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Research Article

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Research Article

The hidden workload of “free” communication: a longitudinal case study of physician e-mail traffic at a Swiss tertiary care centre

Running title: Hidden digital workload

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Abstract

Background

E-mail is embedded in routine clinical work and offers clear advantages as a rapid, asynchronous and paperless communication channel. Yet the cumulative work required to read, write, sort and act on e-mail is poorly represented in conventional measures of clinical activity. Objective longitudinal data on this form of digital work are scarce.

Methods

We conducted a longitudinal single-case observational study of the institutional mailbox of one senior physician (Kaderarzt) at a Swiss tertiary care centre. Inbox, Sent and actively Deleted e-mails from the calendar year 2025 were exported weekly and converted to MBOX format for metadata extraction. Messages were classified as patient-related, scientific or administrative using a hospital-integrated artificial-intelligence assistant with sample-based human validation. Calculated processing time was estimated from message metadata using published reading and typing rates. Working-day and weekend distributions were compared using Mann–Whitney U tests. A secondary analysis estimated the theoretical clinic-level reimbursement attributable to patient-related communication.

Results

After upstream spam filtering, 9,944 e-mails were analysed and were associated with an estimated 913.6 hours of calculated processing time, equivalent to a mean of 2.5 hours per calendar day. Administrative and scientific communication together accounted for approximately three quarters of both message volume and calculated processing time, whereas patient-related communication accounted for approximately one quarter. Workload was concentrated on working days (median 35.0 vs 5.4 e-mails/day and 151.1 vs 18.1 minutes/day; both $p < 0.001$). Annual e-mail volume increased descriptively from 2023 through 2025, with a further increase projected from the first six months of 2026. Theoretical clinic-level reimbursement for patient-related communication was CHF 67,143.

Conclusions

In this single-mailbox case study, routine e-mail represented a substantial component of digital work, most of which was not directly patient-related. The findings do not estimate average physician workload; rather, they illustrate how a communication channel commonly perceived as frictionless can consume substantial professional time while remaining only partly visible in conventional workload and reimbursement systems. Broader multi-user studies are needed to determine generalisability and to inform workforce planning and digital workflow design.

Trial registration: Not applicable.

Keywords: electronic mail; digital workload; physician workflow; non-patient work; health workforce; clinical communication; tertiary care; Switzerland

Background

Electronic communication has become a routine component of clinical work. E-mail in particular is fast, asynchronous, widely available and paperless, and it supports communication across clinical, scientific and administrative domains. These advantages make e-mail efficient at the level of an individual message. At the level of an entire working day, however, the cumulative effort required to read, write, sort, forward, archive and act on messages may become a substantial component of professional work.

This workload is difficult to see in conventional measures of healthcare activity. Administrative coordination, scientific and editorial correspondence, professional-society work and other non-visit tasks may occupy considerable time without appearing in counts of consultations or procedures[1–4]. Academic inboxes are additionally exposed to unsolicited conference and publishing traffic [5, 6], while expectations of rapid responsiveness may extend communication beyond formal working hours[7]. E-mail is therefore not only a communication medium but also a recurring workflow demand that competes for attention and time.

Prior work on physician e-mail has largely comprised surveys, studies of patient–physician communication, short observational snapshots, reviews and individual interventions[1–4, 8–11]. Continuous longitudinal descriptions of complete e-mail traffic handled by an individual hospital physician are uncommon. A single-case design cannot provide a population estimate, but it can offer a detailed view of the magnitude, temporal pattern and composition of one real-world digital workflow.

A second issue is whether this work is visible to the healthcare system. In Switzerland, some individual patient-related electronic contacts can be documented and reimbursed depending on the time spent, whereas administrative and scientific communication generally has no direct billing counterpart. This creates a useful distinction between digital work that is financially visible and work that is operationally necessary but largely invisible in reimbursement metrics.

We therefore performed a longitudinal single-case analysis of one senior physician’s institutional mailbox over the full calendar year 2025. The primary aim was to characterise e-mail-related digital workload in terms of volume, calculated processing time, content composition and temporal distribution. Secondary aims were to describe within-case changes in annual e-mail volume over time and to estimate the theoretical clinic-level reimbursement attributable to the patient-related fraction.

Methods

Study design, setting and period

We conducted a longitudinal single-case observational study of the institutional mailbox of one senior physician (Kaderarzt) at a tertiary care centre in Switzerland for the calendar year 2025. The unit of observation was the e-mail communication handled within this mailbox, not a sample of physicians. The analysis was intended to provide an in-depth description of one real-world digital workflow rather than a population estimate. No formal sample-size calculation was performed because all available e-mails within the predefined one-year study period were included. All dates were treated as Europe/Zurich local dates.

E-mail export, conversion and classification

All e-mails were exported from the dedicated Inbox, Sent and Deleted folders on a weekly basis and converted to MBOX files for extraction of message metadata. Ongoing e-mail conversations (threads containing multiple replies and forwards, for example “Re:” or “Fwd:”) were counted as a single e-mail because the retrospective folder view was configured by thread. Each e-mail was categorised as patient-related, scientific or administrative with the help of a hospital-integrated artificial-intelligence assistant (Microsoft Copilot). To verify categorisation, 10 randomly selected e-mails per month were individually reviewed; no misclassification was detected in this validation sample.

