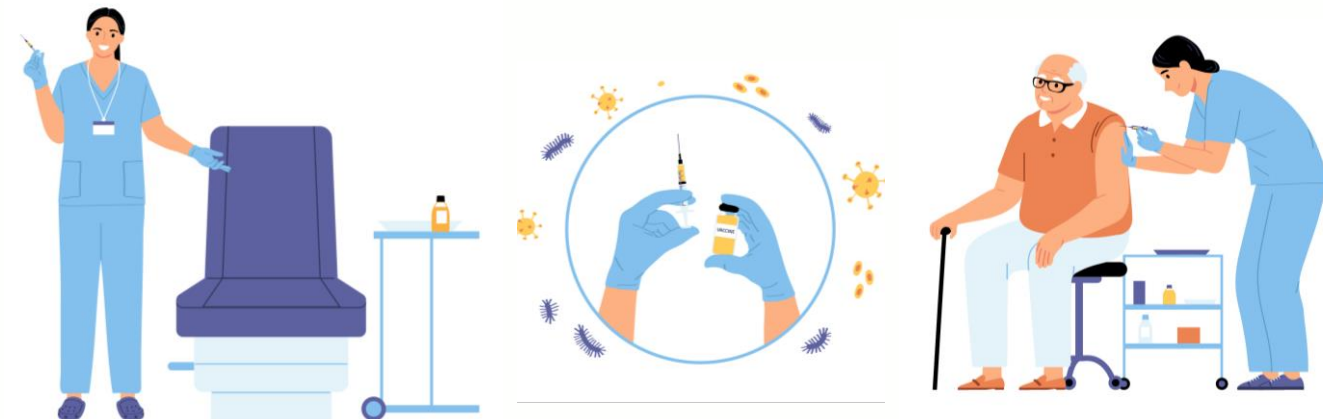
Each hospital admission or outpatient visit is a potential vaccination touchpoint — currently left unexploited

**Result:** Frail, multi-morbid patients — who need protection most — receive the least proactive vaccination outreach.

"Every hospital visit is a missed vaccination opportunity"

**⚠ The core gap:** The system is passive and reactive. Vaccination only happens when a patient or clinician actively seeks it — never when the system proactively identifies need.

Up to ~50% of eligible adult patients are not reached by current systems (literature-based estimates)



# CareVax: From Passive to Proactive Vaccination

CareVax introduces a paradigm shift in how frail adult patients are identified, engaged, and vaccinated — replacing clinician-dependent, reactive processes with a digitally-integrated, automated system.

"We move from patient-driven to system-driven vaccination"

✔ **Core innovation:** The system acts on behalf of the patient, not in response to the patient.



