Fluvoxamine for COVID-19: real-time meta analysis of 20 studies

@CovidAnalysis, November 2023
https://c19early.org/fmeta.html

- Statistically significant lower risk is seen for mortality, hospitalization, progression, recovery, and cases. 13 studies from 13 independent teams in 8 countries show statistically significant improvements.

- Meta analysis using the most serious outcome reported shows 38% [21-52%] lower risk. Results are slightly worse for Randomized Controlled Trials.

- Results are robust — in exclusion sensitivity analysis 11 of 20 studies must be excluded to avoid finding statistically significant efficacy in pooled analysis.

- 1 RCT with 1,200 patients has not reported results (1 year late).

- No treatment or intervention is 100% effective. All practical, effective, and safe means should be used based on risk/benefit analysis. Multiple treatments are typically used in combination, and other treatments may be more effective.

- All data to reproduce this paper and sources are in the appendix. Other meta analyses show significant improvements with fluvoxamine for mortality Deng, hospitalization Deng, Lee, Lu, Marcce, and severity Nakhaee.

HIGHLIGHTS

Fluvoxamine reduces risk for COVID-19 with very high confidence for pooled analysis, high confidence for mortality, hospitalization, progression, and recovery, and low confidence for cases, however increased risk is seen with very low confidence for viral clearance.

We show traditional outcome specific analyses and combined evidence from all studies, incorporating treatment delay, a primary confounding factor in COVID-19 studies.

Real-time updates and corrections, transparent analysis with all results in the same format, consistent protocol for 57 treatments.
### 20 fluvoxamine COVID-19 studies (+1 unreported RCT)

<table>
<thead>
<tr>
<th>Study Description</th>
<th>Improvement, RR [CI]</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (4d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lenz (DB RCT)</td>
<td>93% 0.07 [0.01-0.52]</td>
<td>progression</td>
<td>0/80</td>
<td>6/72</td>
</tr>
<tr>
<td>Señel (QR)</td>
<td>84% 0.16 [0.01-3.29]</td>
<td>death/CU</td>
<td>0/77</td>
<td>2/48</td>
</tr>
<tr>
<td>Reiersen (DB RCT)</td>
<td>-20% 3.01 [0.12-73.6]</td>
<td>oxygen</td>
<td>1/272</td>
<td>0/75</td>
</tr>
<tr>
<td>Seo (SB RCT)</td>
<td>0% 1.00 [0.15-6.57]</td>
<td>progression</td>
<td>2/26</td>
<td>2/26</td>
</tr>
<tr>
<td>Wangiama (RCT)</td>
<td>not reported, &gt;1 year late</td>
<td></td>
<td>1,200 (total)</td>
<td></td>
</tr>
<tr>
<td>Bramante (DB RCT)</td>
<td>-11% 1.11 [0.33-3.61]</td>
<td>death/hosp.</td>
<td>6/329</td>
<td>5/24</td>
</tr>
<tr>
<td>Pineda</td>
<td>94% 0.06 [0.01-0.52]</td>
<td>death</td>
<td>1/594</td>
<td>4/63</td>
</tr>
<tr>
<td>Farahani (DB RCT)</td>
<td>51% 0.49 [0.24-1.02]</td>
<td>PASC</td>
<td>42 (n)</td>
<td>43 (n)</td>
</tr>
<tr>
<td>Res (DB RCT)</td>
<td>-200% 3.00 [0.12-73.5]</td>
<td>death</td>
<td>1/738</td>
<td>0/738</td>
</tr>
<tr>
<td>Siripongboonsitti (RCT)</td>
<td>-2% 1.02 [0.26-4.00]</td>
<td>oxygen</td>
<td>4/162</td>
<td>4/165</td>
</tr>
<tr>
<td>Tsiakalos</td>
<td>67% 0.33 [0.01-7.84]</td>
<td>ICU</td>
<td>0/53</td>
<td>1/50</td>
</tr>
<tr>
<td>Siripongboonsitti (RCT)</td>
<td>59% 0.41 [0.02-9.98]</td>
<td>death</td>
<td>0/234</td>
<td>1/518</td>
</tr>
<tr>
<td>Late treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oskotsky (PSM)</td>
<td>-58% 1.58 [0.42-6.93]</td>
<td>death</td>
<td>2/11</td>
<td>19/166</td>
</tr>
<tr>
<td>Fritz</td>
<td>19% 0.81 [0.26-2.22]</td>
<td>hosp./ER</td>
<td>4/17</td>
<td>18/607</td>
</tr>
<tr>
<td>Diaz (PSM)</td>
<td>28% 0.72 [0.26-0.81]</td>
<td>cases</td>
<td>4,558 (n)</td>
<td>4,558 (n)</td>
</tr>
<tr>
<td>Trijulja (PSM)</td>
<td>27% 0.73 [0.35-1.55]</td>
<td>death</td>
<td>29/94</td>
<td>128/222</td>
</tr>
<tr>
<td>Viskas-Varela</td>
<td>-103% 2.03 [0.24-17.4]</td>
<td>death</td>
<td>case control</td>
<td>n/a</td>
</tr>
<tr>
<td>Late treatment</td>
<td>48% 0.52 [0.35-0.77]</td>
<td></td>
<td>90/1,475</td>
<td>211/1,615</td>
</tr>
</tbody>
</table>

**Prophylaxis**

- **Oskotsky (PSM)**: -58% 1.58 [0.42-6.93] death
- **Diaz (PSM)**: 28% 0.72 [0.26-0.81] cases
- **Trijulja (PSM)**: 27% 0.73 [0.35-1.55] death

**All studies**

- **Prophylaxis**: 27% 0.73 [0.65-0.82]
- **Early treatment**: 43% 0.57 [0.32-1.02]
- **Late treatment**: 48% 0.52 [0.35-0.77]

**Effect extraction prespecified**

- **Most serious outcome**: see appendix

**Favors fluvoxamine**

- **Prophylaxis**: 27% lower risk
- **Early treatment**: 43% lower risk
- **Late treatment**: 48% lower risk
- **All studies**: 38% lower risk

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**Efficacy in COVID-19 fluvoxamine studies (pooled effects)**

- **Prophylaxis**
- **Early treatment**
- **Late treatment**
- **All studies**

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**Effect extraction prespecified (most serious outcome, see appendix)**

- **Favors fluvoxamine**
- **Favors control**
Figure 1. A. Random effects meta-analysis. This plot shows pooled effects, see the specific outcome analyses for individual outcomes, and the heterogeneity section for discussion. Effect extraction is pre-specified, using the most serious outcome reported. For details of effect extraction see the appendix. B. Scatter plot showing the most serious outcome in all studies, and for studies within each stage. Diamonds shows the results of random effects meta-analysis. C. Results within the context of multiple COVID-19 treatments. 0.7% of 5,722 proposed treatments show efficacy. D. Timeline of results in fluvoxamine studies. The marked dates indicate the time when efficacy was known with a statistically significant improvement of ≥10% from ≥3 studies for pooled outcomes, one or more specific outcome, and pooled outcomes in RCTs. Efficacy based on RCTs only was delayed by 16.9 months, compared to using all studies.
Introduction

We analyze all significant studies concerning the use of fluvoxamine for COVID-19. Search methods, inclusion criteria, effect extraction criteria (more serious outcomes have priority), all individual study data, PRISMA answers, and statistical methods are detailed in Appendix 1. We present random effects meta-analysis results for all studies, studies within each treatment stage, individual outcomes, and Randomized Controlled Trials (RCTs).

Figure 2 shows stages of possible treatment for COVID-19. Prophylaxis refers to regularly taking medication before becoming sick, in order to prevent or minimize infection. Early Treatment refers to treatment immediately or soon after symptoms appear, while Late Treatment refers to more delayed treatment.

Mechanisms of Action

Table 1 shows potential mechanisms of action for the treatment of COVID-19 using fluvoxamine.
Fluvoxamine is a functional inhibitor of acid sphingomyelinase (FIASMA). SARS-CoV-2 activates the ASM/ceramide system which may facilitate viral entry. ASM inhibition may reduce the concentration of ceramides and inhibit viral entry. Carpinteiro, Carpinteiro (B), Hashimoto, Hoertel.

**Sigma-1 activation**
Fluvoxamine may reduce clinical deterioration via σ-1 (S1R) receptor activation, which regulates cytokine production. Hashimoto, Hashimoto (B), Sukhatme.

**Platelet activation**
Platelet activation may contribute to COVID-19 severity. Fluvoxamine inhibits platelet activation. Battinelli, Sukhatme.

**Lysosomal trafficking**
SARS-CoV-2 uses lysosomal trafficking to escape from infected cells. Fluvoxamine is lysosomotropic and interferes with endolysosomal viral trafficking. Hashimoto, Norinder, Sukhatme.

**Heme oxygenase**
COVID-19 risk may be related to low intracellular heme oxygenase (HO-1). Fluvoxamine increases HO-1 and HO-1 has cytoprotective and anti-inflammatory properties. Almási, Hooper, Hooper (B).