The patient-related category was defined narrowly as communication concerning a concrete identifiable patient or case, including communication directly with a patient or with a treating hospital, practice or physician. Generic clinical operations, operating-room coordination, bed-capacity information, departmental communication and professional-society work without a specific identifiable patient were not classified as patient-related. The scientific category included journals, publications, peer review, studies, research projects, congresses, conferences, abstracts and research administration. Professional-society committee work, general education announcements, hospital administration, staff communication, operational coordination, training, courses and information from other hospitals or nursing services were classified as administrative unless they met the strict patient-related or scientific definitions. Only aggregate and classification-level metadata were used for analysis.

Spam filtering

A strict institutional spam filter operated upstream of the inbox. It was updated at least weekly and continuously trained by feeding it newly identified unwanted senders and message types. A substantial volume of unsolicited mail was therefore removed before delivery and never reached the analysed folders. The reported inbound workload should consequently be interpreted as a lower bound. A retrospective count of spam-filtered messages for 2025 was not possible because these messages were continuously deleted after seven days. The Spam folder was prospectively reviewed during seven individual weeks in 2026 (weeks 5, 7, 10, 12, 13, 17 and 23), and these observations were used only to provide an approximate indication of upstream filtering activity.

Definition of actively deleted mail

“Deleted” comprised exclusively e-mails that were actively deleted by the user—messages that had been read and were no longer needed—together with self-removing items such as accepted calendar invitations and Microsoft Teams meeting invitations that delete themselves after processing. Quarantined or spam-filtered messages were not included in this category.

Missing data and imputation

Owing to technical issues during export and conversion of the e-mail metadata, certain values were missing in the final analysis. Missing calendar days were imputed using the mean of observed days with the same weekday. Imputed values were retained for aggregate estimates but excluded from distributional and inferential analyses.

Calculated processing time

Reading time, writing time and total calculated processing time were computed automatically from the e-mail metadata. Published average reading and writing rates — 238 words per minute for reading and 40 words per minute for writing/typing[12] — were doubled, corresponding to an assumption of processing at twice the published average speed. This was intended to reflect fast academic reading and a focus on message content rather than greetings and sign-offs. Counts, classifications and word/character counts were unchanged. Total calculated processing time was defined as the sum of estimated reading and writing/handling time. These values are modelled estimates and not direct time-on-task measurements.

Reimbursement estimation

Reimbursement was estimated only for e-mails classified as direct patient communication and always at clinic level, not as individual physician income. In Switzerland, outpatient medical services are billed in tax points under the TARDOC tariff, in force since 1 January 2026. The franc amount of a service is the number of tax points multiplied by the tax-point value; a value of CHF 0.82 was used here. For each patient-related contact, two physician-service positions were applied: a base consultation fee (AA.10.0030) and one 15-minute time unit (AA.10.0010), together corresponding to 25.94 tax points. Where calculated processing time exceeded 15 minutes, additional documented minutes were assigned to further time units. This analysis was intended solely to illustrate the potential financial visibility of patient-related e-mail work and does not constitute legal, tariff or billing validation.

Longitudinal comparison

To place the 2025 case-year in temporal context, total annual e-mail counts in Inbox, Sent and Deleted folders for 2023 and 2024 and for the first half of 2026 were compared descriptively with 2025. Detailed metadata classification was not performed for these additional years. The 2026 annual total was extrapolated from the first six months. These data describe the trajectory of this mailbox only and were not interpreted as a general trend among physicians.

Statistical analysis

Descriptive statistics were computed as counts, means, standard deviations, medians, quartiles and ranges. Aggregates used the complete day-level dataset; distributional and inferential analyses used observed days only. The primary inferential comparison was working days (Monday–Friday) versus weekend days (Saturday–Sunday), tested with the Mann–Whitney U test with rank-biserial correlation as effect size. Because an omnibus test across all seven weekdays would be dominated by the working-day/weekend contrast, differences among individual working days were examined separately and exploratively using a Kruskal–Wallis test restricted to Monday–Friday. A two-sided $p < 0.05$ was considered statistically significant.

Results

Overall e-mail volume and calculated workload

In 2025, 9,944 e-mails were processed after upstream spam filtering (8,902 Inbox/Sent and 1,043 actively Deleted). Incoming mail clearly exceeded outgoing mail (6,492 received vs 2,411 sent), indicating that the analysed mailbox was predominantly reactive. Total calculated processing time was 913.6 hours (54,813 minutes), corresponding to a mean of 2.5 hours per calendar day (Figure 1a).

Reading, writing and seasonal pattern

Writing/processing accounted for most of the calculated time burden: reading accounted for 7,343 minutes (122.4 h) and writing/processing for 47,648 minutes (794.1 h). Monthly calculated processing time decreased during the summer, coinciding with holiday time, and increased again in the second half of the year, peaking in September (152.6 h) and October (163.8 h). This temporal pattern is descriptive for the analysed mailbox and may partly reflect work accumulating around periods of absence (Figure 1b).

