

Unspoken Needs: Discrepancies between Medical Guidelines and Real-World Practices in Menopause Treatment

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Key words:

Menopause, Standard of Care, Mental Health, Clinical Guidelines, HRT, Hormone Replacement Therapy, Psychological, Framework, Gap

Acronyms:

CE/BZA= Bazedoxifene + Conjugated Estrogen

GP= General Practitioner (Medical)

GSM= Genitourinary Syndrome of Menopause

HPG= Hypothalamic–Pituitary–Gonadal (Axis)

HRT= Hormone Replacement Therapy

ET= Estrogen Therapy

EPT= Estrogen-Progestosterone Therapy

MH= Mental Health

MHT= Menopausal Hormonal Therapy (often interchangeable with HRT)

VMS= Vasomotor (Symptoms)

Abstract

What symptoms, characteristics, abstracts and concepts does the public commonly associate menopause with? Among the wider social network, stereotypes, and across society- moodiness, irritability, and anger are often casually referenced as key correlates of the condition known as menopause, or the time period in which women typically around age 40 experience a sudden decline in estrogen and the termination of menstrual periods. But despite this common conceptualization surrounding the condition, mental health symptoms aren't as clinically acknowledged as the other buckets of symptoms are (VMS, GSM, sleep, etc). Menopause is a systemic condition affecting multiple organ systems in the body, among which the brain is highly involved in configuring, which in turn can affect neurotransmitters and mood regulation. Therefore, mental health (MH) symptoms are directly connected to menopause, and the mood-related symptoms menopausal women experience are very real. While MH issues are also attributed to the drugs taken to relieve menopause symptoms, studies that control for medications show women experience psychiatric symptoms prior to the intake of any drugs, being 4 times as likely to develop depressive symptoms upon entering perimenopause (Freeman et Al, 2006).

While we are well aware of the interconnection between psychiatric symptoms to menopause via the drop in oestrogen hormone, the question of whether this is effectively addressed and treated remains.

This review investigates what the population of menopausal women are doing to treat their symptoms, and raises the question, are the guidelines adequately addressing the most relevant aspects of the menopausal experience? We find that there is a gap between what the guidelines are addressing versus what the population reports experiencing; although mental health took up the overwhelming majority of symptom discussions throughout the forums, descriptions of psychiatric, mood, or cognitive-related symptoms in the top clinical guidelines demonstrated great variability in acknowledgement, typically lacking detail regarding psychological symptom relief. Further, users do not demonstrate positive increasing sentiment over time, showing a high degree of stagnation in their search for symptom minimization, suggesting little improvement on the medical end to help patients find relief for their symptoms.

While the standard of care may not yet have a clear direction for treating mental health symptoms, this real-world analysis strives to inspire future clinical trials regarding psychological symptoms in menopause, which would motivate future women's health guidelines to include a clearer set of steps for treatment for mental health and other under-addressed indications as relevant characteristics of menopausal symptoms. Further, we advocate for community and organizational-based solutions, highlighting resources such as Menolearn, a website and chatbot offering symptom resolution, support, and a place to share experiences for menopausal women and concerned family members. Such resources are significant in working to inform the public, and to let menopausal women experiencing mental health symptoms know that they are not alone; that their symptoms are real and valid, and that there are countless communities with personalized experiences to share.

Introduction

Despite affecting half of the global population in the latter half of their lives, Menopause is often the subject of insufficient research within the medical community. Women's health is notorious for having mixed opinions and differing guidelines, leading to a lack of consensus on best practices that remain shrouded in mystery, even amidst rapidly medically advancing societies. Menopause, the time-period in which women typically around age 40 experience a sudden decline in estrogen and the termination of menstrual periods- as a condition has been slowly gaining greater visibility in medical research, with several major studies coming out in the early 2000s that rigorously investigated the treatment options available (Rossouw et al., 2002), (Hulley et al., 1998) . However, while great advancements into menopausal research have been made over the past few decades, the standard of care for its treatment remains inconsistent.