**Mast cell degranulation**
Fluvoxamine may reduce cytokine storm due to decreased mast cell degranulation. Sukhatme.

**Melatonin**
Melatonin may be beneficial for COVID-19, and fluvoxamine may elevate melatonin levels via CYP1A2 and CYP2C19 inhibition. Anderson, Camp, Hashimoto, Ramos, Sukhatme.

**Table 1.** Fluvoxamine mechanisms of action. Submit updates.

### Preclinical Research

An *In Silico* study supports the efficacy of fluvoxamine Abatematteo.

An *In Vitro* study supports the efficacy of fluvoxamine Abatematteo.

Preclinical research is an important part of the development of treatments, however results may be very different in clinical trials. Preclinical results are not used in this paper.

### Results

Table 2 summarizes the results for all stages combined, after exclusions, and for specific outcomes. Table 3 shows results by treatment stage. Figure 3, 4, 5, 6, 7, 8, 9, 10, and 11 show forest plots for random effects meta-analysis of all studies with pooled effects, mortality results, ventilation, ICU admission, hospitalization, progression, recovery, cases, and viral clearance.
<table>
<thead>
<tr>
<th>Improvement</th>
<th>Studies</th>
<th>Patients</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>All studies</td>
<td>38% [21-52%] ***</td>
<td>20</td>
<td>37,785</td>
</tr>
<tr>
<td>Randomized Controlled Trials</td>
<td>31% [2-50%] *</td>
<td>9</td>
<td>5,964</td>
</tr>
<tr>
<td>Mortality</td>
<td>43% [12-62%] *</td>
<td>9</td>
<td>4,976</td>
</tr>
<tr>
<td>Ventilation</td>
<td>18% [-32-50%]</td>
<td>2</td>
<td>2,249</td>
</tr>
<tr>
<td>ICU admission</td>
<td>-10% [-326-72%]</td>
<td>3</td>
<td>855</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>26% [4-42%] *</td>
<td>12</td>
<td>6,712</td>
</tr>
<tr>
<td>Recovery</td>
<td>49% [7-72%] *</td>
<td>4</td>
<td>2,368</td>
</tr>
<tr>
<td>Cases</td>
<td>27% [18-35%] ****</td>
<td>2</td>
<td>9,116</td>
</tr>
<tr>
<td>Viral</td>
<td>-25% [-78-13%]</td>
<td>2</td>
<td>1,003</td>
</tr>
<tr>
<td>RCT mortality</td>
<td>27% [-33-60%]</td>
<td>2</td>
<td>2,973</td>
</tr>
<tr>
<td>RCT hospitalization</td>
<td>20% [-3-37%]</td>
<td>7</td>
<td>5,827</td>
</tr>
</tbody>
</table>

**Table 2.** Random effects meta-analysis for all stages combined, after exclusions, and for specific outcomes. Results show the percentage improvement with treatment and the 95% confidence interval. *p<0.05  **p<0.01  ****p<0.0001.

<table>
<thead>
<tr>
<th>Early treatment</th>
<th>Late treatment</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>All studies</td>
<td>43% [-2-68%]</td>
<td>48% [23-65%] **</td>
</tr>
<tr>
<td>Randomized Controlled Trials</td>
<td>30% [-17-59%]</td>
<td>31% [-9-56%]</td>
</tr>
<tr>
<td>Mortality</td>
<td>67% [-236-97%]</td>
<td>51% [22-69%] **</td>
</tr>
<tr>
<td>Ventilation</td>
<td>-48% [-777-75%]</td>
<td>22% [-28-54%]</td>
</tr>
<tr>
<td>ICU admission</td>
<td>37% [-160-85%]</td>
<td>-395% [-7042-66%]</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>36% [-2-61%]</td>
<td>22% [-3-41%]</td>
</tr>
<tr>
<td>Recovery</td>
<td>88% [-446-100%]</td>
<td>45% [6-68%] *</td>
</tr>
<tr>
<td>Cases</td>
<td>27% [18-35%] ****</td>
<td></td>
</tr>
<tr>
<td>Viral</td>
<td>-4% [-19-9%]</td>
<td>-49% [-138-6%]</td>
</tr>
<tr>
<td>RCT mortality</td>
<td>-200% [-7253-88%]</td>
<td>30% [-26-63%]</td>
</tr>
<tr>
<td>RCT hospitalization</td>
<td>12% [-46-47%]</td>
<td>22% [-3-41%]</td>
</tr>
</tbody>
</table>

**Table 3.** Random effects meta-analysis results by treatment stage. Results show the percentage improvement with treatment, the 95% confidence interval, and the number of studies for the stage. *p<0.05  **p<0.01  ****p<0.0001.
Figure 3. Random effects meta-analysis for all studies with pooled effects. This plot shows pooled effects, see the specific outcome analyses for individual outcomes, and the heterogeneity section for discussion. Effect extraction is pre-specified, using the most serious outcome reported. For details of effect extraction see the appendix.
9 fluvoxamine COVID-19 mortality results

<table>
<thead>
<tr>
<th>Study</th>
<th>Improvement, RR [CI]</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (4d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineda</td>
<td>94% 0.06 [0.01-0.52]</td>
<td>1/594</td>
<td>463</td>
<td>800mg</td>
</tr>
<tr>
<td>Reis (DB RCT)</td>
<td>90% 3.03 [0.12-73.5]</td>
<td>1/738</td>
<td>0/738</td>
<td>800mg</td>
</tr>
<tr>
<td>Siriponganmoontiti</td>
<td>69% 0.41 [0.02-9.98]</td>
<td>0/234</td>
<td>1/518</td>
<td></td>
</tr>
</tbody>
</table>

**Early treatment**: 67% 0.33 [0.03-3.36] 2/1,566 5/1,319

Tau² = 2.14, I² = 50.7%, p = 0.35

**Late treatment**: 51% 0.49 [0.31-0.78] 76/886 190/1,029

Tau² = 0.19, I² = 78.4%, p = 0.0027

**Prophylaxis**: 5% 0.95 [0.51-1.76] 2/11 19/165

Tau² = 0.00, I² = 0.0%, p = 0.87

**All studies**: 43% 0.57 [0.38-0.88] 802.463 214/2,513

Favors fluvoxamine

Figure 4. Random effects meta-analysis for mortality results.

2 fluvoxamine COVID-19 mechanical ventilation results

<table>
<thead>
<tr>
<th>Study</th>
<th>Improvement, RR [CI]</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (1m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siriponganmoontiti</td>
<td>-48% 1.48 [0.25-8.77]</td>
<td>2/234</td>
<td>3/518</td>
<td></td>
</tr>
</tbody>
</table>

**Early treatment**: 48% 1.48 [0.25-8.77] 2/234 3/518

Tau² = 0.00, I² = 0.0%, p = 0.68

**Late treatment**: 22% 0.78 [0.46-1.28] 26/741 34/756

Tau² = 0.00, I² = 0.0%, p = 0.33

**All studies**: 18% 0.82 [0.50-1.32] 289/75 371/274

Favors fluvoxamine

Figure 5. Random effects meta-analysis for ventilation.
Figure 6. Random effects meta-analysis for ICU admission.

Figure 7. Random effects meta-analysis for hospitalization.
**9 fluvoxamine COVID-19 progression results**

<table>
<thead>
<tr>
<th>Study</th>
<th>Improvement, RR [CI]</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (4d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenze (DB RCT)</td>
<td>93% 0.07 [0.01-0.52]</td>
<td>06/55</td>
<td>09/78</td>
<td>1200mg</td>
</tr>
<tr>
<td>Reiersen (DB RCT)</td>
<td>89% 0.09 [0.06-1.1]</td>
<td>13/272</td>
<td>15/105</td>
<td>09/80</td>
</tr>
<tr>
<td>Sec (SB RCT)</td>
<td>0% 1.00 [0.15-6.57]</td>
<td>02/26</td>
<td>02/26</td>
<td>800mg</td>
</tr>
<tr>
<td>Bramante (DB RCT)</td>
<td>-16% 1.16 [0.58-2.25]</td>
<td>18/329</td>
<td>15/124</td>
<td>400mg</td>
</tr>
<tr>
<td>Reis (DB RCT)</td>
<td>50% 0.50 [0.25-0.92]</td>
<td>13/738</td>
<td>27/738</td>
<td>800mg</td>
</tr>
<tr>
<td>Tsiafakos</td>
<td>86% 0.14 [0.02-0.74]</td>
<td>2/53</td>
<td>8/50</td>
<td>800mg</td>
</tr>
<tr>
<td>Siripongboonsitti</td>
<td>40% 0.32 [0.10-1.05]</td>
<td>13/217</td>
<td>49/475</td>
<td></td>
</tr>
</tbody>
</table>

**Early treatment** 38% 0.62 [0.39-0.98] 61/1,715 122/1,960 38% lower risk

**Late treatment** 31% 0.69 [0.27-1.21] 14/589 21/586 31% lower risk

**Prophylaxis** 32% 0.68 [0.18-2.50] n/a n/a 32% lower risk

All studies 35% 0.65 [0.46-0.91] 752,304 143,254 35% lower risk

1 CT: comparison with other treatment
2 CT: study uses combined treatment

**Figure 8. Random effects meta-analysis for progression.**

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**4 fluvoxamine COVID-19 recovery results**

