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Effectiveness of email -based reminders to increase vaccine uptake

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Reminders work, but where does email fit?

> *Reminding people to be vaccinated increases coverage by an average of* ***8 percentage points*** *across populations and settings.*
>
> *Cochrane Review, Jacobson Vann et al. 2018 · CPSTF Community Guide · Groom et al. 2015*

Telephone & traditional

Long-established gold standard. Increasingly costly, slow, opt-out by default.

SMS / text messages

Cheap, scalable, high open rate. Leading evidence base in 2020s.

Email -based reminders

Cheap, fast, no character limit, automatable. Evidence still scant in 2020.

The question in 2019

281 billion emails were sent globally in 2018. Yet **no systematic review** had ever assessed how email reminders perform, alone or compared with traditional and digital alternatives.

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Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Review

Effectiveness of email-based reminders to increase vaccine uptake: a systematic review

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Objective & study selection

Objective

To systematically retrieve and critically appraise the available literature on the **effectiveness of email-based reminders** to increase vaccine uptake, to inform their integration into immunization programmes.

PICOS

- **P** children, adolescents, adults, elderly, at-risk groups, international travellers, healthcare professionals.
- **I** email-based reminders applied to immunization programmes.
- **C** no reminders; traditional (mail / telephone); other digital reminders; email + other components.
- **O** vaccine uptake (any measure of coverage).
- **S** quantitative studies with comparison group; English language.

PRISMA flowchart

Search string: email -based interventions + vaccinations

Medline; Embase; Cochrane Library (23 Apr 2019)
Records identified: 919

- 272 duplicates

After removing duplicates: 647

- 594 excluded

Full text assessed: 53

- 3 full text N/A

- 39 excluded

Studies included for qualitative synthesis: 11

N=10 experimental study designs (90%)

What we extracted

Reference

Year of publication

Country

Study design

Target population

Comparison

Vaccine

Email-based intervention

Quality appraisal

- **RoB-2 (Cochrane revised)** for RCTs.
- **ROBINS-I** for non-randomized.
- **QA Tool** for pre-post.

Primary outcome

- **VACCINE UPTAKE**

  any measure of coverage / uptake reported by the study (vaccinations administered, % up-to-date, dose completion, etc.).

What we extracted


Intervention


Email sender


Email recipient


Intervention phase


Email content


Number of emails


Comparator Group

Data synthesis approach

- **Pooled by type of comparison:** no reminder, traditional, other digital, email + other.
- **Independent dual extraction:** two authors + senior author for disagreements.
- **Spreadsheet pre-piloted:** tested on 10 randomly selected papers, then refined.
- **Qualitative synthesis:** no meta-analysis; heterogeneity in design, vaccine, outcome.

Characteristics of the 11 studies

Target population

Adolescents (5);
Adults/HCWs (4);
Students/Women (2).

Vaccine

Influenza (6);
HPV (3);
Multi/Pneumococcal (1+1).

Country

US (9);
Lebanon (1);
Netherlands (1).

Study design

RCT (5); Cluster RCT (4);
Controlled (1);
Pre-post (1).

Sender

Health services (5);
Workplace (2);
School/University (4).

Recipient

Vaccine target population (5);
Parents (adolescents) (5);
HCWs + supervisors (1).

Phase

Delivery only (7);
Delivery + Education (3);
Delivery + Monitoring (1).

N° of emails

1 email (2);
2—3 emails (4);
4+ emails (5).

What the original review told us

Email > No reminder *(4 studies)*

- Morris 2015 (adolescents, multi-vaccine). **aOR 2.43**
- Dombkowski 2017 (parents, influenza). **aOR 1.28**
- Szilagyi 2016 (parents, influenza). **+70%** (email arm). p < 0.001 *vs* no reminder.
- Quan 2014 (HCWs, influenza). No substantial difference.

Email = traditional or digital *(5 studies)*

- Ghadieh 2015 (telephone vs email). **16.5% vs 5.7%** . p < 0.05 (favours phone).
- Szilagyi 2017 (email + paper vs email). **3.8% vs 2.1%.** p < 0.001 (favours combo).
- Kempe 2016 (email + IVR vs email). **p = 0.008** (favours combo).
- Patel 2014 / Richman 2016 (HPV). No substantial difference .

Email content matters *(2 studies)*

- Baskin 2018 (workplace, influenza) Map of nearest centres , **p < 0.01** Incentives, fear messaging, No effect.
- Lehmann et al. 2016 (HCWs, influenza) Opt-in vs opt-out email: no difference among HCWs.