Harper et al (2022) conducted an online survey designed to evaluate attitudes and knowledge of Menopause in women older than 40 years. In total 3150 women started the survey and data from 947 perimenopausal women were analyzed. The results showed that more than 90% of women had never been taught about menopause at school, and more than 60% did not feel informed about it at all. Additionally, they discovered that a lack of perimenopausal education for General Practitioners (GP) was significant, and had profound effects on the women when their practitioner's approach was coloured by the perception that perimenopausal symptoms were an isolated, biological event (Harper et al., 2022). Further, their survey showed some women found it difficult to get HRT, when others found that it was prescribed too freely. This discrepancy likely takes root from the publishing of the initial findings of the 2002 Women's Health Initiative study, with some medical practitioners primarily using these trials as the basis for their

advice regarding HRT to their patients; meaning, taking a very cautious, conservative approach to prescribing HRT given the findings initially suggested that the risks of using combined estrogen plus progestin exceeded the benefits for an average healthy postmenopausal US women, with a statistically significant increased risk of stroke, deep vein thrombosis, gallbladder disease, heart disease and breast cancer associated with the medication (Rossouw et al., 2002). Yet, others advocate for the differing results coming from re-analysis of the data, showing that the use of HRT in younger women (50–59 years) or in early postmenopausal women (within 10 years of menopausal onset) had a beneficial effect on the cardiovascular system, reducing coronary diseases and all-cause mortality (Manson et al. 2013). If the practitioners are not aligned on the standard of care, this inconsistency consequently bleeds into the medical guidelines, the clinician's management of the diagnosis, ultimately resulting in contradictory perspectives and information filling the gaps of the public's perception of the condition.

Menopause consists of several classes of symptoms, which are clinically classified as Vasomotor symptoms (VMS), Genitourinary Syndrome (GSM), as well as mood-related changes and other symptoms that are associated with the sudden drop in Estrogen hormone that don't fit as neatly into the other categories (Peacock et al., 2023). This class of symptoms describes the thermodynamic changes resulting from the drop in estrogen, famously known as “hot flashes”, referring to episodes of sudden overheating that often begins in the face and upper body, often spreading to other parts, and can be accompanied by anxiety, shivering, palpitation, or perspiration (Lee, Cho, Chun, 2020). Vasomotor symptoms are associated with diminished sleep quality, irritability, difficulty concentrating, reduced quality of life, and poorer health status (Journal of The North American Menopause Society, 2022). These symptoms can be mild, moderate, or severe, interfering with quality of life to where prescription treatment may be necessary. Sweating, palpitations, dizziness, tachycardia and changes in blood pressure may also accompany the hot flash episodes.

Genitourinary syndrome is the class of symptoms referring to vulvovaginal atrophy, or the thinning of the vaginal walls that results from declining levels of oestrogens during and following the menopausal transition. This can result in significant vaginal and bladder problems, among the most commonly reported being vaginal dryness and itch, dysuria, polyuria and incontinence (Menopause physiology, Gattenby, 2024).

In addition, there is both a widespread social and clinical recognition of the association between menopause and mood changes (Soares et al 2019; Guérin, Prud'Homme, & Goldfield, 2017; Cohen, Soares, Vitonis, Otto, & Harlow, 2006; Hickey, Schoenaker, Joffe, & Mishra, 2016; Woods et al., 2008) While menopause is characterized broadly by fewer ovulatory cycles and estrogen withdrawal, the Journal of Neuroscience (2006) urges us to consider that the high variability in ovarian hormone secretion surrounding menopause- going from high to low, to high again- creates mixed signals in the brain, leading to a disbalance in the mental and emotional state. Therefore, while after menopause, estrogen levels do stay low, the transition period is very unstable, and this process cannot just be collapsed into a single physiologic event such as one singular drop in estrogen.

Similarly, the resulting psychological symptoms cannot necessarily be neatly mapped by the same manner, nor reduced to just a side effect of medication when examining the impact of reproductive hormones on brain function and behavior during the menopause transition (Morrison et al., 2006). As it follows, the brain both controls and responds to estrogen release through the hypothalamus–pituitary–gonadal (HPG) axis, functioning as a communication loop or a feed-forward system that helps the body make, monitor, and adjust hormone levels. Further, neuroendocrine function

initiates in the hypothalamus, and the circuits that respond to estrogens go well beyond it to include the neocortex, hippocampus, and brainstem- areas that affect thinking and decision making, emotions and memory, and basic functions like heart rate and breathing. Therefore, when estrogen levels change, people may feel brain fog, emotional swings, and cognitive issues such as trouble remembering things.