<table>
<thead>
<tr>
<th>Study</th>
<th>Improvement, RR [CI]</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (4d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seftel (QR)</td>
<td>99% 0.01 [0.00-0.21]</td>
<td>03/11</td>
<td>29/566</td>
<td>500mg</td>
</tr>
<tr>
<td>Siripongboonsitti</td>
<td>34% 0.66 [0.59-0.75]</td>
<td>234 (n)</td>
<td>518 (n)</td>
<td></td>
</tr>
</tbody>
</table>

**Early treatment** 88% 0.12 [0.00-5.46] 0/311 29/566 88% lower risk

**Late treatment** 45% 0.55 [0.32-0.94] 06/83 0/808 45% lower risk

All studies 49% 0.51 [0.28-0.93] 0/994 29/1374 49% lower risk

Figure 9. Random effects meta-analysis for recovery.
Randomized Controlled Trials (RCTs)

Figure 12 shows a comparison of results for RCTs and non-RCT studies. Figure 13, 14, and 15 show forest plots for random effects meta-analysis of all Randomized Controlled Trials, RCT mortality results, and RCT hospitalization results. RCT results are included in Table 2 and Table 3.

RCTs have many potential biases. Bias in clinical research may be defined as something that tends to make conclusions differ systematically from the truth. RCTs help to make study groups more similar and can provide a higher level of evidence, however they are subject to many biases 

Jadad, and analysis of double-blind RCTs has identified extreme levels of bias Gøtzsche. For COVID-19, the overhead may delay treatment, dramatically compromising efficacy; they may encourage monotherapy for simplicity at the cost of efficacy which may rely on combined or synergistic effects; the participants that sign up may not reflect real world usage or the population that benefits most in terms of age, comorbidities, severity of illness, or other factors; standard of care may be compromised and unable to evolve quickly based on emerging research for new diseases; errors may be made in randomization and medication delivery; and investigators may have hidden agendas or vested interests influencing design, operation, analysis, and the potential for fraud. All of these biases have been observed with COVID-19 RCTs. There is no guarantee that a specific RCT provides a higher level of evidence.

RCTs for novel acute diseases requiring rapid treatment. High quality RCTs for novel acute diseases are more challenging, with increased ethical issues due to the urgency of treatment, increased risk due to enrollment delays, and more difficult design with a rapidly evolving evidence base. For COVID-19, the most common site of initial infection is the upper respiratory tract. Immediate treatment is likely to be most successful and may prevent or slow
progression to other parts of the body. For a non-prophylaxis RCT, it makes sense to provide treatment in advance and instruct patients to use it immediately on symptoms, just as some governments have done by providing medication kits in advance. Unfortunately, no RCTs have been done in this way. Every treatment RCT to date involves delayed treatment. Among the 57 treatments we have analyzed, 64% of RCTs involve very late treatment 5+ days after onset. No non-prophylaxis COVID-19 RCTs match the potential real-world use of early treatments (they may more accurately represent results for treatments that require visiting a medical facility, e.g., those requiring intravenous administration).

**RCT bias for widely available treatments.** RCTs have a bias against finding an effect for interventions that are widely available — patients that believe they need the intervention are more likely to decline participation and take the intervention. RCTs for fluvoxamine are more likely to enroll low-risk participants that do not need treatment to recover, making the results less applicable to clinical practice. This bias is likely to be greater for widely known treatments, and may be greater when the risk of a serious outcome is overstated. This bias does not apply to the typical pharmaceutical trial of a new drug that is otherwise unavailable.

**Non-RCT studies have been shown to be reliable.** Evidence shows that non-RCT trials can also provide reliable results. Concato find that well-designed observational studies do not systematically overestimate the magnitude of the effects of treatment compared to RCTs. Anglemyer summarized reviews comparing RCTs to observational studies and found little evidence for significant differences in effect estimates. Lee (B) shows that only 14% of the guidelines of the Infectious Diseases Society of America were based on RCTs. Evaluation of studies relies on an understanding of the study and potential biases. Limitations in an RCT can outweigh the benefits, for example excessive dosages, excessive treatment delays, or Internet survey bias could have a greater effect on results. Ethical issues may also prevent running RCTs for known effective treatments. For more on issues with RCTs see Deaton, Nichol.

Using all studies identifies efficacy 5.7+ months faster for COVID-19. Currently, 39 of the treatments we analyze show statistically significant efficacy or harm, defined as ≥10% decreased risk or >0% increased risk from ≥3 studies. Of the 39 treatments with statistically significant efficacy/harm, 24 have been confirmed in RCTs, with a mean delay of 5.7 months. For the 15 unconfirmed treatments, 4 have zero RCTs to date. The point estimates for the remaining 11 are all consistent with the overall results (benefit or harm), with 9 showing >20%. The only treatments showing >10% efficacy for all studies, but <10% for RCTs are sotrovimab and aspirin.

**Summary.** We need to evaluate each trial on its own merits. RCTs for a given medication and disease may be more reliable, however they may also be less reliable. For off-patent medications, very high conflict of interest trials may be more likely to be RCTs, and more likely to be large trials that dominate meta analyses.

**Efficacy in COVID-19 fluvoxamine studies (pooled effects)**

![Figure 12. Results for RCTs and non-RCT studies.](image-url)
**Figure 13.** Random effects meta-analysis for all Randomized Controlled Trials. This plot shows pooled effects, see the specific outcome analyses for individual outcomes, and the heterogeneity section for discussion. Effect extraction is pre-specified, using the most serious outcome reported. For details of effect extraction see the appendix.

**Figure 14.** Random effects meta-analysis for RCT mortality results.
7 fluvoxamine COVID-19 RCT hospitalization results

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Treatment</th>
<th>Control</th>
<th>Dose (4d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>82%</td>
<td>0.18 [0.05-0.65]</td>
<td>hospital.</td>
<td>1/80</td>
</tr>
<tr>
<td>9%</td>
<td>0.91 [0.38-2.20]</td>
<td>hospital.</td>
<td>9/272</td>
</tr>
<tr>
<td>2%</td>
<td>0.98 [0.29-3.37]</td>
<td>hospital.</td>
<td>5/329</td>
</tr>
<tr>
<td>12%</td>
<td>0.88 [0.32-2.40]</td>
<td>hospital.</td>
<td>7/738</td>
</tr>
<tr>
<td>-2%</td>
<td>1.22 [0.38-3.93]</td>
<td>hospital.</td>
<td>6/162</td>
</tr>
</tbody>
</table>

Early treatment 12% 0.88 [0.53-1.46] 28/1,581 33/1,574

Late treatment 22% 0.78 [0.59-1.03] 76/1,330 99/1,342

All studies 20% 0.80 [0.63-1.03] 104/2,911 132/2,916

Table 4. Studies of baloxavir for influenza show that early treatment is more effective.

Figure 15. Random effects meta-analysis for RCT hospitalization results.

Unreported RCTs

1 fluvoxamine RCT has not reported results Wannigama. The trial reports total actual enrollment of 1,200 patients. The result is delayed over 1 year.

Heterogeneity

Heterogeneity in COVID-19 studies arises from many factors including:

Treatment delay. The time between infection or the onset of symptoms and treatment may critically affect how well a treatment works. For example an antiviral may be very effective when used early but may not be effective in late stage disease, and may even be harmful. Oseltamivir, for example, is generally only considered effective for influenza when used within 0-36 or 0-48 hours McLean, Treanor. Baloxavir studies for influenza also show that treatment delay is critical Ikematsu report an 86% reduction in cases for post-exposure prophylaxis, Hayden show a 33 hour reduction in the time to alleviation of symptoms for treatment within 24 hours and a reduction of 13 hours for treatment within 24-48 hours, and Kumar report only 2.5 hours improvement for inpatient treatment.

Table 4. Studies of baloxavir for influenza show that early treatment is more effective.
Figure 16 shows a mixed-effects meta-regression for efficacy as a function of treatment delay in COVID-19 studies from 57 treatments, showing that efficacy declines rapidly with treatment delay. Early treatment is critical for COVID-19.

**Patient demographics.** Details of the patient population including age and comorbidities may critically affect how well a treatment works. For example, many COVID-19 studies with relatively young low-comorbidity patients show all patients recovering quickly with or without treatment. In such cases, there is little room for an effective treatment to improve results (as in López-Medina).

**Effect measured.** Efficacy may differ significantly depending on the effect measured, for example a treatment may be very effective at reducing mortality, but less effective at minimizing cases or hospitalization. Or a treatment may have no effect on viral clearance while still being effective at reducing mortality.