## Automated Identification

Algorithm-based screening of all patients at hospital contact



## Digital Integration

Hospital EHR connected to regional vaccine registry in real time

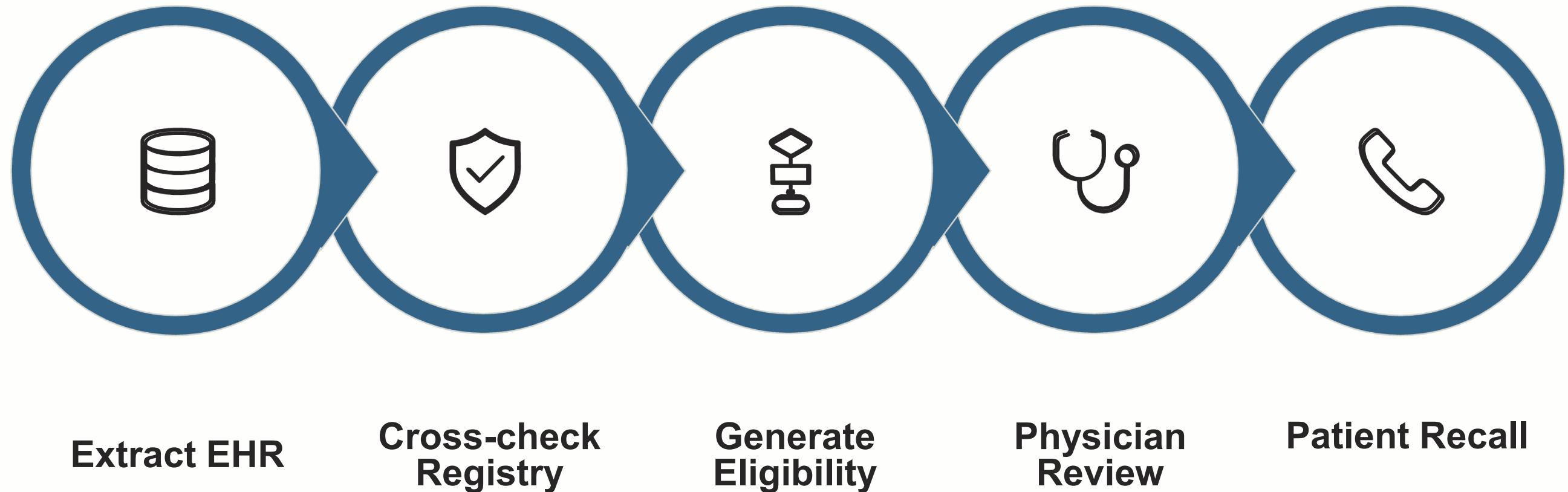


## Active Patient Recall

Eligible patients are directly contacted and offered vaccination

# How CareVax Works: Digital Integration Pathway

CareVax operationalizes a fully integrated digital workflow, linking hospital clinical data with the regional vaccine registry to generate personalized, actionable vaccination offers for every eligible patient.



This end-to-end pathway transforms each hospital encounter from a missed opportunity into a systematic vaccination touchpoint — requiring no additional burden on clinicians after initial validation.

# The Algorithm: Decision-Support System

The CareVax eligibility algorithm processes structured clinical data to identify patients who would benefit from vaccination — without requiring manual review of every patient record.

## Input Data Sources



### Age

Age-based eligibility thresholds for each vaccine type



### ICD-9-CM Codes

Diagnosis codes identifying at-risk conditions



### Exemption Codes


Structured exemption data from administrative records




### Clinical History

Relevant comorbidities and past medical events

## Algorithm Output

 Patient data is cross-checked with the **regional vaccination registry** to identify what vaccines have already been administered — and which are still needed.

 Algorithm generates a **personalized vaccine recommendation list** for each eligible patient, ready for physician validation.

This decision-support approach eliminates reliance on clinician memory and ensures systematic, reproducible eligibility detection at scale.

# CareVax Study Protocol: Design

The CareVax study is designed to rigorously evaluate the feasibility, accuracy, and real-world impact of the digital integration pathway across a multi-department hospital setting.

## Study Design

Single-arm pre-post study

## Duration


4 years

## Target Sample

~1,500 patients

## Population

Frail patients across multiple hospital departments

-  **Rationale for pre-post design:** Allows direct comparison of vaccination coverage and pathway performance before and after CareVax implementation within the same clinical setting, maximising internal validity without requiring a parallel control arm.

# Population & Setting: Real-World Hospital Implementation

## Study Site

**Policlinico Gemelli** — a major academic hospital providing the real-world multi-specialty environment required for generalisable results.

## Participating Departments

 Nephrology

 Geriatrics

 Dermatology

 Gynecologic Oncology

 Gastroenterology



## Institutional Integration

- ☐ CareVax operates in direct integration with **ASL Roma 1** (Local Health Authority), enabling real-time cross-referencing of the hospital's EHR data with the regional vaccination registry.

The multi-department structure ensures that the pathway is tested across a diverse frail patient population — from oncology to nephrology — reflecting the real heterogeneity of at-risk adult patients encountered in tertiary care.

- ☑ Departments were selected to maximise clinical diversity and ensure the algorithm is validated across distinct comorbidity profiles.

# Outcomes: What Are We Measuring?

## Primary Outcomes

### Feasibility of the Pathway

Can the full digital integration workflow be operationalised and sustained within a real hospital environment?

### Algorithm vs. Clinician Agreement

How well does the algorithm's eligibility determination align with the judgement of specialist clinicians?

