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2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



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INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

PRIORITISATION OF ANTIDEPRESSANTS BASED ON RISK-BASED APPROACH OF AQUATIC ORGANISMS IN MALAYSIA

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Abstract: Numerous studies have shown the occurrence of pharmaceuticals, including antidepressants in the natural environment. This has led to further concern about their impact on non-target organisms and humans. Malaysia is one of the countries where antidepressants studies in environments are still scarce, little to none known the exposure and impacts of antidepressants studies in surface water in Malaysia. Due to the increase prevalence of mental health problem in Malaysia, the consumption of antidepressants is expected to be increase in the future. Therefore, a systematic approach is needed to identify the compounds that should be monitored in the environment. In this study, a prioritization approach was applied to 23 antidepressants compounds in Malaysia. Initially, the information on antidepressants consumption in year 2012, 2013, 2014, 2015 and 2016 were obtained from statistics report of medicines by Ministry of Health Malaysia. The studied antidepressant compounds included agomelatine, amitriptyline, bupropion, citalopram, clomipramine, desvenlafaxine, dosulepin, duloxetine, escitalopram, fluoxetine, fluvoxamine, imipramine, moclobemide, maprotiline, mianserin, mirtazapine, nortriptyline, paroxetine, sertraline, tianeptine, tranylcypromine, venlafaxine and vortioxetine. The predicted no-effect concentration (PNECs) was derived from ecotoxicological end- points and effect related to the studied antidepressant compounds. The information on fractional excretion and fractional emission of antidepressants was all obtained from previous studies to calculate Predicted Environmental Concentrations (PECs). Then, the calculated data were used to rank the antidepressant compounds in terms of risks to the environment, according to its risk quotient (PEC/PNEC). The findings of this study found that mirtazapine and sertraline were estimated to have the highest PECs in those five years. Interestingly, based on the values of risk quotient (RQ) for all antidepressant compounds, only fluoxetine and sertraline were classified to have risks to the aquatic organisms where the highest RQ recorded at 0.08 for algae, 0.22 for Daphnia and 0.06 for fish. Fluoxetine dominated the first rank as the most concern antidepressants in the aquatic environment of Malaysia. Therefore, there is a need to establish a comprehensive, nationwide monitoring program to assess the presence and trends of antidepressants in surface waters, with a focus on high-risk areas such as urban centers and locations near healthcare facilities.

Keywords: *Antidepressant, predicted no-effect concentrations (PNECs), predicted environment concentrations (PECs), risk quotient (RQ), fluoxetine, sertraline*

INTRODUCTION

Emerging pollutants (EPs) are synthetic or naturally occurring chemicals not routinely monitored in the environment but may pose risks to ecosystems and human health. Over 600 active pharmaceutical ingredients and their metabolites have been found in surface water, groundwater, and sediments (Singh et al., 2022). These compounds enter the environment through treated and untreated wastewater from households, hospitals, and industrial sources.

Among the EPs, especially antidepressants, are increasingly detected in aquatic environments due to widespread use and inadequate removal by wastewater treatment plants (WWTPs). Antidepressants such as SSRIs, SNRIs, and TCAs are commonly prescribed, with SSRIs like fluoxetine, sertraline, and citalopram being the most prevalent due to their effectiveness and minimal side effects. Antidepressants are excreted in active forms and may revert from metabolites back to parent compounds under certain conditions, contributing to environmental persistence. Research has shown that even low concentrations of antidepressants can disrupt aquatic life. For instance, fluoxetine has been found to affect fish gene expression and behaviour, while other compounds impair reproduction and predator avoidance in invertebrates and fish (Moreira et al., 2022).

In Malaysia, rising mental health issues have driven increased antidepressant use. The National Health and Morbidity Survey (NHMS) 2015 reported that 29.2% of Malaysian adults experience mental health problems, up from 10.6% in 1996. This surge correlates with higher environmental loads of antidepressants, raising concern over their ecological impact (Singh et al., 2022). Due to their environmental persistence, bioactive toxicity, and frequent occurrence in surface waters, this study seeks to prioritize antidepressant commonly used in Malaysia in order to identify those posing the highest ecological risks to aquatic ecosystems.