Although menopause is marked by a loss of ovarian follicles, this process does need to be considered in the context of the three levels of the HPG axis due to its intertwined circuitry. Even though menopause is triggered by the ovaries stopping their usual function, the whole brain-hormone communication system (HPG axis) is involved, so it can't just be looked at in the scope of the ovaries. Additionally, if the hypothalamus isn't working right, that messes with other hormone signals too, as it sends messages to a ton of other brain regions- not just through hormones, but through nerves and other signaling pathways. Therefore, as menopause features a plummeting of circulating estradiol levels, the involvement of the HPG axis means many of these effects go far beyond reproductive symptoms. Any change in HPG activity, and hence hormonal output, will affect other, non hypothalamic brain systems that respond to hormones. Further, the hypothalamus communicates with other CNS regions in a multitude of ways aside from just hormonal feedback- via both direct and indirect pathways that bring information to the cortex, thalamus, amygdala, brainstem, cerebellum, and most other brain regions, showcasing multiple neural pathways by which age-related changes in hypothalamic function may affect brain function (Morrison et al., 2006). Estrogen withdrawal doesn't just affect one system- it echoes through the entire brain, like a ripple in a pond. Multiple longitudinal studies back up this connection to psychological symptoms; particularly regarding an increased risk of depression surrounding the menopausal transition, even in previously healthy women (Schmidt et al., 2004; Guérin, Prud'Homme, & Goldfield, 2017; Cohen, Soares, Vitonis, Otto, & Harlow, 2006; Hickey, Schoenaker, Joffe, & Mishra, 2016; Woods et al., 2008). While circumstantial factors could also lead to depression among these populations, this doesn't diminish the strong link between hormonal events during the menopausal transition and the onset of depression. In late perimenopause, the body enters a phase of prolonged hormonal decline- hypogonadism- where estradiol levels become consistently low. This is highly suggestive of an endocrine mechanism related to the estradiol withdrawal and recent-onset of prolonged hypogonadism in the pathophysiology of perimenopausal depression (Morrison et al., 2006).

Further, studies assessing public reports of psychological symptom experience in the menopausal transition correlates with the scientific findings. Soares (2019) discusses the relationship between menopause and depression, emphasizing that up to 70% of women experience psychogenic symptoms associated with perimenopause and menopause, including things such as anger/irritability, anxiety/tension, depression, loss of concentration, and loss of self-esteem/confidence. Multiple surveys have been conducted in the past decade assessing the distribution of menopausal symptoms across women- particularly noteworthy, a multinational survey conducted in 2021 assessed the cross-cultural experience of menopausal symptoms, finding a high percentage reporting psychiatric symptoms associated with their condition: "Among women who identified as menopausal, 90% of Europeans and 97% of Australians experienced physical symptoms, and 55% of European women and 63% of Australian women reported psychological symptoms associated with menopause" (Panay, 2021). It's not just reports, but the science backs the association- yet despite this transparency, are mental health symptoms as clinically acknowledged as the other buckets of symptoms (VMS, GSM, sleep, etc)? Psychological symptoms often get attributed to the drugs taken to relieve menopause symptoms, studies that control for medications show women experience psychiatric symptoms prior to the intake of any drugs. The Penn

Ovarian Aging Study (2006) found women with no history of depression during their menopausal transition were four times more likely to develop depression compared to their pre-menopausal status, and a diagnosis of MDD was more than twice likely to occur in women with no history of pre-menopausal depression: *“Within-woman change in menopausal status, increased levels of follicle-stimulating hormone and luteinizing hormone, and increased variability of estradiol, follicle-stimulating hormone, and luteinizing hormone around the woman's own mean levels were each significantly associated with high CES-D scores after adjusting for smoking, body mass index, premenstrual syndrome, hot flashes, poor sleep, health status, employment, and marital status. A diagnosis of depressive disorder was 2(1/2) times more likely to occur in the menopausal transition compared with when the woman was premenopausal (odds ratio, 2.50; 95% confidence interval, 1.25-5.02; P=.01); the hormone measures were also significantly associated with this outcome.”* (Freeman et al., 2006). Similar studies similarly found similar results suggesting an increase in depressive symptoms around the menopausal transition in previously healthy, unmedicated women [Cohen et al., 2006, Bromberger et al., 2015, Mulhall et al., 2018]. Altogether, this evidence confirms that there is a strong degree of association between menopause, psychological symptoms, the GPG axis and declining levels of estrogen; that menopause is a system-wide bodily condition, including the brain, but the question of whether it is treated like one remains.