### Patient Participation Rate

What proportion of identified patients accept the vaccination offer when proactively contacted?

## Secondary Outcomes

**Vaccination Coverage Increase**  
Measured at **6 months, 12 months, and 24 months** post-implementation — tracking change in coverage for influenza, pneumococcus, herpes zoster, and HBV across all enrolled patients.

The longitudinal coverage measurement at multiple timepoints allows assessment of both immediate impact and sustained benefit of the CareVax pathway over the study duration.



# Early-phase pilot data from CareVax: Patient Flow

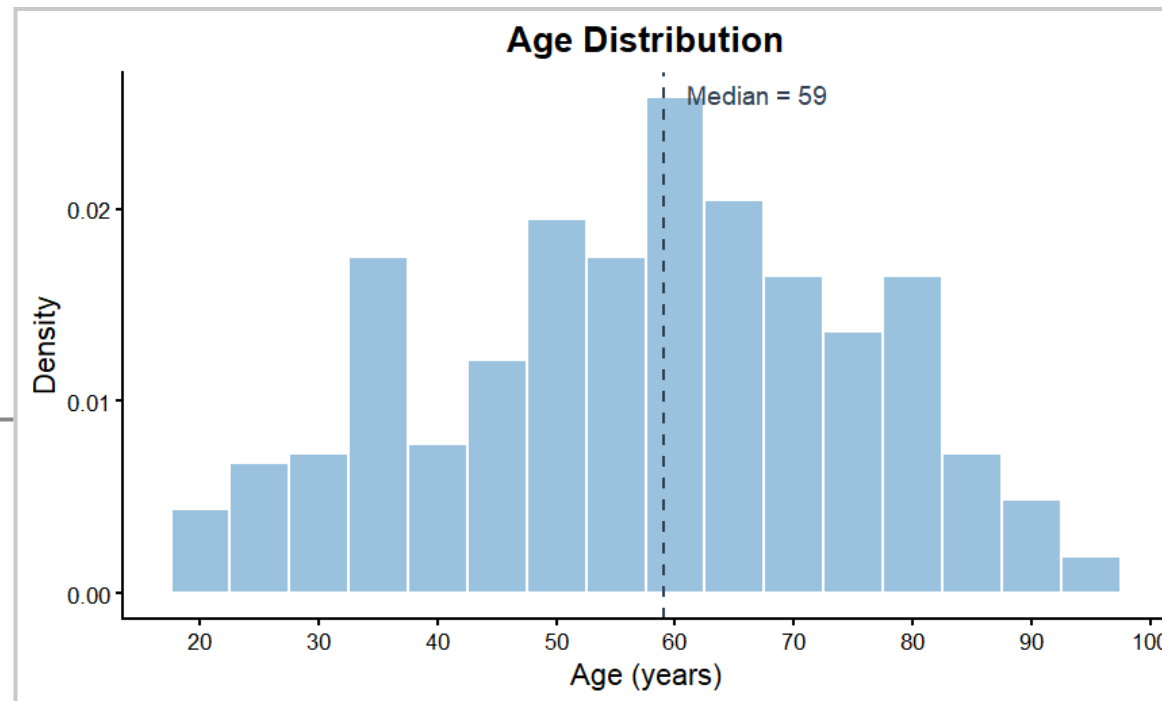