Content composition: patient-related versus non-patient work

Administrative messages accounted for 6,125 e-mails (61.6%) and 33,179 minutes (60.5%) of calculated processing time, and scientific messages for 1,309 e-mails (13.2%) and 7,007 minutes (12.8%). Together, these non-patient categories represented approximately three quarters of both message volume and calculated processing time in the analysed mailbox. Patient-related e-mail accounted for 2,510 messages (25.2%) and 14,623 minutes (26.7%) (Figure 1c–e).

The dataset recorded counts of attachment objects rather than the number of messages carrying substantive attachments. On 67 days, attachment-object counts exceeded the number of e-mails, with up to 7.2 objects per e-mail and an annual mean of 0.73 objects per e-mail, indicating inclusion of inline images such as signature logos, banners and tracking pixels. Because substantive documents could not be distinguished reliably from inline graphics, attachment-related work was not analysed further.

Temporal distribution

Daily e-mail intensity (mean e-mails per day per month) broadly tracked monthly volume, with lower values during the summer and higher values in the second half of the year (Figure 2a).

On observed days, workload showed a pronounced working-day/weekend contrast. Median daily volume was 35.0 e-mails (IQR 27.5–43.0) on working days versus 5.4 (3.4–9.3) at weekends (Mann–Whitney U, $p < 0.001$; rank-biserial $r = 0.94$). Median daily calculated processing time was 151.1 minutes (58.6–260.4) versus 18.1 minutes (4.0–44.1), respectively ($p < 0.001$; $r = 0.65$). Among Monday–Friday observations, calculated processing time did not differ significantly in the exploratory Kruskal–Wallis analysis ($H = 6.6$, $p = 0.16$) (Figure 2b–c).

Financial visibility of patient-related communication

Billable minutes totalled 81,884 for the year under the theoretical tariff model. At a tax-point value of CHF 0.82, this corresponded to a theoretical clinic-level reimbursement of CHF 67,143 for patient-related communication: CHF 65,160 from the base-fee component plus CHF 1,983 for additional documented minutes beyond the 15-minute time unit (Figure 3). This estimate should be interpreted as an illustration of financial visibility rather than as a billing claim.

Within-case longitudinal trend

Annual total e-mail volume increased descriptively from 7,116 in 2023 to 7,372 in 2024 and 9,943 in 2025; extrapolation from the first six months of 2026 projected 12,177. The increase was present across Inbox, Sent and Deleted streams (Figure 4). Because these observations originate from a single mailbox, they represent a within-case temporal pattern rather than evidence of a general increase in physician e-mail traffic.

Spam-filter activity estimated from 2026

Across seven sampled weeks in 2026, the upstream spam filter removed a mean of 165 messages per week (SD 21), corresponding to an approximate extrapolation of 8,580 filtered messages per year. Because this estimate was based on selected weeks in a different calendar year, it was not added to the 2025 workload totals.

Discussion

Principal findings

This longitudinal single-mailbox case study provides an objective description of one component of digital work in hospital medicine. Across one year, the analysed mailbox contained almost 10,000 processed e-mails and was associated with an estimated 913.6 hours of calculated processing time. Approximately three quarters of both message volume and calculated time were administrative or scientific rather than directly patient-related. The central finding is therefore not simply that this physician received many e-mails, but that a routine communication channel generated a large amount of professional work that is only partly visible in conventional measures of clinical activity.

The study should not be interpreted as an estimate of average physician e-mail workload. Its contribution is different: it uses a complete, longitudinal case to make an otherwise diffuse form of work measurable. The granularity of the data allows volume, time, content and temporal pattern to be considered together, thereby illustrating how small, repeated digital interactions can accumulate into a substantial workload.

E-mail as hidden digital work and a workforce issue

The relevance of e-mail workload lies less in the burden of any single message than in its cumulative and fragmented nature. Reading, writing, triage, forwarding, filing and deciding what action is required repeatedly interrupt or compete with other tasks. Many messages also trigger downstream work that was not captured in the present analysis. The estimated processing time therefore represents only the communication component of e-mail-related work and not the full task chain initiated by the inbox.

For workforce planning, this distinction matters. Clinical workload is commonly described through visits, procedures, operating lists or other directly observable activities. Digital communication is distributed between these activities and may therefore remain under-recognised even when it consumes substantial time[13]. In the analysed mailbox, administrative and scientific communication accounted for about three quarters of calculated e-mail work, illustrating how non-patient work can occupy clinical professionals without appearing as direct patient-facing activity. This is consistent with prior descriptions of non-visit and administrative work in medical practice[1, 2, 4, 14, 15].

Financial visibility and invisible organisational work

The reimbursement analysis provides a second way to examine visibility. Approximately one quarter of the analysed messages were patient-related, and this fraction could be translated into a theoretical clinic-level monetary value under the Swiss outpatient tariff framework. The purpose of this calculation is not to advocate increased revenue or to imply that every message is billable. Rather, it demonstrates that some forms of digital work have a mechanism through which they can become visible to the healthcare system.