Therein lies a gap in the identification of how exactly women are currently experiencing mental health symptoms associated with their menopausal status, and whether their needs are being sufficiently met. Previous studies have suggested that women can face a great deal of barriers while seeking support, which includes not just their own initial attitudes towards treatment, but difficulties created by their general practitioners; These may be due to their attitudes and beliefs about the menopause, doubting the seriousness of the symptoms and their impact on women's lives, difficulty in asking embarrassing/difficult questions, and conflicted beliefs and misperceptions of HRT and when to use it (Barber & Charles, 2023). However, a more direct analysis towards whether women feel healthcare professionals and the medical world is sufficiently helping their menopause symptoms has not really been conducted outside of analyzing barriers and treatment options. Additionally, studies of women's attitudes surrounding menopause have largely been conducted as surveys and interviews. A review of public discussion via social media has not been assessed, which offers a new perspective to look at more unfiltered commentary, a greater variety of responses women can provide, and the potential for conducting temporal analysis. Further, we have a more general lack of information on the unfiltered, unbiased perspective of women who are looking to treat their menopause symptoms, how they are being told to treat them, and whether they found it successful. Analyzing social media forums can allow us to confirm that public perception does recognize mental health as an issue, that its not being sufficiently met, and we will use our analysis of the guidelines as a comparison point of the clinician/professional perspective.

In other words, this is a review with several goals, which ultimately aims to bridge together clinicians, patients, and policymakers in the problem space that is currently surrounding menopause. assess (1) whether the guidelines are consistent with science, each other, and what approaches they take to treatment for the buckets of symptoms and managing the risks associated with treatment. (2) visualize what problems women report facing in menopause, and compare to see whether this is proportionately addressed by the guidelines (3) Analyze the current real-world sentiment surrounding menopause, as well as the most common themes being discussed to uncover trends over time. (4) Visualize these factors in an interconnected framework to show what part of the system is not currently flowing, leading to the

problems surrounding this community, and (5) provide a potential solution in addressing this problem space in the form of platforms such as Menolearn to help bridge this gap.

While guidelines may not yet have a clear direction for the treatment of mood-related symptoms, hopefully this analysis will help to at least inform the public, and to let menopausal women experiencing mental health symptoms know that they are not alone; that their symptoms are real and valid, and there are countless communities with personalized experiences to share. Hopefully, this will inspire future clinical trials regarding these widely-used therapies, which will motivate future menopausal guidelines to include a clearer set of steps for treatment for mental health as a cluster of menopausal symptoms.

Part. 1: Guidelines

The first goal is to examine the most highly referenced and most widely recognized clinical guidelines for menopause treatment to get an idea of what aspects of menopause gets covered. To do this, we reviewed approximately 20–30 guidelines published within the past 10 years by organizations specializing in menopause, women's health, and the development of medical standards in the U.S. and other English-speaking countries. This review aims to gain a comprehensive assessment of these guidelines' coverage of menopausal symptoms, mental health assessment, stance on hormonal therapy, and their risk and prevention assessment of the medications recommended. The guideline selection process was guided by both established criteria on recognizing a trustworthy clinical practice guideline from Lima, Mirza, and Guyatt (2023) and menopause-specific criteria recommended by Dr. LaCroix on behalf of the Women's Health Initiative (WHI), to ensure we select for articles which emphasize scientific rigor, unbiased citations, and comprehensiveness. [see Figure 1.1 and 1.2 for these specific criteria]. To assess the trustworthiness of clinical guidelines, we applied the established criteria as outlined by Lima et al, which, to assess the trustworthiness of clinical guidelines, emphasizes factors such as methodological rigor, transparency, and the quality of supporting evidence. In accordance with LaCroix's recommendation, guidelines were excluded if they claimed that menopause universally requires hormone therapy, if they failed to address the discontinuation of hormone therapy, or if they framed menopause as a disease rather than a natural life stage. Additionally, we excluded guidelines that outright dismissed the findings of the Women's Health Initiative studies [Rossouw et al., 2002), (Manson et al. 2013)], claimed that hormone therapy reduces dementia risk, or failed to specify contraindications and breast cancer risk factors associated with combined hormone therapy. Further exclusion criteria included guidelines that broadly labeled hormone therapy as safe for all women in their fifties without qualification, did not emphasize patient counseling and shared decision-making, or omitted discussions on mental health and non-hormonal treatment options.