**Variants.** There are many different variants of SARS-CoV-2 and efficacy may depend critically on the distribution of variants encountered by the patients in a study. For example, the Gamma variant shows significantly different characteristics Faria, Karita, Nonaka, Zavascki. Different mechanisms of action may be more or less effective depending on variants, for example the viral entry process for the omicron variant has moved towards TMPRSS2-independent fusion, suggesting that TMPRSS2 inhibitors may be less effective Peacock, Willett;

**Regimen.** Effectiveness may depend strongly on the dosage and treatment regimen.

**Other treatments.** The use of other treatments may significantly affect outcomes, including anything from supplements, other medications, or other kinds of treatment such as prone positioning.

**Medication quality.** The quality of medications may vary significantly between manufacturers and production batches, which may significantly affect efficacy and safety. Williams analyze ivermectin from 11 different sources, showing highly variable antiparasitic efficacy across different manufacturers. Xu analyze a treatment from two different manufacturers, showing 9 different impurities, with significantly different concentrations for each manufacturer.

**Pooled outcome analysis.** We present both pooled analyses and specific outcome analyses. Notably, pooled analysis often results in earlier detection of efficacy as shown in Figure 17. For many COVID-19 treatments, a reduction in mortality logically follows from a reduction in hospitalization, which follows from a reduction in symptomatic cases, etc. An antiviral tested with a low-risk population may report zero mortality in both arms, however a reduction in
severity and improved viral clearance may translate into lower mortality among a high-risk population, and including these results in pooled analysis allows faster detection of efficacy. Trials with high-risk patients may also be restricted due to ethical concerns for treatments that are known or expected to be effective.

Pooled analysis enables using more of the available information. While there is much more information available, for example dose-response relationships, the advantage of the method used here is simplicity and transparency. Note that pooled analysis could hide efficacy, for example a treatment that is beneficial for late stage patients but has no effect on viral replication or early stage disease could show no efficacy in pooled analysis if most studies only examine viral clearance. While we present pooled results, we also present individual outcome analyses, which may be more informative for specific use cases.

Pooled outcomes identify efficacy faster. Currently, 39 of the treatments we analyze show statistically significant efficacy or harm, defined as ≥10% decreased risk or >0% increased risk from ≥3 studies. 89% of treatments showing statistically significant efficacy/harm with pooled effects have been confirmed with one or more specific outcomes, with a mean delay of 3.4 months. When restricting to RCTs only, 52% of treatments showing statistically significant efficacy/harm with pooled effects have been confirmed with one or more specific outcomes, with a mean delay of 3.6 months.

**Figure 17.** The time when studies showed that treatments were effective, defined as statistically significant improvement of ≥10% from ≥3 studies. Pooled results typically show efficacy earlier than specific outcome results. Results from all studies often shows efficacy much earlier than when restricting to RCTs. Results reflect conditions as used in trials to date, these depend on the population treated, treatment delay, and treatment regimen.

**Meta analysis.** The distribution of studies will alter the outcome of a meta analysis. Consider a simplified example where everything is equal except for the treatment delay, and effectiveness decreases to zero or below with increasing delay. If there are many studies using very late treatment, the outcome may be negative, even though early treatment is very effective. This may have a greater effect than pooling different outcomes such as mortality and hospitalization. For example a treatment may have 50% efficacy for mortality but only 40% for hospitalization when used within 48 hours. However efficacy could be 0% when used late.
All meta analyses combine heterogeneous studies, varying in population, variants, and potentially all factors above, and therefore may obscure efficacy by including studies where treatment is less effective. Generally, we expect the estimated effect size from meta analysis to be less than that for the optimal case. Looking at all studies is valuable for providing an overview of all research, important to avoid cherry-picking, and informative when a positive result is found despite combining less-optimal situations. However, the resulting estimate does not apply to specific cases such as early treatment in high-risk populations. While we present results for all studies, we also present treatment time and individual outcome analyses, which may be more informative for specific use cases.

Discussion

Publication bias. Publishing is often biased towards positive results, however evidence suggests that there may be a negative bias for inexpensive treatments for COVID-19. Both negative and positive results are very important for COVID-19, media in many countries prioritizes negative results for inexpensive treatments (inverting the typical incentive for scientists that value media recognition), and there are many reports of difficulty publishing positive results. For fluvoxamine, there is currently not enough data to evaluate publication bias with high confidence.

One method to evaluate bias is to compare prospective vs. retrospective studies. Prospective studies are more likely to be published regardless of the result, while retrospective studies are more likely to exhibit bias. For example, researchers may perform preliminary analysis with minimal effort and the results may influence their decision to continue. Retrospective studies also provide more opportunities for the specifics of data extraction and adjustments to influence results.

Figure 18 shows a scatter plot of results for prospective and retrospective studies. 71% of retrospective studies report a statistically significant positive effect for one or more outcomes, compared to 62% of prospective studies, consistent with a bias toward publishing positive results. The median effect size for retrospective studies is 27% improvement, compared to 31% for prospective studies, showing similar results.

Funnel plot analysis. Funnel plots have traditionally been used for analyzing publication bias. This is invalid for COVID-19 acute treatment trials — the underlying assumptions are invalid, which we can demonstrate with a simple example. Consider a set of hypothetical perfect trials with no bias. Figure 19 plot A shows a funnel plot for a simulation of 80 perfect trials, with random group sizes, and each patient’s outcome randomly sampled (10% control event probability, and a 30% effect size for treatment). Analysis shows no asymmetry (p > 0.05). In plot B, we add a single typical variation in COVID-19 treatment trials — treatment delay. Consider that efficacy varies from 90% for treatment within 24 hours, reducing to 10% when treatment is delayed 3 days. In plot B, each trial’s treatment delay is randomly selected. Analysis now shows highly significant asymmetry, p < 0.0001, with six variants of Egger’s test all showing p < 0.05. Note that these tests fail even though treatment delay is uniformly distributed. In reality treatment delay is more complex — each trial has a different distribution of delays across patients, and the distribution across trials may be biased (e.g., late treatment trials may be more common). Similarly, many other variations in trials may produce asymmetry, including dose, administration, duration of treatment, differences in SOC, comorbidities, age, variants, and bias in design, implementation, analysis, and reporting.
Conlicts of interest. Pharmaceutical drug trials often have conlicts of interest whereby sponsors or trial staff have a financial interest in the outcome being positive. Fluvoxamine for COVID-19 lacks this because it is off-patent, has multiple manufacturers, and is very low cost. In contrast, most COVID-19 fluvoxamine trials have been run by physicians on the front lines with the primary goal of nding the best methods to save human lives and minimize the collateral damage caused by COVID-19. While pharmaceutical companies are careful to run trials under optimal conditions (for example, restricting patients to those most likely to benet, only including patients that can be treated soon after onset when necessary, and ensuring accurate dosing), not all fluvoxamine trials represent the optimal conditions for efficacy.

Limitations. Summary statistics from meta analysis necessarily lose information. As with all meta analyses, studies are heterogeneous, with differences in treatment delay, treatment regimen, patient demographics, variants, conlicts of interest, standard of care, and other factors. We provide analyses by specic outcomes and by treatment delay, and we aim to identify key characteristics in the forest plots and summaries. Results should be viewed in the context of study characteristics.

Some analyses classify treatment based on early or late administration, as done here, while others distinguish between mild, moderate, and severe cases. Viral load does not indicate degree of symptoms — for example patients may have a high viral load while being asymptomatic. With regard to treatments that have antiviral properties, timing of treatment is critical — late administration may be less helpful regardless of severity.

Details of treatment delay per patient is often not available. For example, a study may treat 90% of patients relatively early, but the events driving the outcome may come from 10% of patients treated very late. Our 5 day cuto for early treatment may be too conservative, 5 days may be too late in many cases.

Comparison across treatments is confounded by differences in the studies performed, for example dose, variants, and conlicts of interest. Trials afliated with special interests may use designs better suited to the preferred outcome.

In some cases, the most serious outcome has very few events, resulting in lower conidence results being used in pooled analysis, however the method is simpler and more transparent. This is less critical as the number of studies increases. Restriction to outcomes with sufcient power may be benefcial in pooled analysis and improve accuracy when there are few studies, however we maintain our pre-specied method to avoid any retrospective changes.

Studies show that combinations of treatments can be highly synergistic and may result in many times greater eficacy than individual treatments alone. Therefore standard of care may be critical and benefts may diminish or disappear if standard of care does not include certain

\figure

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure19}
\caption{Example funnel plot analysis for simulated perfect trials.}
\end{figure}
treatments.

This real-time analysis is constantly updated based on submissions. Accuracy benefits from widespread review and submission of updates and corrections from reviewers. Less popular treatments may receive fewer reviews.

No treatment, vaccine, or intervention is 100% available and effective for all current and future variants. Efficacy may vary significantly with different variants and within different populations. All treatments have potential side effects. Propensity to experience side effects may be predicted in advance by qualified physicians. We do not provide medical advice. Before taking any medication, consult a qualified physician who can compare all options, provide personalized advice, and provide details of risks and benefits based on individual medical history and situations.

**Notes.** 1 of the 20 studies compare against other treatments, which may reduce the effect seen. 1 of 20 studies combine treatments. The results of fluvoxamine alone may differ. 1 of 9 RCTs use combined treatment. Currently all studies are peer-reviewed. Other meta analyses show significant improvements with fluvoxamine for mortality Deng, hospitalization Deng, Lee, Lu, Marcec, and severity Nakhaee.