MATERIALS AND METHODS

The prioritization involved the integrating of various information including antidepressant usage data, fraction excretion of the compound (Fexcreta), predicted environmental concentration (PEC) and predicted no-effect concentration (PNEC). Figure 1 shows a procedure involved in this study (Budin et al., 2023).

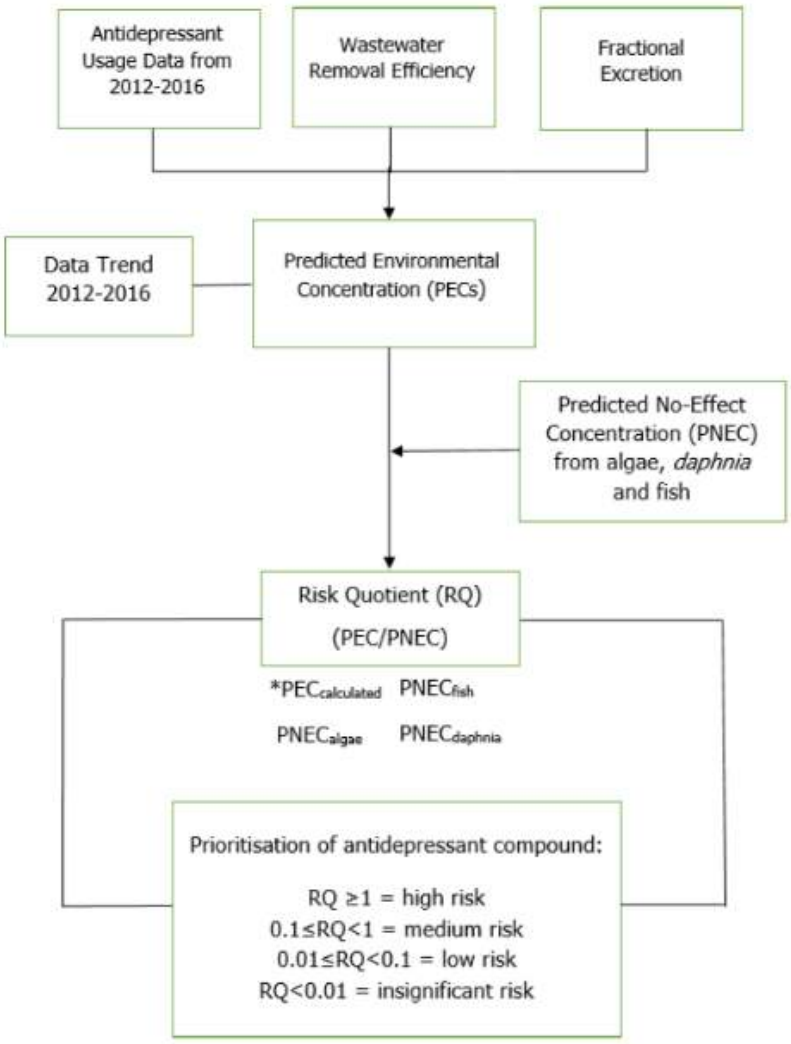


Figure 1. Flowchart diagram of this study

RESULTS AND DISCUSSIONS

The antidepressants usage patterns that were mostly consumed by Malaysian were selective serotonin reuptake inhibitors (SSRIs). Figure 2, 3 and 4 shows the consumptions, PEC values and RQ of antidepressant from year 2012 to 2016. From that figure, fluvoxamine, sertraline and venlafaxine showed the highest consumption in year 2012 until 2016.Clearly, fluvoxamine was the main antidepressants consumed in Malaysia in year 2012 (459.93kg), 2013 (417.23kg), 2014 (471.7kg), 2015 (354.67kg) and 2016 (466.812kg). Meanwhile, antidepressants with the highest PEC values were sertraline, mirtazipine and amitriptyline (Figure 3).