After attending to these criteria, the remaining guidelines were scored 0-5, 0 being worst and 5 being most thorough, on how well they addressed the following topics: their standards on Hormone Replacement Therapy, the extent to which they emphasized a patient-centered medical judgement, prevention medicine and risk management associated with treatments, their stance on alternative and lifestyle measures as treatments, and their general approaches to the following categories of symptoms: Vasomotor, Genitourinary, Mental Health, and Other symptoms that don't fit in the other buckets as neatly. The scoring methods are laid out under each respective paragraph discussing their results. These scores are plotted in a heatmap (Figure 1.2) mapping the guidelines with their scores on these various topics to analyze what aspects of care are addressed. Next, a principal component analysis (PCA) was performed to evaluate the degree of alignment among the guidelines. The results were then compared to identify which guidelines are most similar or divergent on specific topics, providing clearer insight into

Figure 1: Table 1.1

ID	Project Name	Type	Phase	Status	Lead	Start Date	End Date	Progress (%)	Issues	Comments	Next Steps	Owner
1	Project Alpha: New Product Development	Development	Phase 1	In Progress	John Doe	2023-01-15	2023-06-30	75	2	Minor bugs in UI, need more testing.	Complete development and testing.	John Doe
2	Project Beta: Marketing Campaign	Marketing	Phase 2	Completed	Jane Smith	2023-02-01	2023-05-15	100	0	Campaign launched successfully.	Review results and plan next steps.	Jane Smith
3	Project Gamma: System Upgrade	IT	Phase 3	On Hold	Mike Johnson	2023-03-10	2023-09-30	30	5	Technical challenges, budget concerns.	Re-evaluate scope and timeline.	Mike Johnson
4	Project Delta: Customer Service Initiative	Customer Service	Phase 1	In Progress	Sarah Lee	2023-04-01	2023-08-31	60	1	Training modules being developed.	Implement new service protocols.	Sarah Lee
5	Project Epsilon: Data Analytics Platform	Analytics	Phase 2	On Hold	David Kim	2023-05-01	2023-11-30	20	3	Integration issues with existing systems.	Consult with vendors for solutions.	David Kim
6	Project Zeta: HR System Rollout	HR	Phase 1	In Progress	Emily White	2023-06-01	2023-10-31	40	0	Vendor selection in progress.	Finalize vendor and start implementation.	Emily White
7	Project Eta: Compliance Audit	Compliance	Phase 1	Completed	Chris Brown	2023-07-01	2023-07-31	100	0	Audit completed with no major findings.	Implement corrective actions.	Chris Brown
8	Project Theta: Mobile App Development	Mobile	Phase 2	In Progress	Alex Green	2023-08-01	2023-12-31	50	4	Designing user interface, testing backend.	Complete app development.	Alex Green
9	Project Iota: Supply Chain Optimization	Supply Chain	Phase 1	On Hold	Mia Black	2023-09-01	2024-03-31	10	2	Market volatility affecting costs.	Monitor market trends closely.	Mia Black
10	Project Kappa: Internal Audit	Internal Audit	Phase 1	Completed	Noah Grey	2023-10-01	2023-10-31	100	0	Audit completed successfully.	Review findings and report.	Noah Grey
11	Project Lambda: New Market Entry	Market Entry	Phase 2	In Progress	Olivia Blue	2023-11-01	2024-06-30	25	1	Researching local regulations.	Develop market entry strategy.	Olivia Blue
12	Project Mu: IT Security Enhancement	IT Security	Phase 1	On Hold	Peter Red	2023-12-01	2024-05-31	15	3	Identifying vulnerabilities.	Implement security patches.	Peter Red
13	Project Nu: Employee Training Program	HR	Phase 1	In Progress	Quinn Purple	2024-01-01	2024-04-30	35	0	Designing training modules.	Launch training program.	Quinn Purple
14	Project Xi: Product Redesign	Product	Phase 2	On Hold	Rachel Yellow	2024-02-01	2024-09-30	10	2	Customer feedback analysis.	Revise product design.	Rachel Yellow
15	Project Omicron: Financial Review	Finance	Phase 1	Completed	Sam Green	2024-03-01	2024-03-31	100	0	Financial statements reviewed.	Report to board.	Sam Green
16	Project Pi: Customer Feedback Analysis	Customer Service	Phase 1	In Progress	Tina Blue	2024-04-01	2024-07-31	45	1	Gathering feedback from surveys.	Analyze feedback trends.	Tina Blue
17	Project Rho: New Software Implementation	IT	Phase 2	On Hold	Uma Red	2024-05-01	2024-11-30	20	4	Software selection in progress.	Finalize software choice.	Uma Red
18	Project Sigma: Compliance Training	Compliance	Phase 1	Completed	Victor Purple	2024-06-01	2024-06-30	100	0	Training modules completed.	Monitor compliance levels.	Victor Purple
19	Project Tau: HR Policy Update	HR	Phase 1	In Progress	Wendy Yellow	2024-07-01	2024-09-30	55	0	Drafting new policies.	Implement updates.	Wendy Yellow
20	Project Upsilon: Marketing Strategy Review	Marketing	Phase 1	On Hold	Xavier Blue	2024-08-01	2024-10-31	10	2	Market research ongoing.	Re-evaluate marketing strategy.	Xavier Blue
21	Project Phi: System Integration	IT	Phase 2	In Progress	Yara Red	2024-09-01	2024-12-31	30	3	Testing integration points.	Complete integration.	Yara Red
22	Project Chi: Customer Loyalty Program	Customer Service	Phase 1	On Hold	Zoe Purple	2024-10-01	2025-03-31	5	1	Conceptualizing program.	Develop program details.	Zoe Purple
23	Project Psi: Internal Audit	Internal Audit	Phase 1	Completed	Adam Yellow	2024-11-01	2024-11-30	100	0	Audit completed.	Report findings.	Adam Yellow
24	Project Omega: New Product Launch	Product	Phase 2	In Progress	Bella Blue	2024-12-01	2025-06-30	15	2	Finalizing product details.	Launch product.	Bella Blue