**621**  
Patients approached

**411**  
Enrolled (study consent)

**315**  
Recalled patients

**94**  
Vaccination consent

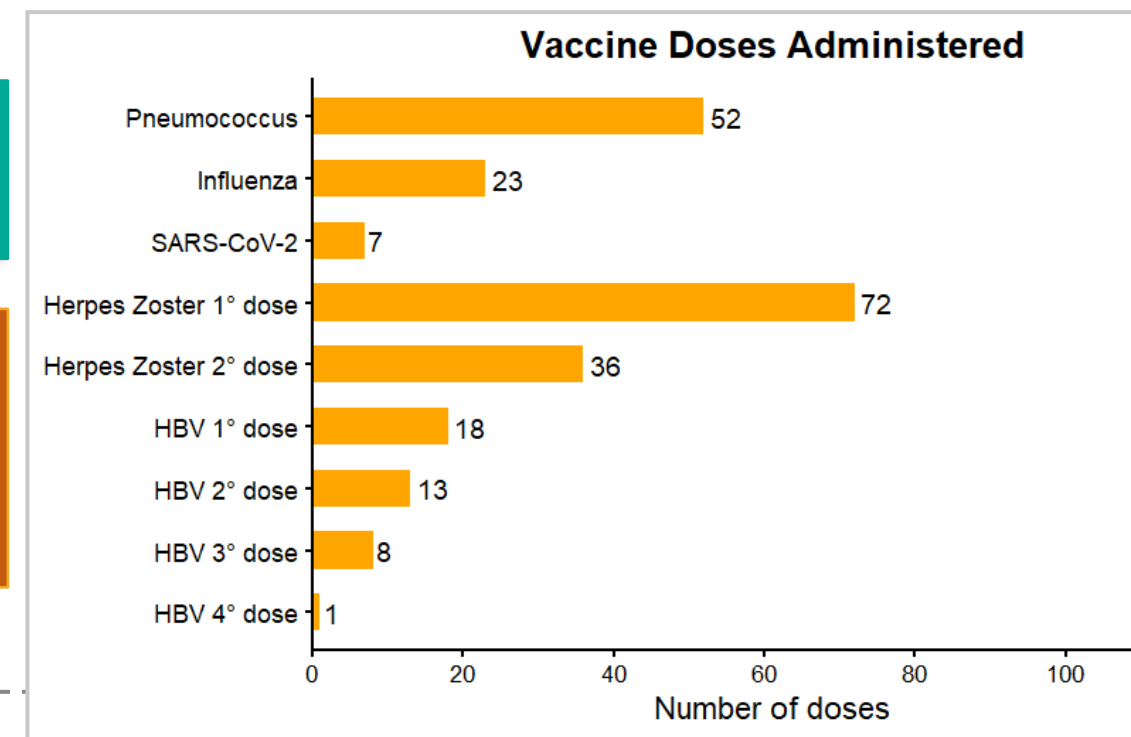
**230 doses**  
Vaccines administered



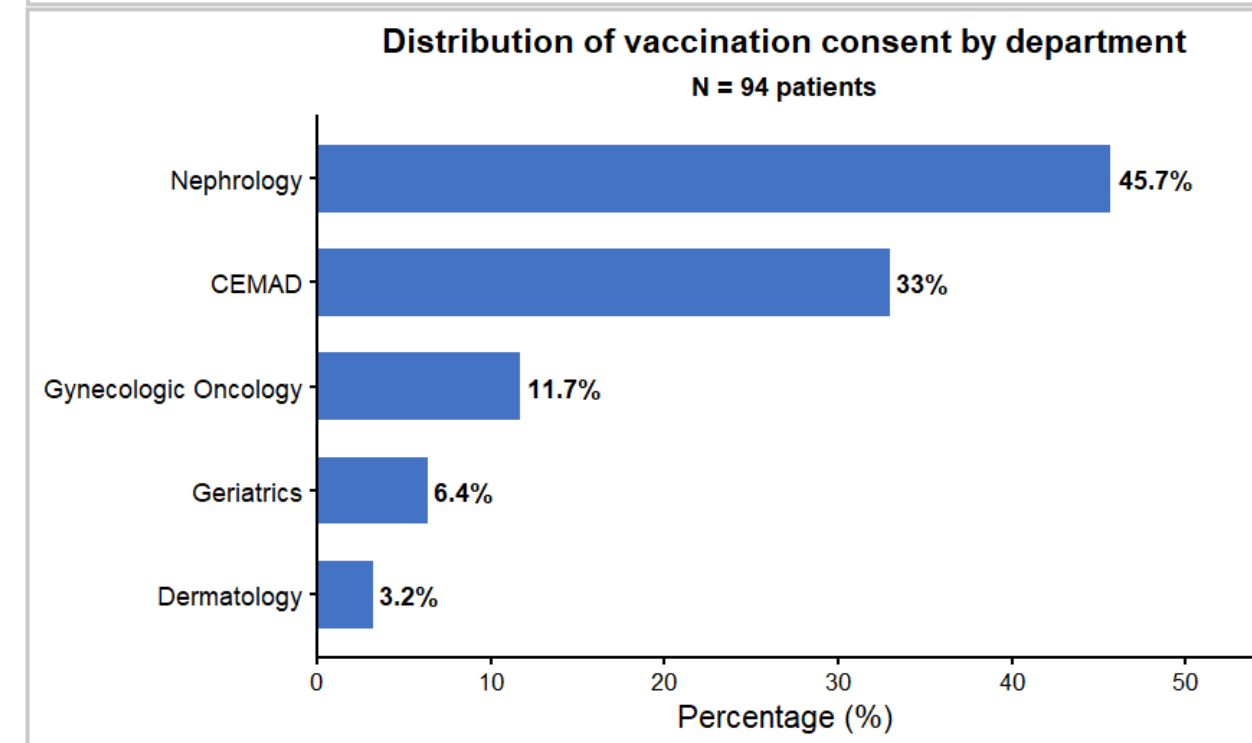