By contrast, the larger administrative and scientific fraction has no comparable direct reimbursement signal despite requiring professional time. This creates a mismatch between work performed and work captured by financial or activity metrics. From a health-services perspective, the important question is therefore not only whether communication can be billed, but whether workforce and organisational models adequately account for necessary digital work that remains outside traditional measures of service delivery.

E-mail within a multi-channel digital work environment

E-mail represented only one communication channel in the analysed setting. Patient-related information is increasingly handled through the hospital's electronic health record (EHR) system (Epic), which supports communication with patients, referring practices and clinicians involved in a case[13]. Administrative and scientific communication is also increasingly handled through Microsoft Teams. Neither Epic nor Teams traffic was included in the dataset. The present study

therefore does not estimate total digital communication workload; it isolates one channel within a broader communication ecosystem.

The coexistence of several platforms may itself have workflow consequences because each channel requires monitoring, prioritisation and task management. Secure platforms may improve confidentiality but can also introduce access constraints or additional platform switching. Ordinary e-mail remains convenient and mobile, whereas patient-identifiable information requires appropriate data-protection safeguards. These trade-offs illustrate that communication-system design involves not only information transfer but also usability, security and workload.

Spam filtering, information volume and residual workload

The strict upstream spam filter reduced the number of unsolicited messages reaching the mailbox, meaning that the observed inbound volume was already a post-filter workload[16]. The 2026 sample suggests that a substantial additional volume was removed before delivery. Filtering therefore acts as a workload-reduction mechanism, but it also creates a need for confidence that relevant messages are not lost[16]. The present study did not quantify false-positive filtering and cannot estimate that risk.

Potential implications for clinician wellbeing

The present study did not measure stress, burnout, sleep, work-life balance or any other health outcome. It therefore cannot determine whether the observed e-mail workload harmed clinician wellbeing. Nevertheless, prior literature has linked after-hours electronic communication and persistent availability expectations with work-related rumination and boundary erosion[2, 4, 13–15]. The magnitude and temporal persistence of the workload observed here support further investigation of how digital communication volume, timing and fragmentation relate to clinician wellbeing, but such effects should not be inferred from the present data.

Generalisability and future research

The single-case design is both the main limitation and a defining feature of the study. A single mailbox cannot establish prevalence, averages or causal relationships across physicians, specialties or institutions. At the same time, complete longitudinal case data can identify patterns and generate hypotheses that are difficult to obtain from surveys or short snapshots. Future studies should apply comparable methods across multiple physicians, professional roles, institutions and communication platforms, ideally combining metadata-derived workload with directly measured time, task switching, after-hours activity and wellbeing outcomes.

Limitations

The most important limitation is the single-case design. Only one mailbox belonging to one senior physician was analysed. The findings therefore characterise this particular role, institution, work pattern and period and cannot be used to estimate average physician e-mail workload or to infer specialty-, institution- or country-level prevalence. Replication across multiple users and settings is required before broader conclusions can be drawn.

The analysed data represent a lower bound of inbound traffic because a strict, continuously updated spam filter removed unsolicited mail upstream. Spam volume was sampled only during selected weeks in 2026, so extrapolation to an annual value is approximate and may not represent seasonal variability in 2025.

Technical issues during transformation of exported .olm files to .mbox format resulted in missing values for several weekend and Monday observations. Missing calendar days were imputed for aggregate estimates, whereas inferential analyses used observed days only. Imputation may therefore affect some descriptive values but not the reported inferential comparisons.

Calculated processing time was modelled rather than directly observed. The estimates rely on published reading and typing rates and on the assumption of processing at twice the published average speed. Message metadata may include text in headers, footers or other elements that a user would skim or ignore. Conversely, the model does not capture time spent opening

substantive attachments, switching context, deciding on actions or completing tasks triggered by a message. The results should therefore be interpreted as a workload model rather than measured time-on-task.

Conversation threads were counted as single e-mails because the retrospective folder view was configured by thread. This may understate the number of discrete exchanges and limits comparability with datasets in which each individual message is counted separately.

Message categorisation was automated using a hospital-integrated artificial-intelligence assistant and validated on a sample of 10 randomly selected e-mails per month. No misclassification was detected in the validation sample, but classification errors outside that sample cannot be excluded.

The reimbursement estimate is a theoretical clinic-level upper bound and should not be interpreted as legal, tariff or billing validation. Eligibility of individual communications for reimbursement was not adjudicated.

Attachment information was available only as object counts and did not distinguish substantive documents from inline graphics such as logos or tracking images. Attachment-related work could therefore not be quantified reliably.

Finally, the study captured e-mail only. Communication through the EHR (Epic), Microsoft Teams, telephone and other channels was not measured. The present results therefore describe one component of digital communication workload and should not be interpreted as total electronic workload.