**Conclusion**

Fluvoxamine is an effective treatment for COVID-19. Statistically significant lower risk is seen for mortality, hospitalization, progression, recovery, and cases. 13 studies from 13 independent teams in 8 countries show statistically significant improvements. Meta analysis using the most serious outcome reported shows 38% [21-52%] lower risk. Results are slightly worse for Randomized Controlled Trials. Results are robust — in exclusion sensitivity analysis 11 of 20 studies must be excluded to avoid finding statistically significant efficacy in pooled analysis.

Other meta analyses show significant improvements with fluvoxamine for mortality Deng, hospitalization Deng, Lee, Lu, Marcec, and severity Nakhaee.

**Study Notes**

Bramante

COVID-OUT remotely operated RCT, showing no significant difference in outcomes. Results for other treatments are listed separately - metformin, ivermectin.

The “control” group includes patients receiving metformin, which is known to be beneficial for COVID-19 c19early.org (B).
Authors note that the dosage used in the trial is lower than that of other trials twitter.com.

Control arm results are very different between treatments, for example considering hospitalization/death, this was 1.0% for ivermectin vs. 2.7% for overall control, however it was 1.3% for the ivermectin-specific control. 394 control patients are shared. The rate for the non-shared 261 metformin control patients is 5%, compared to 1.3% for ivermectin control patients. The metformin arm started earlier, however it is unclear why the difference in outcomes is so large.

Results were delayed for 6 months with no explanation, with followup ending Feb 14, 2022.

Multiple outcomes are missing, for example time to recovery (where ACTIV-6 showed superiority of ivermectin).

Adherence was very low, with 77% overall reporting 70+% adherence. Numbers for 100% adherence are not provided.

Treatment was 14 days for metformin and fluvoxamine, but only 3 days for ivermectin.

Trial outcomes were changed on January 20, 2022 clinicaltrials.gov, and again on March 2, 2022 clinicaltrials.gov (B). COVIDOUT.

Medication delivery varied significantly over the trial. In this presentation vimeo.com, author indicates that delivery was initially local, later via FedEx, was much slower in August, there were delays due to team bandwidth issues, and they only realized they could use FedEx same day delivery in September.

Calusic

Calusic: Prospective PSM study of 51 COVID-19 ICU patients in Croatia and 51 matched controls, showing significantly lower mortality with treatment.

Diaz

Diaz: TriNetX PSM retrospective 82,069 OCD patients, showing lower risk of COVID-19 with fluvoxamine use.
**Farahani**

RCT 100 mild/moderate COVID-19 outpatients in Iran, showing lower post COVID symptoms 12 weeks after infection, statistically significant only for fatigue with the small sample size. All symptoms may occur for non-COVID-19 reasons, smell/taste disorder may be the most likely to be related to COVID-19 infection. Fluvoxamine 100mg daily for 10 days.

**Fritz**

Retrospective 25,034 COVID+ outpatients showing significantly lower ER/hospitalization with antidepressants and FIASMA antidepressants, and a dose-dependent response.
**Kirenga**

Prospective study of 316 hospitalized patients in Uganda, 94 receiving fluvoxamine, showing significantly lower mortality and improved recovery with treatment.

**Lenze**

RCT 152 outpatients, 80 treated with fluvoxamine showing lower progression with treatment (0 of 80 versus 6 of 72 control).

**Naggie**

Double-blind RCT 1,175 patients in the USA (August 2022 - January 2023) Lower progression ($p=0.34$) and improved recovery ($p=0.32$), not sig. Multiple major issues with trial, see notes.
**Naggie:** Late treatment low risk population RCT showing lower progression to hospitalization or urgent care/ER visits with fluvoxamine, without statistical significance.

There was no mortality and only three hospitalizations. Authors provide no details on the cause of hospitalization, but they appear to be unrelated to COVID-19. eFigure 5 shows no COVID-19 clinical progression to hospitalization (note that a hospitalization can be seen in the equivalent plot for the low dose arm), and the text indicates that the "COVID clinical progression scale simplified into a self-reported evaluation of home levels (limited vs not)".

Note that the urgent care/ER visit outcome is also likely diluted due to inclusion of all-cause events, and could be statistically significant for only COVID-19 events.

The sustained recovery outcome, which shows no difference, was a post-hoc creation used to hide efficacy for ivermectin, and is not logical for evaluating efficacy in this trial. The definition includes any minor symptom within a three day period - e.g., any minor cough, headache, body ache, or fatigue that occurs in a three day period, regardless of cause, results in the treatment being considered a failure. For example, late treatment that is effective at minimizing progression, but has no improvement in resolution of cough, would not be detected. (Authors even use the end of the three day period to further minimize efficacy).

Late treatment - median 5 days, 75% 4+ days, 25% 7+ days, up to 12 days.

Also see *Naggie (B)* for many issues with this trial, and *McCarthy* for the lower dose arm.

**Oskotsky**

![Fluvoxamine for COVID-19 Oskotsky et al. Prophylaxis](image)

Is prophylaxis with fluvoxamine beneficial for COVID-19?
PSM retrospective 7,696 patients in the USA
Study underpowered for fluvoxamine, only 11 patients

c19early.org  Oskotsky et al., JAMA Network Open, Nov 2021

**Oskotsky:** Retrospective database analysis of 83,584 patients in the USA, showing lower mortality with existing fluoxetine use in PSM analysis. There were 11 fluvoxamine patients, showing non-statistically significant higher mortality.
**Pineda**: Prospective study of 657 COVID+ outpatients in Honduras, 594 accepting fluvoxamine treatment, showing significantly lower mortality and hospitalization with treatment.

**Reiersen**: Remote RCT 547 outpatients a median of 5 days from onset, showing no significant differences with fluvoxamine. The trial was stopped early and underpowered due to low event rates. The trial does not report outcomes that may not be underpowered like time to recovery. Authors note that treatment may have been too late.
**Fluvoxamine TOGETHER EARLY TREATMENT DB RCT**

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>-20%</td>
</tr>
<tr>
<td>Hospitalization</td>
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</tr>
<tr>
<td>Hospitalization or ER &gt;6h..</td>
<td>50%</td>
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</table>

*Is early treatment with fluvoxamine + budesonide beneficial for COVID-19?*

Double-blind RCT 1,476 patients in Brazil (January - July 2022)

Lower progression with fluvoxamine + budesonide (p=0.037)

c19early.org  Reis et al., Annals of Internal Medicine, Apr 2023

**Fluvoxamine TOGETHER LATE TREATMENT DB RCT**

<table>
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<tr>
<td>Extended ER observation..</td>
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<tr>
<td>Extended ER observa.. (b)</td>
<td>31%</td>
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<tr>
<td>Extended ER observa.. (c)</td>
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<td>Viral clearance</td>
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</table>

*Is late treatment with fluvoxamine beneficial for COVID-19?*

Double-blind RCT 1,497 patients in Brazil (January - August 2021)

Fewer hosp./ER visits with fluvoxamine (p=0.0041)

c19early.org  Reis et al., The Lancet Global Health, Aug 2021

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**Reis**: Low-risk (1% hospitalization) outpatient RCT with 738 fluvoxamine + budesonide patients and 738 placebo patients, showing significantly lower hospitalization/ER visits with treatment.

The TOGETHER trial has extreme COI, impossible data, blinding failure, randomization failure, uncorrected errors, and many protocol violations. Authors do not respond to these issues and they have refused to release the data as promised. Some issues may apply only to specific arms. For more details see [Reis (B), Reis (C), Reis (D), Reis (E), Reis (F)].

**Reis (B)**: Together Trial showing significantly lower hospitalization/extended ER visits with fluvoxamine treatment. Adherence was only 73.2%. Symptom onset was unspecified or >= 4 days for 57% of patients. The schedule of study activities specifies treatment administration only one day after randomization, adding an additional day delay. Overall mortality is high for the patient population. Results may be impacted by late treatment, poor SOC, and may be specific to local variants. [science.sciencemag.org, thelancet.com]. Per-protocol analysis shows significantly improved results in this trial, however this may be subject to bias - the probability of adherence may be related to the probability of the outcome.

Regarding the combined hospitalization/extended ER observation outcome, authors have noted that at the study sites, extended medical observation was essentially equivalent to being hospitalized. “These were not standard emergency rooms but instead were COVID-19 emergency centers that were set up due to hospitals being overloaded,” Reiersen
noted in an email to The Scientist. “A stay in these centers >6 hours was an indication that the patient was receiving care equivalent to hospitalization.”

Authors state “this study is only the second study to show an important treatment benefit for a repurposed drug in the early treatment population”, however the actual number is at least 66 based on our database at the time of publication, using a conservative definition of at least 10% benefit (with statistical significance).