Bottom line in 2020: email beats no reminder, but does not consistently beat phone calls, SMS or paper. *Combinations and actionable content drive the additional gain..*

Six lessons from our SR

- **Email works against "nothing", not against alternatives:** email reminders **increase uptake** vs no intervention, confirming the broad reminder evidence base. But 80%+ of included studies are RCTs and yet no robust signal of email superiority over phone, mail, SMS or portal emerges.
- **Users prefer SMS — even college students and adolescents:** when given a choice, study populations consistently picked **text messages over email**. Preference correlates with effectiveness. **Patient-centered** reminder design must start from the channel users actually open, not the one we'd predict they'd open.
- **Email lives at work; reminders need to live everywhere:** adults check email during working hours, while SMS and social-media notifications reach people across leisure time. Combined with **inbox overload** (and spam), this can dilute the importance of an email-based vaccination reminder.
- **Combinations beat email alone:** email + IVR (*Kempe*), email + paper mail (*Szilagyi 2017*), and broader multicomponent quality-improvement **bundles consistently outperform email** as a single channel. Email is a node in a network, not a stand-alone solution.
- **Cheap, fast, automatable, registry-linkable (in theory):** *Morris 2015* reports email reminders are **36% cheaper** than postcards. Beyond cost, email is uniquely automatable and linkable to electronic immunization registries (EIRs). Practice-level cost-effectiveness data, however, remain scant.
- **Equity is a precondition, not a post-hoc concern:** **internet access** and **digital literacy** are unevenly distributed by age, socioeconomic status, geography. The empowering potential of digital reminders risks bypassing the populations who would benefit most: a Lancet-flagged structural concern.

A new evidence landscape after 2020

COVID-19 changed everything

First mass adult vaccination campaign in living memory; new urgency for scalable, low-cost reminder systems.

Europe entered the field

From a literature dominated by US studies to nationwide trials in Denmark, Netherlands, Norway, UK, Italy, Germany.

Email blurred into 'messages'

The boundary between email, SMS and patient-portal messages is now porous: what works often combines them.

Megastudies became feasible

Behavioural science platforms ran preregistered RCTs at scale (4,000 to 700,000+ participants).

Today's update integrates evidence from 20+ post-2020 studies: systematic reviews with metaanalysis · nationwide registry-based RCTs · primary-care megastudies · patient-portal trials.

What over 2 million participants have taught us

Study	Setting	N	Vaccine	Effect	Key Feature
Johansen et al. 2023	Denmark · nationwide	964,870	Influenza ⩾ 65yr	+0.89 pp	Cardiovascular gain-frame electronic letter via mandatory Digital Post.
Hanley et al. 2023	USA · primary care	7,408	HPV9-25y	+17% odds	Multi-channel electronic reminder (SMS / email/portal).
Johansen et al.2024	Denmark · nationwide	299,881	Influenza 18–64y	+11.7 pp	Chronic disease cohort (+9.1pp DM subgroup).
Szilagyi et al. 2024	USA · UCLA Health	262,085	Influenza adults	No effect	Patient portal vs text vs standard care.
Johansen et al. 2024	Denmark · nationwide	881,373	Influenza ≥ 65yr	Sustained	2023/24 season replication; effects largest among prior non-vaccinees.
Jaca et al. 2025	SR/MA adult populations	161,495	Influenza	RR 1.75	Letter reminders pooled effect for influenza (95% CI: 0.97—3.17).

Take-away: the post-Frascella email evidence converges on one finding

INFRASTRUCTURE BEATS CONTENT

4 principles, 3 modalities, 1 robust email replication

Ownership framing

"Your vaccine is ready for you."

Buttenheim 2022 (*JAMA Netw Open* , SMS), Dai 2021 (*Nature* , SMS, +3.6 pp), Meeldijk 2025 (*Vaccine* , SMS, OR 2.10). Principle is robust but evidence base is text - message - driven: **no email - specific RCT exists** .

Gain framing

Highlight downstream benefits

NUDGE- FLU trilogy (Denmark, n>2.1M total): **cardiovascular benefits letter outperforms standard letter** ; +1.8 pp in AMI survivors, +3.9 pp pooled across NUDGE- FLU + NUDGE- FLU- 2 + NUDGE- FLU- CHRONIC.

Specific date / time / place

Pre - booking + concrete coordinates

Milkman 2021 (*PNAS*, SMS, megastudy): " *reserved for you* " + concrete timing wins. Baskin 2018 (in our SR): **map** of nearest centres = **only effective email component** (p<0.01).