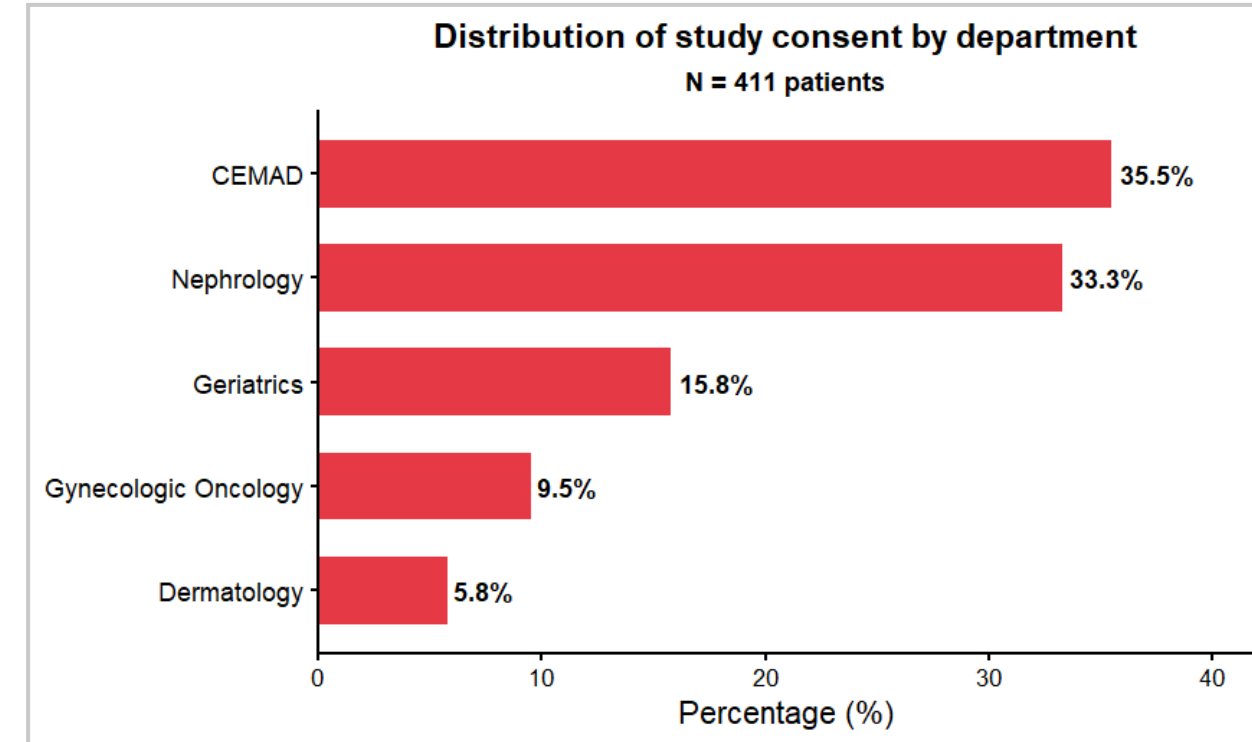
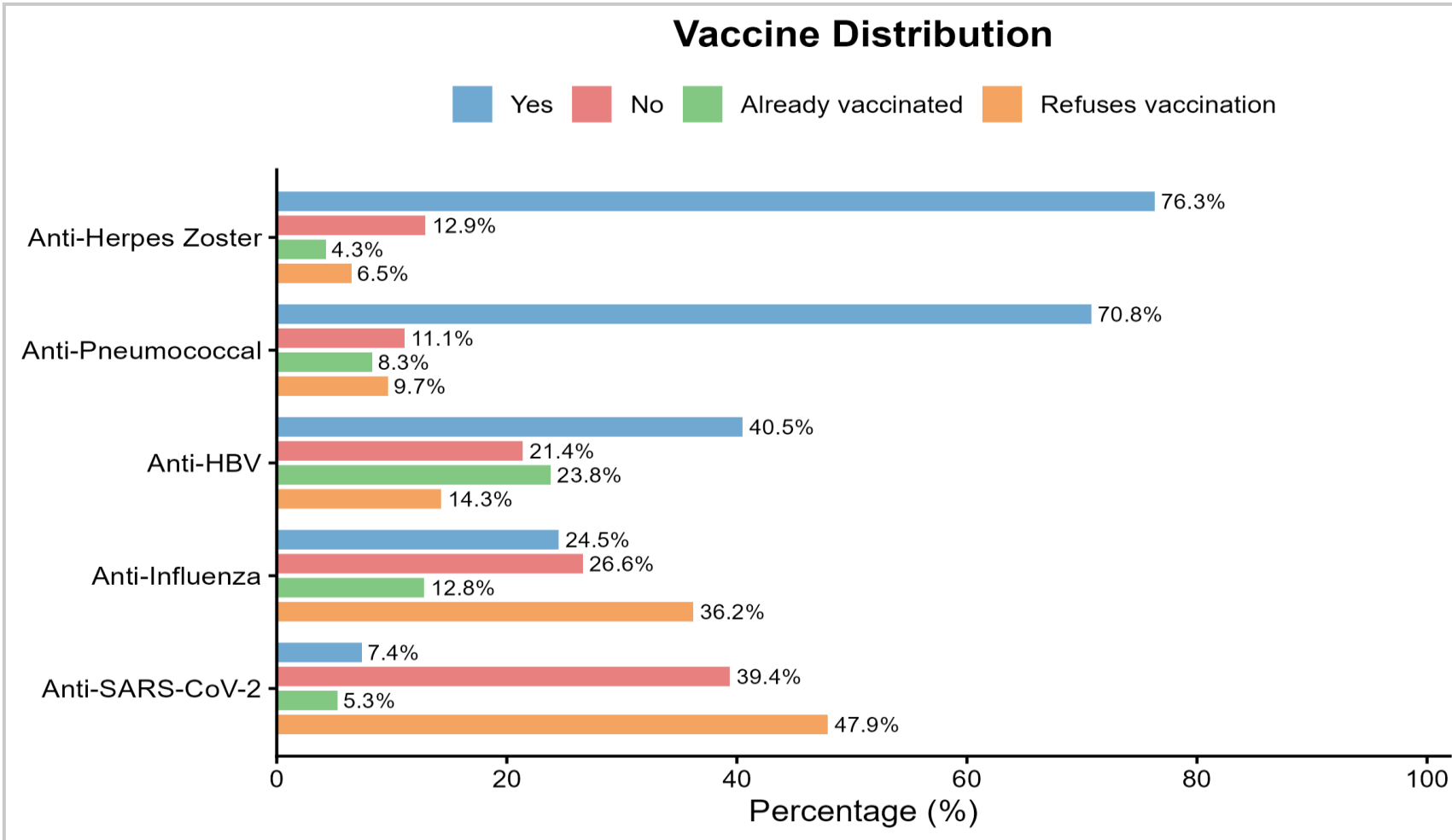
Early-phase pilot data from CareVax provide the first real-world evidence that the pathway is operational, that patients can be systematically identified, and that a meaningful proportion engage when proactively contacted.