The total dose used is less than half of that in Lenze et al. There is an unusual amount of missing data - age is unknown for 6.5% of patients according to the sub-group analysis. Both age <=50 and >50 show better results on the primary outcome than the overall result. The number of placebo patients changed significantly between the preprint and journal version. The number of treatment patients with viral clearance results reduced significantly between the preprint and journal version. Also see twitter.com (B), NCT04727424.

Authors do not specify if the placebo looks identical to the film-coated Luvox tablets. Reportedly there is no registration of manufacturing for matching tablets by Abbott in Brazil, and no import license for identical placebo tablets abroad. This would be an additional reason for blinding failure if the placebo tablets are not identical in appearance.

For other issues with this trial see: twitter.com (C), twitter.com (D), twitter.com (E).

The TOGETHER trial has extreme COI, impossible data, blinding failure, randomization failure, uncorrected errors, and many protocol violations. Authors do not respond to these issues and they have refused to release the data as promised. Some issues may apply only to specific arms. For more details see Reis, Reis (C), Reis (D), Reis (E), Reis (F).

Seftel

<table>
<thead>
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<th>Fluvoxamine Seftel et al. EARLY TREATMENT</th>
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<tr>
<td>Death/ICU</td>
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<td>Improvement 84%</td>
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<td>Relative Risk</td>
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<tr>
<td>Hospitalization 94%</td>
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<td>Recovery 99%</td>
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Is early treatment with fluvoxamine beneficial for COVID-19?
Prospective study of 125 patients in the USA
Lower hospitalization (p=0.0026) and improved recovery (p<0.0001)

Seftel: Prospective quasi-randomized (patient choice) study with 125 outpatients, 77 treated with fluvoxamine, showing lower death/ICU admission (0 of 77 vs. 2 of 48), lower hospitalization (0 of 77 vs. 6 of 48), and faster recovery with treatment. Note that 12 treatment patients were added but are not reflected in the table in the paper (because the numbers had been previously published and the IRB did not allow updating the table).
Seo: Early terminated RCT with 52 COVID+ patients in South Korea, showing no significant difference in progression with fluvoxamine treatment. There were only 2 events in each arm, and only one event for fluvoxamine in PP analysis. The trial was terminated early because the treatment center closed. 100mg fluvoxamine bid for 10 days.

Siripongboonsitti: Retrospective 752 patients in Thailand showing mixed results with 50mg fluvoxamine bid. Authors note that trials showing benefit mostly used 100mg bid.
Siripongboonsitti

**Fluvoxamine EFFaCo EARLY TREATMENT RCT**

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</thead>
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<td>Oxygen therapy</td>
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<td></td>
</tr>
<tr>
<td>Hospitalization</td>
<td>-22%</td>
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</table>

*Is early treatment with fluvoxamine beneficial for COVID-19?*
RCT 327 patients in Thailand (June 2021 - February 2022)
Trial underpowered to detect differences

Siripongboonsitt (B): RCT 327 outpatients in Thailand, showing no significant difference with 50mg fluvoxamine bid added to favipiravir. Authors note that trials showing benefit mostly used 100mg bid.

Trkulja

**Fluvoxamine for COVID-19 Trkulja et al. Prophylaxis**

<table>
<thead>
<tr>
<th></th>
<th>Improvement</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Hospitalization</td>
<td>-37%</td>
<td></td>
</tr>
</tbody>
</table>

*Is prophylaxis with fluvoxamine beneficial for COVID-19?*
PSM retrospective 32,085 patients in Croatia
Lower mortality (p=0.41) and higher hospitalization (p=0.5), not sig.

Trkulja: Retrospective COVID+ patients in Croatia, showing no significant difference in outcomes with fluvoxamine prophylaxis.

Tsiakalos

**Fluvoxamine Tsiakalos et al. EARLY TREATMENT**

<table>
<thead>
<tr>
<th></th>
<th>Improvement</th>
<th>Relative Risk</th>
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</thead>
<tbody>
<tr>
<td>ICU admission</td>
<td>67%</td>
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<tr>
<td>Hospitalization</td>
<td>84%</td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td>86%</td>
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</tbody>
</table>

*Is early treatment with fluvoxamine beneficial for COVID-19?*
Retrospective 103 patients in Greece (September - December 2021)
Lower progression with fluvoxamine (p=0.02)

Tsiakalos: Retrospective 103 outpatients in Greece, showing lower risk of progression with fluvoxamine 100mg bid for 10 days. 2 patients (4%) in the fluvoxamine group had clinical deterioration compared to 8 patients (16%) in the standard care group (p<0.05). After adjusting for confounders, fluvoxamine was associated with a lower risk of clinical
deterioration (adjusted OR 0.12, p=0.02). Fluvoxamine was also associated with improved lymphocyte count. Control patients were during Sep-Nov 2021, and treatment patients Nov-Dec 2021, introducing potential confounding by time due to changes in variants, although the change in risk during this period is expected to be relatively low.

Visos-Varela

Visos-Varela: Retrospective 86,602 patients in Spain, showing lower COVID-19 risk SSRIs citalopram and paroxetine. There were no significant difference for fluvoxamine, which few patients were taking.

Wannigama

Wannigama: 1,200 patient fluvoxamine early treatment RCT with results not reported over 1 year after completion.

Appendix 1. Methods and Data

We performed ongoing searches of PubMed, medRxiv, ClinicalTrials.gov, The Cochrane Library, Google Scholar, Collabovid, Research Square, ScienceDirect, Oxford University Press, the reference lists of other studies and meta-analyses, and submissions to the site c19early.org. Search terms were fluvoxamine, filtered for papers containing the terms COVID-19 or SARS-CoV-2. Automated searches are performed every few hours with notification of new matches. All studies regarding the use of fluvoxamine for COVID-19 that report a comparison with a control group are included in the main analysis. This is a living analysis and is updated regularly.

Visos-Varela et al. Prophylaxis

<table>
<thead>
<tr>
<th></th>
<th>Improvement</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>-103%</td>
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</tr>
<tr>
<td>ICU admission</td>
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<tr>
<td>Hospitalization</td>
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</tr>
<tr>
<td>Progression</td>
<td>32%</td>
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</tr>
<tr>
<td>Case</td>
<td>12%</td>
<td></td>
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</table>

Is prophylaxis with fluvoxamine beneficial for COVID-19?
Retrospective 86,602 patients in Spain
Higher mortality (p=0.52) and ICU admission (p=0.24), not sig.

c19early.org Visos-Varela et al., European Neuropsych., Apr 2023

Zhang

Favors fluvoxamine
Favors control
more serious outcome when the adjustments significantly alter results. When needed, conversion between reported p-
values and confidence intervals followed Altman, Altman (B), and Fisher's exact test was used to calculate p-values for
event data. If continuity correction for zero values is required, we use the reciprocal of the opposite arm with the sum
of the correction factors equal to 1 Sweeting. Results are expressed with RR < 1.0 favoring treatment, and using the risk
of a negative outcome when applicable (for example, the risk of death rather than the risk of survival). If studies only
report relative continuous values such as relative times, the ratio of the time for the treatment group versus the time
for the control group is used. Calculations are done in Python (3.11.6) with scipy (1.11.3), pythonmeta (1.26), numpy
(1.26.1), statsmodels (0.14.0), and plotly (5.17.0).

Forest plots are computed using PythonMeta Deng (B) with the DerSimonian and Laird random effects model (the fixed
effect assumption is not plausible in this case) and inverse variance weighting. Mixed-effects meta-regression results
are computed with R (4.1.2) using the metafor (3.0-2) and rms (6.2-0) packages, and using the most serious
sufficiently powered outcome.

We received no funding, this research is done in our spare time. We have no affiliations with any pharmaceutical
companies or political parties.

We have classified studies as early treatment if most patients are not already at a severe stage at the time of treatment
(for example based on oxygen status or lung involvement), and treatment started within 5 days of the onset of
symptoms. If studies contain a mix of early treatment and late treatment patients, we consider the treatment time of
patients contributing most to the events (for example, consider a study where most patients are treated early but late
treatment patients are included, and all mortality events were observed with late treatment patients). We note that a
shorter time may be preferable. Antivirals are typically only considered effective when used within a shorter timeframe,
for example 0-36 or 0-48 hours for oseltamivir, with longer delays not being effective McLean, Treanor.

A summary of study results is below. Please submit updates and corrections at https://c19early.org/fmeta.html.

**Early treatment**

Effect extraction follows pre-specified rules as detailed above and gives priority to more serious outcomes. For pooled
analyses, the first (most serious) outcome is used, which may differ from the effect a paper focuses on. Other
outcomes are used in outcome specific analyses.