Conclusions

In this longitudinal single-mailbox case study, e-mail represented a substantial component of digital work for one senior physician at a Swiss tertiary care centre, with approximately 913.6 hours of calculated processing time in 2025 and most of the measured burden arising from non-patient communication. The study does not establish how much e-mail work physicians generally perform. Instead, it demonstrates that a communication channel commonly treated as frictionless can generate a large, measurable workload that remains only partly visible in conventional clinical activity and reimbursement systems. Multi-user and multi-institutional studies are needed to determine the generalisability of these patterns and to inform workforce planning, workload accounting and the design of digital communication systems.

List of abbreviations

AI – artificial intelligence

EHR – electronic health record

IQR – interquartile range

MBOX – mailbox file format

SD – standard deviation

TARDOC – Swiss outpatient medical tariff

Declarations

Ethics approval and consent to participate

The responsible regional ethics committee (Ethikkommission Nordwest und Zentralschweiz, EKNZ) was formally consulted and confirmed in its decision of September 16th 2026 (Req-2026-01287) that the study does not fall within the scope of the Swiss human research act (HRA) and therefore did not require formal ethics committee approval.

Regarding the analysis of email metadata and the AI-based classification of emails, possibly containing patient data, we additionally consulted the competent local data protection office, responsible as the institutional review board (IRB). Its review raised no data protection concerns.

Both documents available on demand.

Informed consent for participation was obtained from all participants of this study.

Accordance with relevant guidelines

All research for this study was done in accordance with the relevant guidelines and declarations (Declaration of Helsinki, STROBE, institutional guidelines)

Consent for publication

The study concerns one identifiable physician mailbox (senior author). Consent for publication from the mailbox owner is given.

Availability of data and materials

The message-level dataset is not publicly available because it contains confidential institutional and potentially patient-related communication. Aggregated data supporting the reported results can be made available from the corresponding author on reasonable request, subject to institutional and data-protection requirements.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

UCS performed the data collection and statistical analyses. MS prepared the figures. UCS and MS jointly developed the study framing, manuscript structure, interpretation of the findings, and overall idea and narrative. Both authors contributed to drafting and revising the manuscript, read and approved the final version, and agree to be accountable for the work.

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Use of artificial intelligence

A hospital-integrated artificial-intelligence tool (Microsoft Copilot) was used to assist with classification of e-mails into predefined categories. ChatGPT (OpenAI) was used during manuscript preparation for language editing, restructuring and improving clarity. All scientific content, analyses, interpretations and final wording were reviewed and approved by the authors, who take full responsibility for the manuscript.

Authors' information

Not applicable.

Figure legends

Figure 1. E-mail-related digital workload in the analysed mailbox, 2025. (a) Monthly e-mail volume split into received (Inbox), Sent and actively Deleted mail. (b) Monthly reading versus writing/processing time (minutes). (c) Monthly e-mail volume by content category (patient-related, scientific, administrative). (d) Annual e-mail volume by content category. (e) Annual calculated processing time by content category (minutes).

Figure 2. Temporal distribution of e-mail-related digital workload in the analysed mailbox. (a) Daily e-mail intensity per month (mean e-mails per day). (b) Daily e-mail volume by weekday (median, interquartile range and $1.5 \times \text{IQR}$). (c) Daily calculated processing time by weekday (minutes).

Figure 3. Theoretical monthly clinic-level reimbursement for patient-related communication: base fee plus additional documented minutes (CHF).

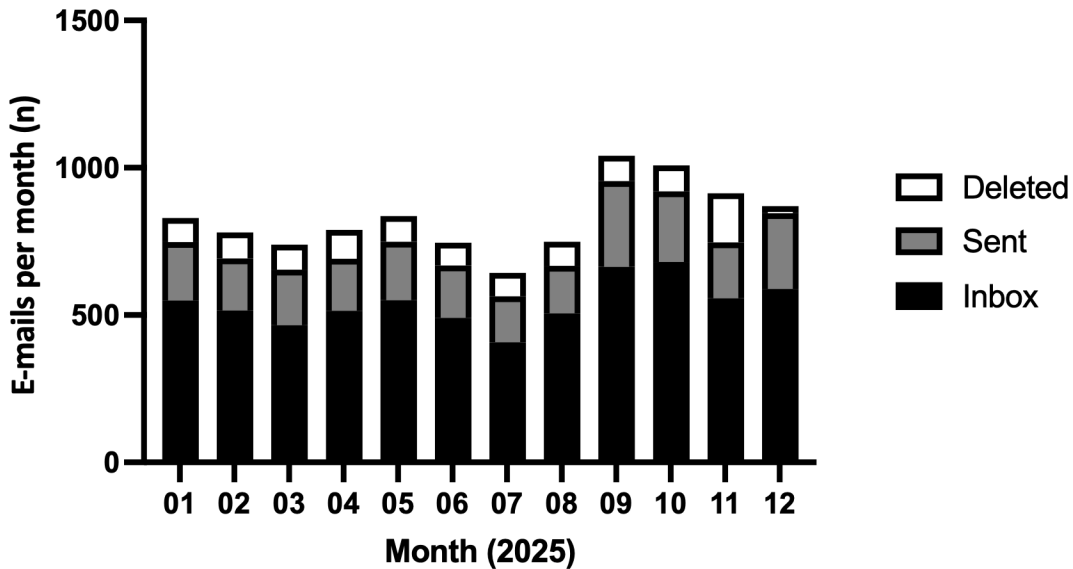
Figure 4. Annual e-mail volume in the analysed mailbox, 2023–2026, by stream (Inbox, Sent, Deleted; 2026 extrapolated from the first six months).