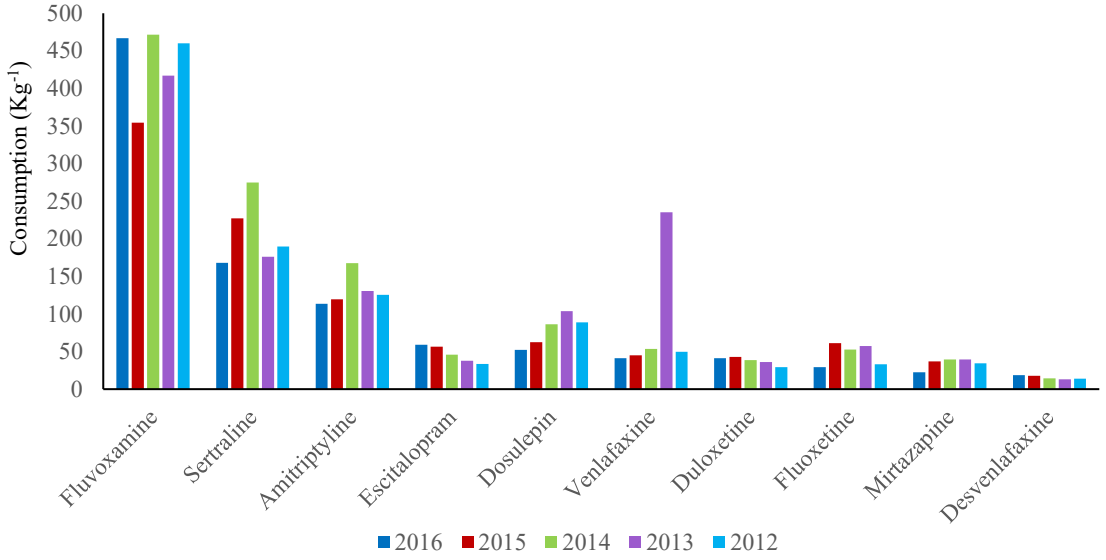


Figure 2. Top ten most consumed antidepressant from 2012 until 2016

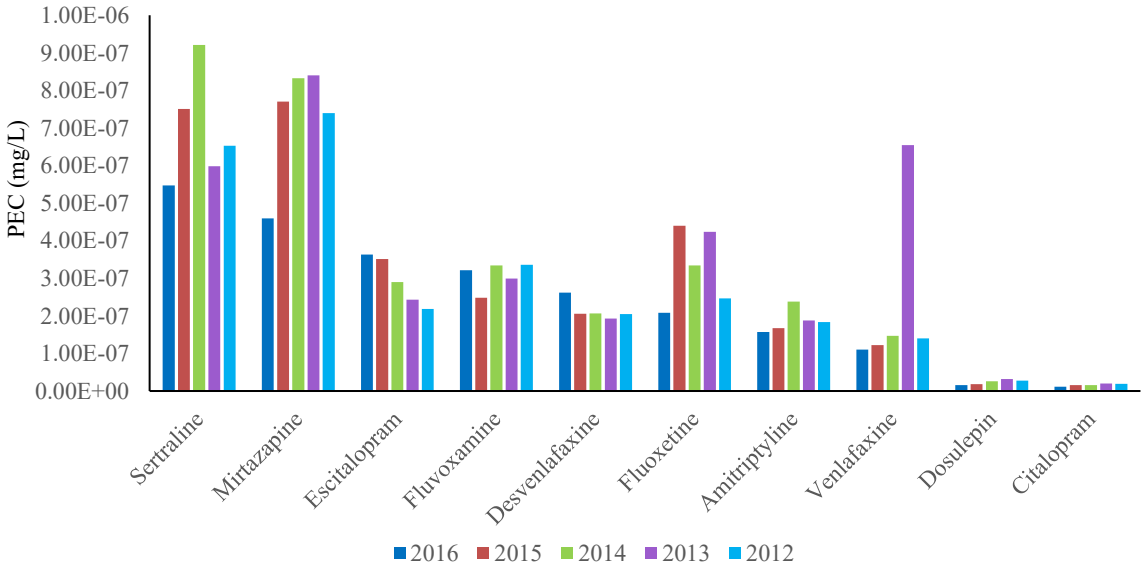


Figure 3. Top ten antidepressant with highest PECs from 2012 until 2016

The risk quotient (RQ) for all antidepressants in year 2012 until 2016 indicates that only fluoxetine and sertraline are likely to be harmful to the environment, particularly those that affect the three trophic levels which is algae, *Daphnia* and fish (Figure 4). RQ values more than o.06 were calculated for fluoxetine with low to medium risk in *Daphnia* and fish. Sertraline was identified with RQ values more than 0.02 with low risk in algae.