<table>
<thead>
<tr>
<th>Bramante, 8/18/2022, Double Blind Randomized Controlled Trial, placebo-controlled, USA, peer-reviewed, 3 authors, average treatment delay 5.0 days, this trial compares with another treatment - results may be better when compared to placebo, trial NCT04510194 (history) (COVID-OUT).</th>
<th>risk of death/hospitalization, 10.8% higher, RR 1.11, p = 0.88, treatment 6 of 329 (1.8%), control 5 of 324 (1.5%), odds ratio converted to relative risk.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>risk of progression, 16.1% higher, RR 1.16, p = 0.68, treatment 18 of 329 (5.5%), control 15 of 324 (4.6%), odds ratio converted to relative risk, combined ER, hospitalization, death.</td>
</tr>
<tr>
<td></td>
<td>risk of hospitalization, 1.5% lower, RR 0.98, p = 1.00, treatment 5 of 329 (1.5%), control 5 of 324 (1.5%), NNT 4264, Figure S8, day 28.</td>
</tr>
<tr>
<td></td>
<td>risk of hospitalization, 1.5% lower, RR 0.98, p = 1.00, treatment 5 of 329 (1.5%), control 5 of 324 (1.5%), NNT 4264, Figure S7, day 14.</td>
</tr>
<tr>
<td></td>
<td>risk of progression, 4.6% lower, RR 0.95, p = 0.75, treatment 79 of 329 (24.0%), control 80 of 321 (24.9%), NNT 110, odds ratio converted to relative risk, combined hypoxemia, ER, hospitalization, death, primary outcome.</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td><strong>Farahani, 3/31/2023</strong>&lt;br&gt;Double Blind Randomized Controlled Trial, placebo-controlled, Iran, peer-reviewed, mean age 38.5, 3 authors, study period March 2022 - June 2022.</td>
<td></td>
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<tr>
<td><strong>Lenze, 11/12/2020</strong>&lt;br&gt;Double Blind Randomized Controlled Trial, USA, peer-reviewed, 11 authors, study period 10 April, 2020 - 5 August, 2020, average treatment delay 4.0 days, trial NCT04342663 (history) (STOP COVID).</td>
<td></td>
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<tr>
<td><strong>Pineda, 10/4/2022</strong>&lt;br&gt;Prospective, Honduras, peer-reviewed, mean age 48.1, 24 authors, study period November 2020 - January 2022.</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Intervention</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td><strong>Risk of Oxygen Therapy</strong>&lt;br&gt;Reisersen, 8/20/2021, Double Blind Randomized Controlled Trial, USA, peer-reviewed, median age 47.0 (treatment) 48.0 (control), 24 authors, study period 22 December, 2020 - 21 May, 2021, average treatment delay 5.0 days, trial NCT04668950 (history) (STOP COVID 2.)&lt;br&gt;Reis, 4/17/2023, Double Blind Randomized Controlled Trial, placebo-controlled, Brazil, peer-reviewed, 35 authors, study period 15 January, 2022 - 6 July, 2022, average treatment delay 3.0 days, this trial uses multiple treatments in the treatment arm (combined with budesonide) - results of individual treatments may vary, trial NCT04727424 (history) (TOGETHER).&lt;br&gt;Seftel, 2/1/2021, prospective quasi-randomized (patient choice), USA, peer-reviewed, 2 authors.</td>
<td>73.0% lower, RR 0.27, p &lt; 0.001, treatment 15 of 594 (2.5%), control 13 of 63 (20.6%), NNT 5.5, adjusted per study.</td>
</tr>
<tr>
<td><strong>Risk of Hospitalization</strong>&lt;br&gt;Reisersen, 8/20/2021, Double Blind Randomized Controlled Trial, USA, peer-reviewed, median age 47.0 (treatment) 48.0 (control), 24 authors, study period 22 December, 2020 - 21 May, 2021, average treatment delay 5.0 days, trial NCT04668950 (history) (STOP COVID 2.)&lt;br&gt;Reis, 4/17/2023, Double Blind Randomized Controlled Trial, placebo-controlled, Brazil, peer-reviewed, 35 authors, study period 15 January, 2022 - 6 July, 2022, average treatment delay 3.0 days, this trial uses multiple treatments in the treatment arm (combined with budesonide) - results of individual treatments may vary, trial NCT04727424 (history) (TOGETHER).&lt;br&gt;Seftel, 2/1/2021, prospective quasi-randomized (patient choice), USA, peer-reviewed, 2 authors.</td>
<td>51.0% lower, RR 0.49, p = 0.04, treatment 23 of 594 (3.9%), control 11 of 63 (17.5%), NNT 7.4, adjusted per study.</td>
</tr>
<tr>
<td><strong>Seo</strong>, 3/3/2022, Single Blind Randomized Controlled Trial, placebo-controlled, South Korea, peer-reviewed, median age 53.5, 14 authors, study period 15 January, 2021 - 19 February, 2021.</td>
<td>risk of progression, no change, RR 1.00, ( p = 1.00 ), treatment 2 of 26 (7.7%), control 2 of 26 (7.7%).</td>
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</tr>
<tr>
<td></td>
<td>risk of progression, 34.2% lower, RR 0.66, ( p = 1.00 ), treatment 1 of 19 (5.3%), control 2 of 25 (8.0%), NNT 37, PP.</td>
</tr>
<tr>
<td></td>
<td>time to progression, 13.3% lower, relative time 0.87, ( p = 0.16 ), treatment mean 6.5 (±0.7) n=26, control mean 7.5 (±3.5) n=26.</td>
</tr>
<tr>
<td><strong>Siripongboonsitti</strong>, 10/6/2023, retrospective, Thailand, peer-reviewed, 4 authors, study period 16 April, 2021 - 24 July, 2021, trial TCTR20230401001 (Fluvoxa).</td>
<td>risk of death, 59.2% lower, RR 0.41, ( p = 1.00 ), treatment 0 of 234 (0.0%), control 1 of 518 (0.2%), NNT 518, relative risk is not 0 because of continuity correction due to zero events (with reciprocal of the contrasting arm), day 28.</td>
</tr>
<tr>
<td></td>
<td>risk of mechanical ventilation, 47.6% higher, RR 1.48, ( p = 0.65 ), treatment 2 of 234 (0.9%), control 3 of 518 (0.6%).</td>
</tr>
<tr>
<td></td>
<td>risk of ICU admission, 26.2% lower, RR 0.74, ( p = 1.00 ), treatment 2 of 234 (0.9%), control 6 of 518 (1.2%), NNT 329.</td>
</tr>
<tr>
<td></td>
<td>risk of oxygen therapy, 67.3% higher, RR 1.67, ( p = 0.02 ), treatment 34 of 234 (14.5%), control 45 of 518 (8.7%).</td>
</tr>
<tr>
<td></td>
<td>risk of deterioration, 41.9% lower, RR 0.58, ( p = 0.08 ), treatment 13 of 217 (6.0%), control 49 of 475 (10.3%), NNT 24, day 14.</td>
</tr>
<tr>
<td></td>
<td>risk of deterioration, 35.0% lower, RR 0.65, ( p = 0.047 ), treatment 23 of 166 (13.9%), control 88 of 413 (21.3%), NNT 12, day 5.</td>
</tr>
<tr>
<td></td>
<td>risk of deterioration, 32.9% lower, RR 0.67, ( p = 0.004 ), treatment 51 of 217 (23.5%), control 132 of 377 (35.0%), NNT 31, day 2.</td>
</tr>
<tr>
<td></td>
<td>risk of progression, 47.6% higher, RR 1.48, ( p = 0.65 ), treatment 2 of 234 (0.9%), control 3 of 518 (0.6%), ARDS.</td>
</tr>
<tr>
<td></td>
<td>WHO-CPS, 33.6% lower, RR 0.66, ( p &lt; 0.001 ), treatment mean 0.73 (±0.67) n=234, control mean 1.1 (±0.75) n=518, WHO-CPS score, day 14.</td>
</tr>
<tr>
<td></td>
<td>WHO-CPS, 7.9% higher, RR 1.08, ( p = 0.06 ), treatment mean 2.06 (±1.07) n=234, control mean 1.91 (±0.98) n=518, WHO-CPS score, day 5.</td>
</tr>
<tr>
<td></td>
<td>WHO-CPS, 3.3% higher, RR 1.03, ( p = 0.34 ), treatment mean 0.21 (±1.25) n=234, control mean 0.24 (±1.06) n=518, WHO-CPS score, day 2.</td>
</tr>
<tr>
<td></td>
<td>risk of no viral clearance, 3.6% higher, RR 1.04, ( p = 0.66 ), treatment 130 of 210 (61.9%), control 218 of 365 (59.7%), day 14.</td>
</tr>
<tr>
<td><strong>Siripongboonsitti (B)</strong>, 6/29/2023, Randomized Controlled Trial, Thailand, peer-reviewed, 9 authors, study period 26 June, 2021 - 22 February, 2022, EFFaCo trial.</td>
<td>risk of oxygen therapy, 1.9% higher, RR 1.02, ( p = 1.00 ), treatment 4 of 162 (2.5%), control 4 of 165 (2.4%).</td>
</tr>
<tr>
<td></td>
<td>risk of hospitalization, 22.2% higher, RR 1.22, ( p = 0.77 ), treatment 6 of 162 (3.7%), control 5 of 165 (3.0%), day 28.</td>
</tr>
</tbody>
</table>
Late treatment

Effect extraction follows pre-specified rules as detailed above and gives priority to more serious outcomes. For pooled analyses, the first (most serious) outcome is used, which may differ from the effect a paper focuses on. Other outcomes are used in outcome specific analyses.