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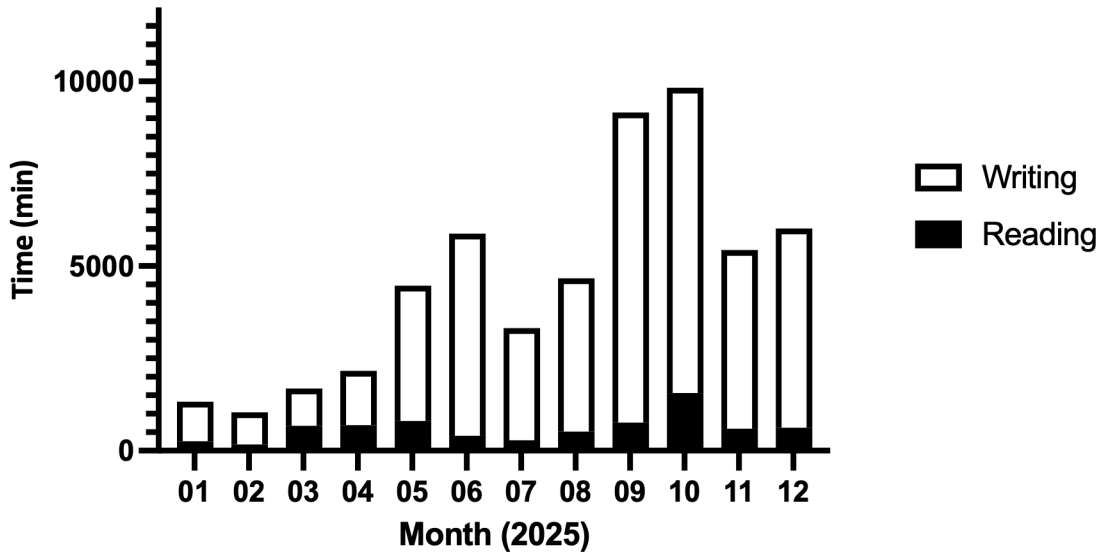
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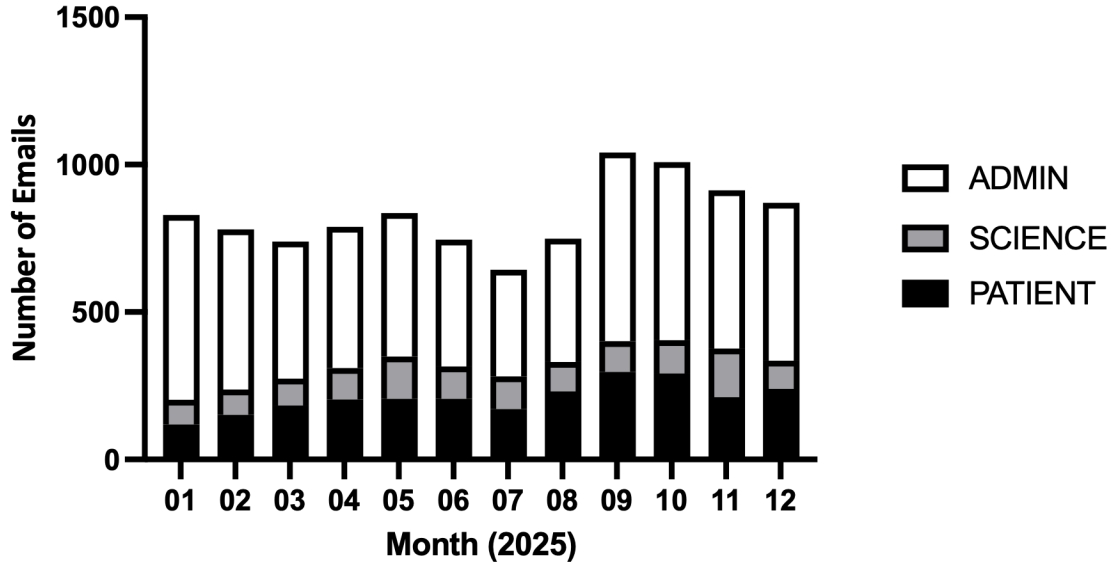
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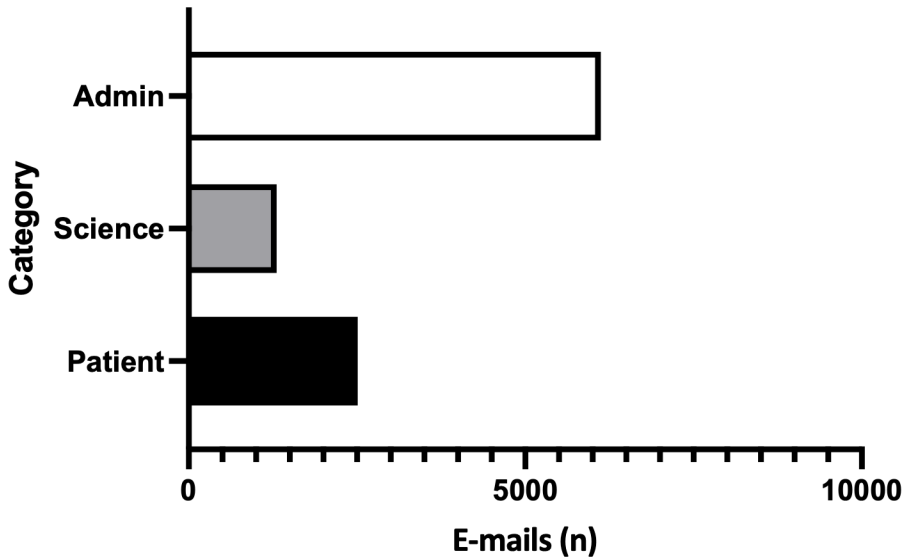