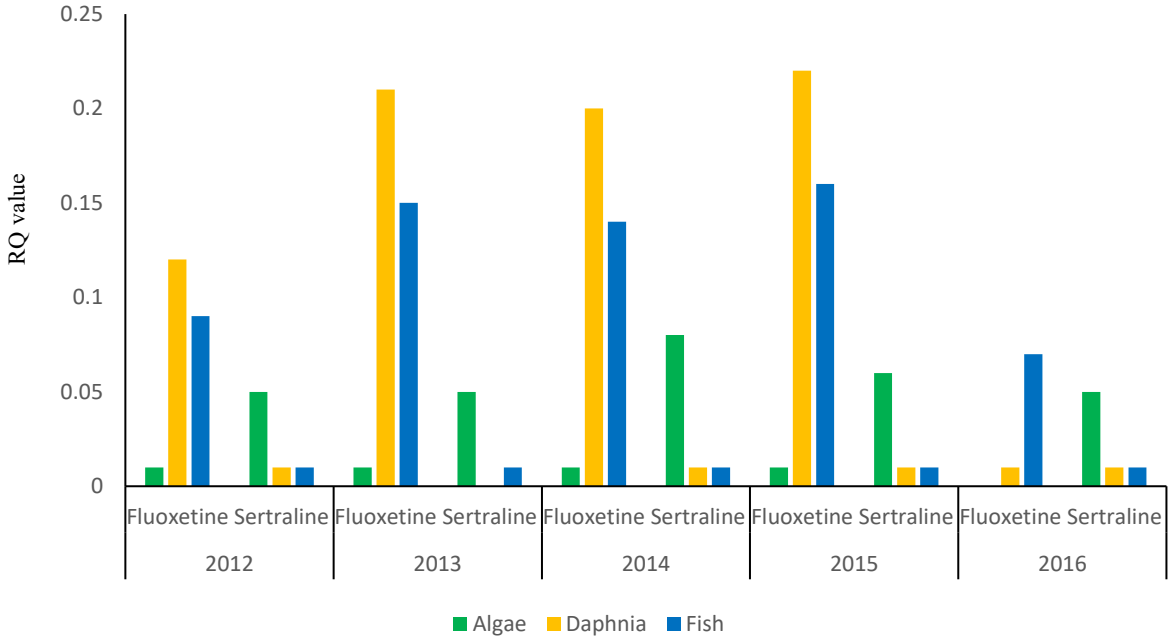


Figure 4. RQ values of Fluoxetine and Sertraline in year 2012 until 2016

This study inflicts that high consumption and concentration in the environment is not enough to prove that it will causing harmful to the ecosystem. For instance, fluvoxamine with highest consumption and mirtazapine with highest concentration in the environment did not pose a risk to aquatic environment in Malaysia as their RQ value are less than 0.01.

Whereas risk quotient for fluoxetine was higher in *Daphnia* and fish compared to algae. Target receptors or enzymes of fluoxetine that being targeted in humans have more similarity to fish and *Daphnia*. Isoenzymes such CYP3A4 that involved in fluoxetine metabolism was highly conserved in fathead minnow and zebrafish, with 92% and 94% of sequence identity respectively, to the human protein (Correia et al., 2023; McRobb et al., 2014). Coherent with Alexandre et al. (2008), fluoxetine seems to interact with growth and reproduction processes in invertebrates such as *Daphnia* and the effects can be determined at low exposure concentrations.

Sertraline can elicit effect on algae as some algal species has similar target receptors (Gangl et al., 2015). This can be assumed that target receptors for sertraline were more coherent in algae. In consistent with EU directive 93/67/EEC (EU, 2003), which classified sertraline as very toxic to algae.

CONCLUSION

Overall, from all 23 antidepressants compounds studied, only fluoxetine and sertraline were found to be the most concern antidepressant with regards to their possible toxicity on aquatic ecosystem in Malaysia. Despite low PECs was recorded by fluoxetine, it obtained the highest risk quotient in this study at a maximum of 0.22 and followed by sertraline at 0.08.

This study suggests that high environmental concentrations alone are insufficient to confirm ecological harm. Instead, assessing the potential risks of a compound is more meaningful than merely monitoring its presence. Prioritising based on RQ values serves as an effective screening tool to identify antidepressants of greatest concern for further investigation.

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Sekian, terima kasih.

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