**Tsiakalos, 8/12/2023,** retrospective, Greece, peer-reviewed, 5 authors, study period 1 September, 2021 - 31 December, 2021.

- **Risk of ICU admission,** 67.3% lower, RR 0.33, p = 0.49, treatment 0 of 53 (0.0%), control 1 of 50 (2.0%), NNT 50, relative risk is not 0 because of continuity correction due to zero events (with reciprocal of the contrasting arm).

- **Risk of hospitalization,** 84.3% lower, RR 0.16, p = 0.06, treatment 0 of 53 (0.0%), control 1 of 50 (2.0%), NNT 9.9.

- **Risk of progression,** 86.0% lower, RR 0.14, p = 0.02, treatment 2 of 53 (3.8%), control 8 of 50 (16.0%), NNT 8.2, adjusted per study, odds ratio converted to relative risk, multivariable.

**Wannigama, 6/21/2022,** Randomized Controlled Trial, Thailand, trial NCT05087381 (history).

- 1,200 patient RCT with results missing over 1 year.

**Calusic, 11/1/2021,** prospective, propensity score matching, Croatia, peer-reviewed, 7 authors, study period 1 April, 2021 - 31 May, 2021.

- **Risk of death,** 42.0% lower, HR 0.58, p = 0.03, treatment 30 of 51 (58.8%), control 39 of 51 (76.5%), NNT 5.7, adjusted per study, propensity score matching.

**Kirenga, 3/3/2023,** prospective, Uganda, peer-reviewed, 19 authors, study period December 2021 - February 2022.

- **Risk of death,** 68.0% lower, HR 0.32, p < 0.001, treatment 29 of 94 (30.9%), control 126 of 222 (56.8%), NNT 3.9, adjusted for unbalanced covariates, propensity score weighting, Cox proportional hazards.

- **Symptom resolution,** 53.1% lower, HR 0.47, p = 0.04, treatment 94, control 222, inverted to make HR<1 favor treatment, propensity score weighting, Cox proportional hazards, RR approximated with OR.

**Naggie, 9/13/2023,** Double Blind Randomized Controlled Trial, placebo-controlled, USA, peer-reviewed, 243 authors, study period 5 August, 2022 - 20 January, 2023, average treatment delay 5.0 days, trial NCT04885530 (history) (ACTIV-6).

- **Risk of progression,** 31.0% lower, RR 0.69, p = 0.34, treatment 14 of 589 (2.4%), control 21 of 586 (3.6%), NNT 83, adjusted per study, urgent or emergency care visits, hospitalizations, or death.

- **Clinical progression,** 34.0% lower, OR 0.66, p = 0.32, treatment 589, control 586, mid-recovery, day 14, RR approximated with OR.

- **Clinical progression,** 15.0% higher, OR 1.15, p = 0.68, treatment 589, control 586, day 7, RR approximated with OR.

- **Clinical progression,** 6.0% lower, OR 0.94, p = 0.90, treatment 589, control 586, day 28, RR approximated with OR.

- **Risk of no recovery,** 1.0% higher, HR 1.01, p = 0.86, treatment 589, control 586, inverted to make HR<1 favor treatment, post-hoc primary outcome.
<table>
<thead>
<tr>
<th><strong>Outcome</strong></th>
<th><strong>Risk</strong></th>
<th><strong>RR</strong></th>
<th><strong>p</strong></th>
<th><strong>Treatment NNT</strong></th>
<th><strong>Control NNT</strong></th>
<th><strong>Adjustment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of hospitalization</td>
<td>49.0% lower</td>
<td>0.51</td>
<td>0.59</td>
<td>583</td>
<td>583</td>
<td>non-COVID-19 hospitalization, day 28</td>
</tr>
<tr>
<td>Risk of death</td>
<td>30.3% lower</td>
<td>0.70</td>
<td>0.24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of mechanical ventilation</td>
<td>22.2% lower</td>
<td>0.78</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of hospitalization</td>
<td>21.6% lower</td>
<td>0.78</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of hospitalization</td>
<td>32.0% lower</td>
<td>0.68</td>
<td>0.004</td>
<td>79</td>
<td>119</td>
<td>ITT, primary outcome</td>
</tr>
<tr>
<td>Risk of hospitalization</td>
<td>31.0% lower</td>
<td>0.69</td>
<td>0.006</td>
<td>78</td>
<td>115</td>
<td>mITT</td>
</tr>
<tr>
<td>Risk of hospitalization</td>
<td>66.0% lower</td>
<td>0.34</td>
<td>&lt; 0.001</td>
<td>541</td>
<td>609</td>
<td>per protocol</td>
</tr>
<tr>
<td>Risk of no viral clearance</td>
<td>49.3% higher</td>
<td>1.49</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prophylaxis**

Effect extraction follows pre-specified rules as detailed above and gives priority to more serious outcomes. For pooled analyses, the first (most serious) outcome is used, which may differ from the effect a paper focuses on. Other outcomes are used in outcome specific analyses.

<table>
<thead>
<tr>
<th><strong>Study</strong></th>
<th><strong>Outcome</strong></th>
<th><strong>Risk</strong></th>
<th><strong>RR</strong></th>
<th><strong>p</strong></th>
<th><strong>Treatment NNT</strong></th>
<th><strong>Control NNT</strong></th>
<th><strong>Adjustment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reis (B), 8/23/2021, Double Blind Randomized Controlled Trial, Brazil, peer-reviewed, 27 authors,</strong></td>
<td>Risk of death</td>
<td>30.3% lower</td>
<td>0.70</td>
<td>0.24</td>
<td>17</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>Diaz, 10/6/2022, retrospective, USA, peer-reviewed, 2 authors.</strong></td>
<td>Risk of case</td>
<td>28.0% lower</td>
<td>0.72</td>
<td>&lt; 0.001</td>
<td>4,558</td>
<td>4,558</td>
<td></td>
</tr>
<tr>
<td><strong>Fritz, 8/22/2022, retrospective, USA, peer-reviewed, 5 authors, study period 1 March, 2020 - 16 May, 2021.</strong></td>
<td>Risk of hospitalization/ER</td>
<td>19.4% lower</td>
<td>0.81</td>
<td>0.69</td>
<td>4</td>
<td>1,896</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Risk of hospitalization/ER</td>
<td>11.9% lower</td>
<td>0.88</td>
<td>0.03</td>
<td>707</td>
<td>1,896</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Date</td>
<td>Setting</td>
<td>Design</td>
<td>RR or OR</td>
<td>p-value</td>
<td>Control Group</td>
<td>Treatment Group</td>
</tr>
<tr>
<td>-------</td>
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<td>---------</td>
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<td>----------------</td>
</tr>
<tr>
<td>Oskotsky</td>
<td>11/15/2021</td>
<td>Retrospective, USA</td>
<td>Propensity score matching</td>
<td>0.88</td>
<td>0.04</td>
<td>1,896 of 20,457 (9.3%)</td>
<td>559 of 2,744 (20.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.90</td>
<td>0.04</td>
<td>1,896 of 20,457 (9.3%)</td>
<td>971 of 4,577 (21.2%)</td>
</tr>
<tr>
<td>Oskotsky</td>
<td>11/15/2021</td>
<td>Retrospective, USA</td>
<td>Propensity score matching</td>
<td>1.58</td>
<td>0.62</td>
<td>19 of 165 (11.5%)</td>
<td>2 of 11 (18.2%)</td>
</tr>
<tr>
<td>Trkulja</td>
<td>11/7/2022</td>
<td>Retrospective, Croatia</td>
<td>Propensity score matching</td>
<td>0.73</td>
<td>0.41</td>
<td>31,336</td>
<td>749</td>
</tr>
<tr>
<td>Trkulja</td>
<td>11/7/2022</td>
<td>Retrospective, Croatia</td>
<td>Propensity score matching</td>
<td>1.37</td>
<td>0.50</td>
<td>7,215 (13.3%)</td>
<td>956 of 7,215 (13.3%)</td>
</tr>
<tr>
<td>Visos-Varela</td>
<td>4/23/2023</td>
<td>Retrospective, Spain</td>
<td>Propensity score matching</td>
<td>2.03</td>
<td>0.52</td>
<td>7,408 (0.1%)</td>
<td>1 of 413 (0.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.95</td>
<td>0.24</td>
<td>4,398 (0.0%)</td>
<td>2 of 228 (0.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.60</td>
<td>0.39</td>
<td>56,785 (0.1%)</td>
<td>69 of 56,785 (0.1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.68</td>
<td>0.56</td>
<td>26,757 (0.1%)</td>
<td>25 of 26,757 (0.1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88</td>
<td>0.60</td>
<td>56,785 (0.1%)</td>
<td>69 of 56,785 (0.1%)</td>
</tr>
</tbody>
</table>

**Supplementary Data**

**Note:** The data above includes various studies comparing the effects of antidepressants on hospitalization, ER visits, death, and other outcomes. The studies used different methods and settings, with the outcomes showing mixed results.
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