**221**  
No Vaccination consent

- Patient refusal 105 (47.5%)
- Patient not reachable 102 (46.2%)
- Already vaccinated 9 (4.1%)
- Patient deceased 5 (2.3%)



# Preliminary results (April 2026)



Of 411 enrolled patients, CEMAD (35.5%) and Nephrology (33.3%) contributed the largest shares. Among the 94 who consented to vaccination, Nephrology led (45.7%), followed by CEMAD (33%) — suggesting higher vaccine receptivity in renal patients despite similar enrolment numbers. For individual vaccines, Herpes Zoster (76.3%) and Pneumococcal (70.8%) showed the highest acceptance among those who consented, while SARS-CoV-2 remained the most refused (47.9%).

# Closing the Gap in Adult Vaccination

Most vaccine-eligible frail adults are not proactively identified by current systems — because structured, systematic outreach does not exist. CareVax is designed to fill this gap.



## Fully Automated Eligibility Detection

No reliance on clinician memory — every patient is screened at every contact



## Real-Time Hospital–Territory Integration

Live connection between hospital EHR and regional vaccine registry



## Personalized Vaccine Offer

Each patient receives a tailored recommendation based on their clinical profile and vaccination history



## Active Patient Recall

Proactive outreach — the system contacts the patient, not the other way around



## Hybrid Delivery

Vaccination can be administered at the hospital or referred to the Local Health Authority — maximising access

# Implications of the CareVax Model: From Local Implementation to System-Level Impact

- ① CareVax addresses structural gaps that are common across healthcare systems — enabling replication, adaptation, and policy-level impact beyond a single implementation context.

## Core Model Components

- Designed for cost-effective implementation in high-volume hospital settings
- SaaS-based architecture enabling deployment across diverse care environments
- Flexible digital infrastructure supporting integration with local registries and data systems
- Replicable organizational framework for hospital–territory coordination

## Context-Specific Adaptations

- Original monocentric design requires structural simplification for smaller healthcare settings
- Integration with heterogeneous EHR systems and data infrastructures
- Dependence on local coding systems (e.g. ICD variants) may require standardization
- Residual human resource involvement — full end-to-end automation remains a future step

A structurally transferable model, adaptable to different healthcare ecosystems

# Future Directions: Next Steps

The CareVax pilot establishes the foundation. The roadmap ahead focuses on expansion, automation, and integration at a national level.

## Scale to Other Hospitals

Extend the CareVax model to additional hospital sites for multicentre validation

## Automation of Booking

Develop automated appointment scheduling to further reduce friction between recall and vaccination