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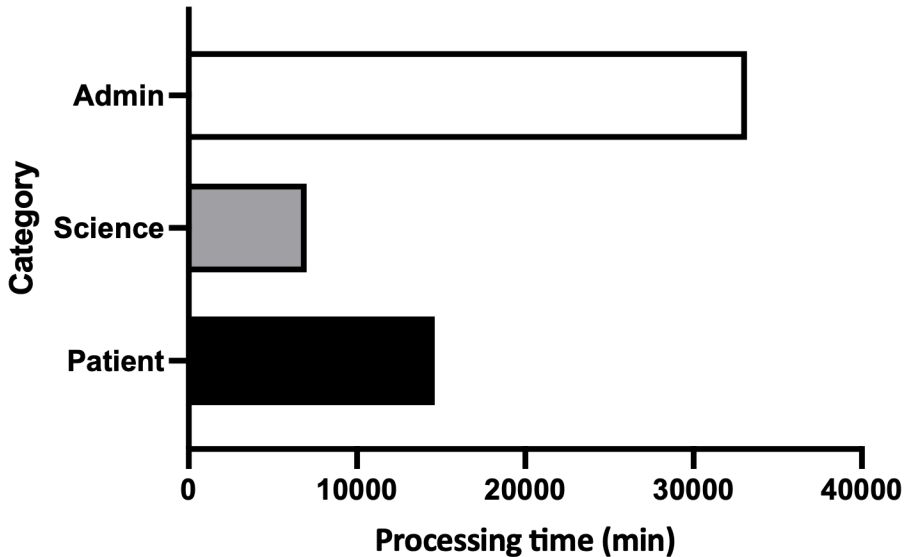
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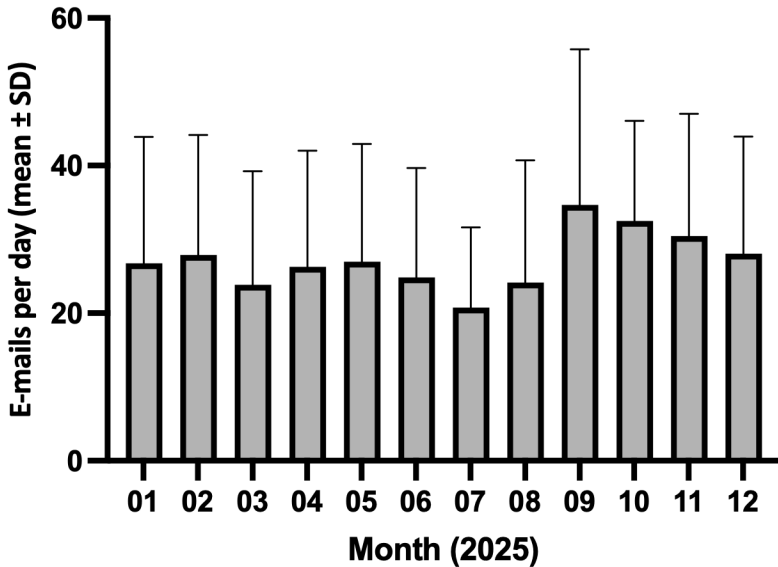
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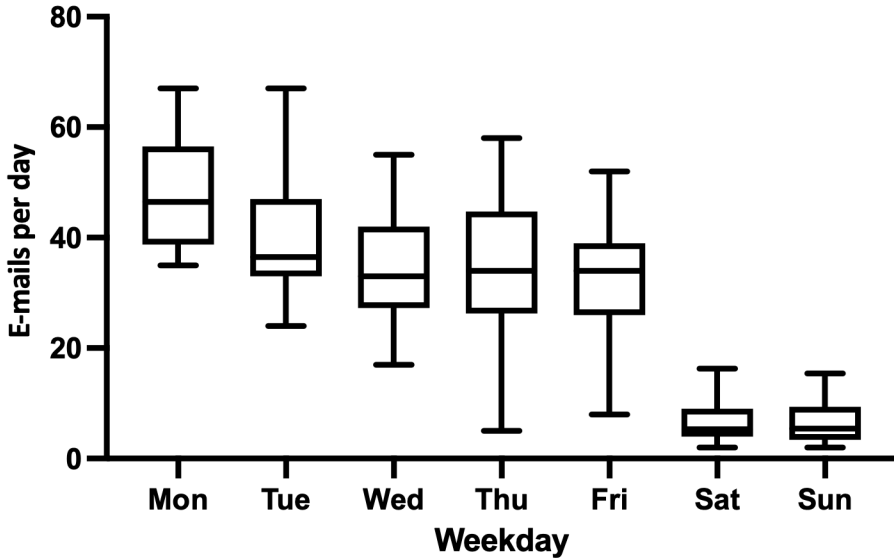
Annual time by category