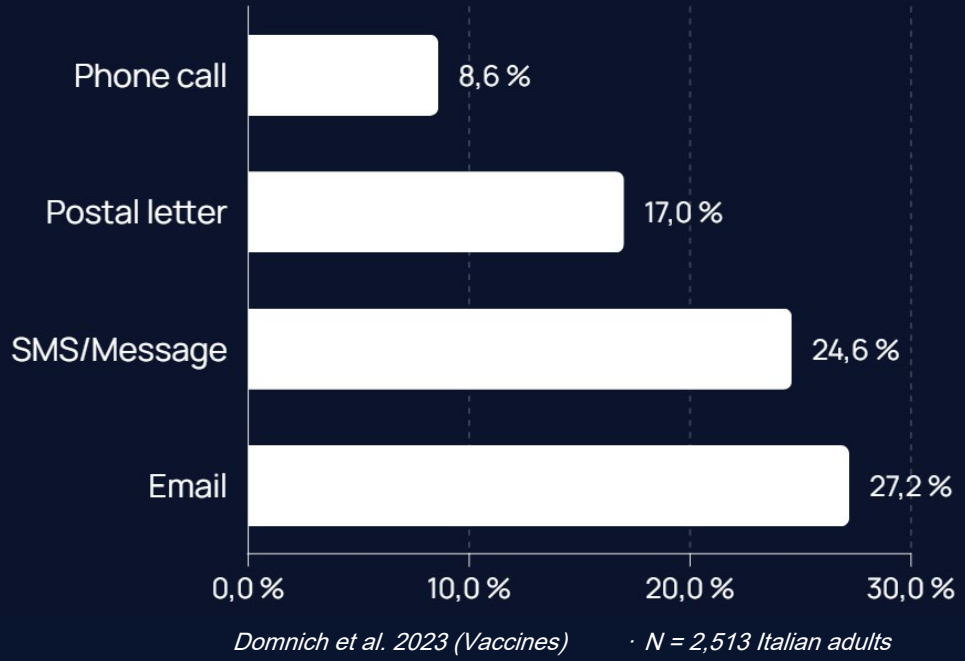
Repetition & timing

1–2 well - timed reminders

Sääksvuori 2022 (postal letter, Finland, +6.4 pp). Milkman 2024 (SMS megastudy , +21% relative). NUDGE- FLU repeated letter arm = largest effect across season. **Channel - agnostic principle** .

What channel do adults actually want?

Preferred channel for influenza vaccine reminder



Domnich et al. 2023 (Vaccines) · N = 2,513 Italian adults

3x

MORE LIKELY TO BE VACCINATED IF A REMINDER WAS RECEIVED

What this means

- **Email** and **text** are now jointly preferred by > 50% of Italian adults.
- **GPs** are the **most trusted source** : channel attractiveness depends on the sender.
- **Traditional channels** (letters, calls) **collapsed** in preference after COVID -19.

What we now know works for adult vaccination

Frascella 2020 (then)

- Emails > no reminder, but no consistent advantage over phone, paper or SMS.
- Email + IVR was the only superior combination.
- Personalised, multi-component, behavioural design = encouraging signal.
- Evidence base small (n = 11), almost entirely US-based, mostly RCTs.

2026 update (now)

- Electronic reminders work consistently across vaccines, ages and countries; at population scale.
- Effects are modest (≈ +1–5 pp absolute, +20–35% relative), but cheap and robust.
- Behavioural design (ownership, gain frame, date/time/place) drives most of the effect.
- Multi-channel and registry-linked delivery beats any single channel, especially for adults.

OPEN ISSUES

- Which systems (IISs) actually use e -mails for reminders?
- Are email addresses up to date in systems' databases in use?
- Can we use emails for such communications in the actual GDPR scenario? If so, how can we enter them in the system, lawfully?
- **?**

Three messages for the AIB

01

Email reminders work, but the contest is about "versus what"

Email beats no - reminder consistently. It does NOT outperform other channels in head - to - head comparisons. Build evidence around context and combinations, not channel superiority.

02

Infrastructure beats content

Where electronic letters live in a mandatory governmental Digital Post (Denmark NUDGE - FLU, N>2.1M), they work consistently. Where they live as opt - in patient portal in fragmented systems (USA Szilagyi 2024, N=262k), they fail. The question is institutional, not technological.

03

Behavioral design transfers, but evidence is asymmetric

Cardiovascular gain - framing: solid email replication. Ownership framing, specific timing, and repetition: validated mostly via SMS megastudies . Email - specific replication of these principles is the next research priority.

Thank you

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