1

2

3

4

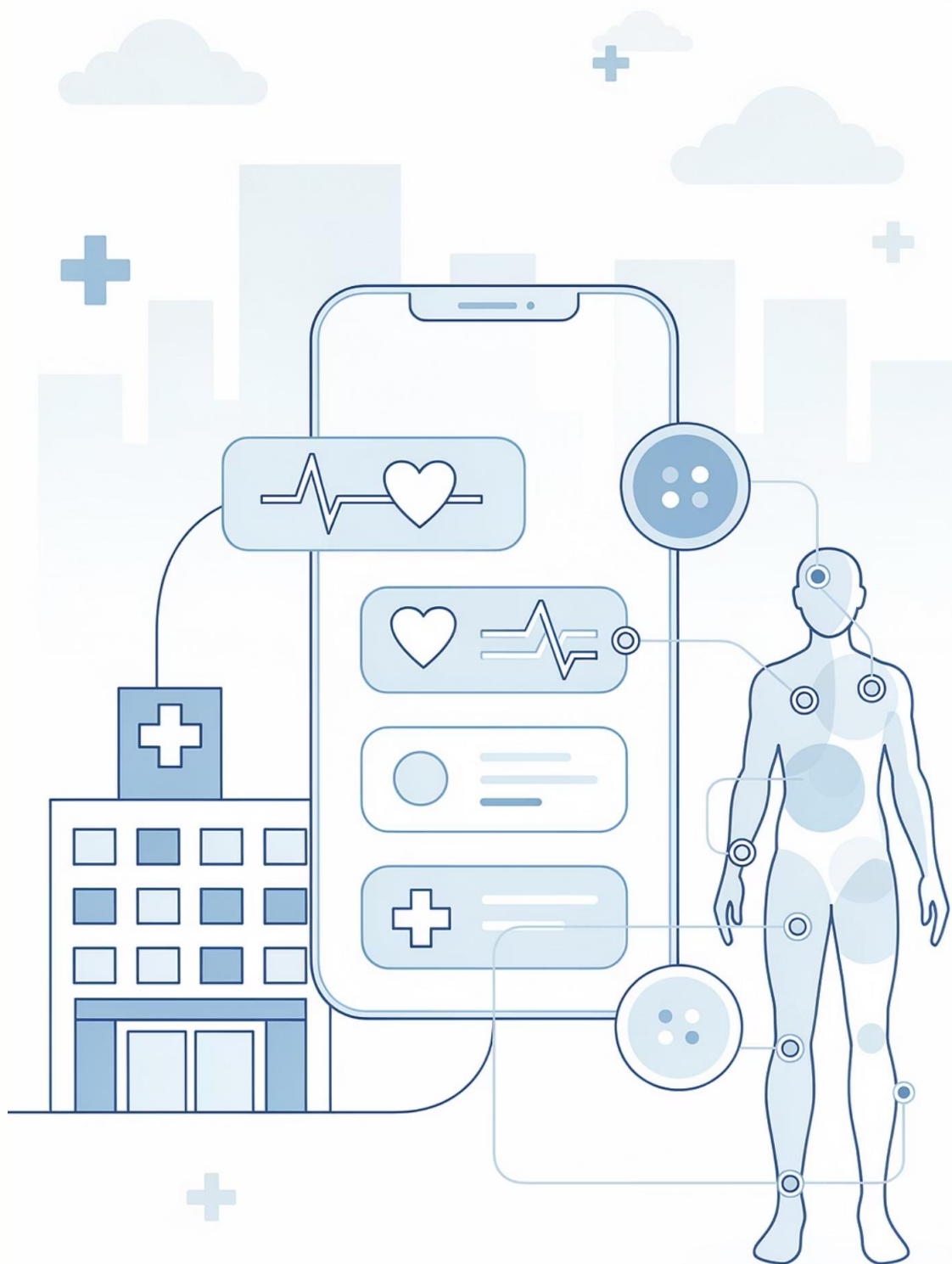
## National Registry Integration

Connect the pathway with the national vaccination registry for broader population coverage and longitudinal tracking

## Standalone Modular Version

Create a deployable, institution-agnostic modular version adaptable to different national health system architectures

✓ The modular and interoperable design of CareVax means each of these steps can be pursued independently — making the path to scale both realistic and achievable without requiring full national infrastructure from day one.



TAKE-HOME MESSAGE

# The Core Message

"CareVax shows that digital integration can transform vaccination from opportunistic to systematic care for frail patients"

## Identify

Automated algorithm detects every eligible patient

## Integrate

Hospital EHR meets regional vaccine registry

## Engage

Active recall brings the offer to the patient

## Vaccinate

Flexible delivery — hospital or LHA


# Thank You

## Acknowledgments


 **Dr. Domenico Pascucci**  
Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy


 **Dr. Simone Crovella**  
Fondazione Policlinico Universitario "A. Gemelli" IRCCS, Rome, Italy

 **Dr. Arianna Magnanti**  
Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy

 **Prof. Roberta Pastorino**  
Università Cattolica del Sacro Cuore, Rome, Italy

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 Medical Resident : **Dr. Rossella Mancini, Dr. Daniele Postorino, Dr. Donato Cocolicchio,** and defend **Dr. Cristina Pais** to believe in the power of vaccinations them

 The CareVax team gratefully acknowledges the collaboration of **ASL Roma 1**, the participating clinical departments, and all patients enrolled in the study.