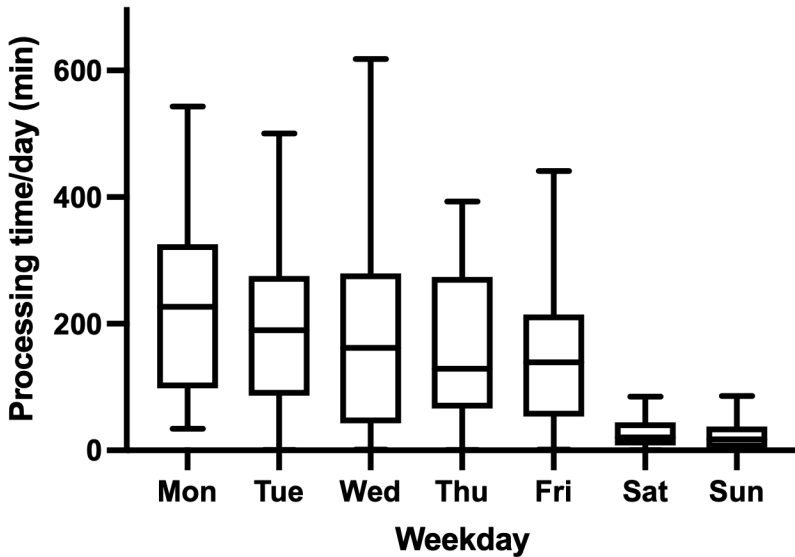
Daily E-mail intensity per month



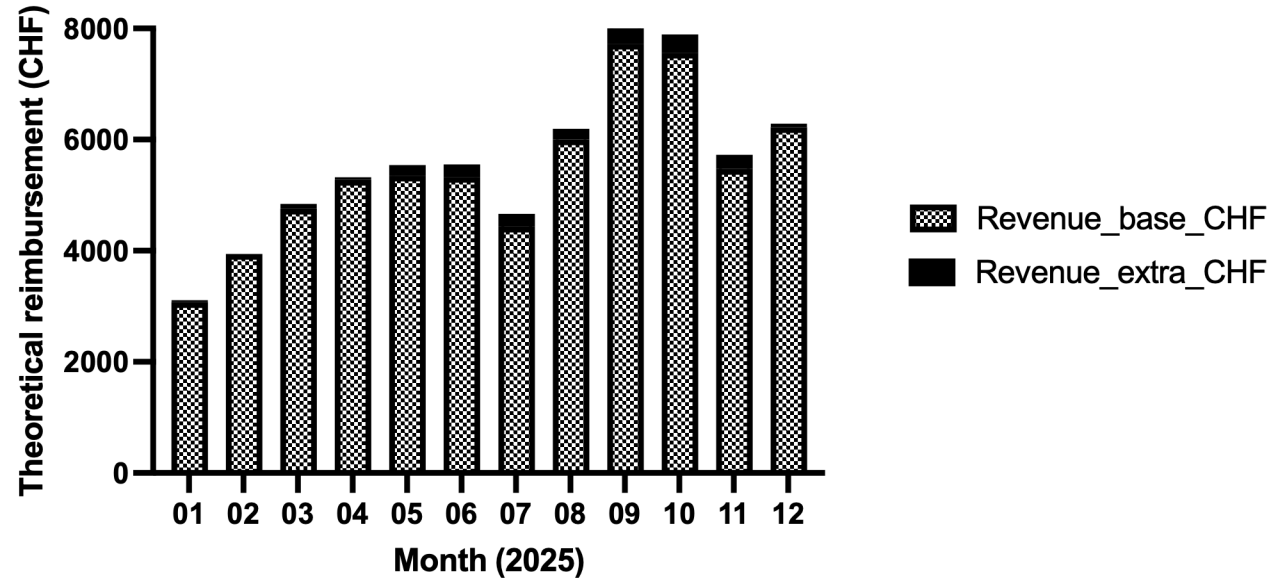
E-mails/day by weekday



Processing time/day by weekday



Reimbursement: base fee + extra minutes



E-mail volume per year