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Figure 1.2 :

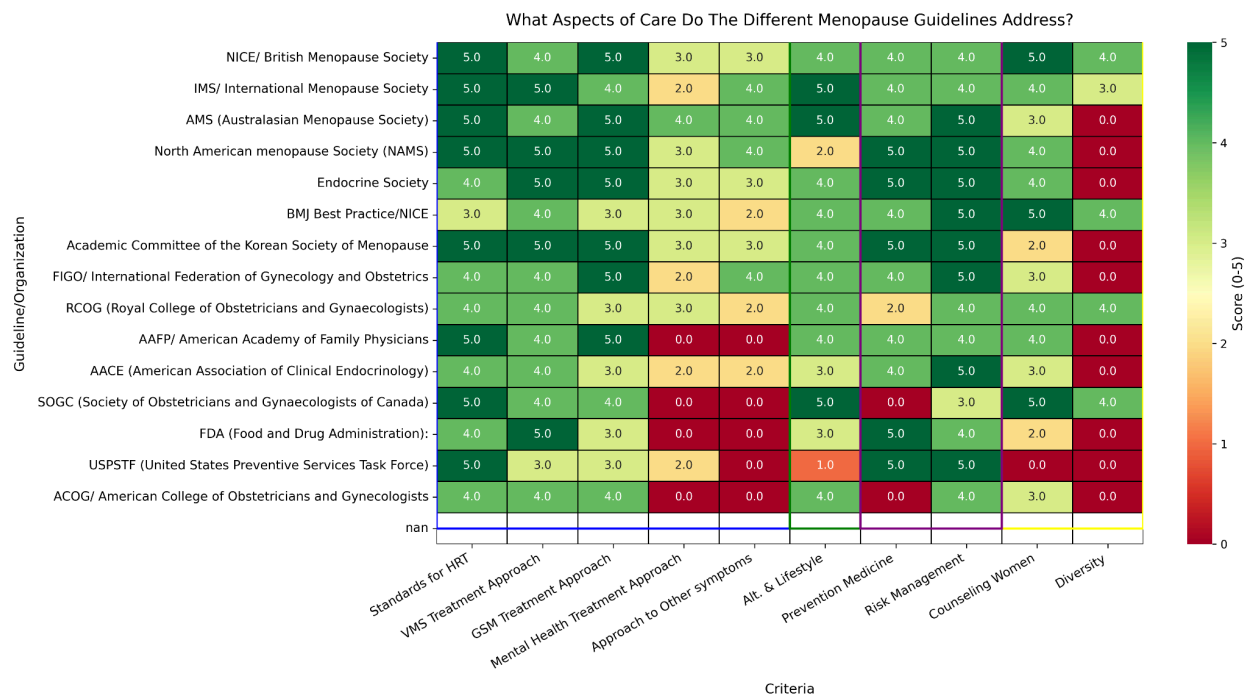


Figure 1.2: This heat map visually illustrates and ranks how menopause care guidelines address various themes and criteria based on the previously described standards, including general accuracy and depth of coverage. The X-axis represents the different themes and criteria, while the Y-axis lists the individual guidelines. Each guideline is rated on a scale from 0 to 5, where 0 indicates the criterion is not included or addressed, and 5 reflects a high-quality and thorough inclusion. The color gradient ranges from red (low score) to green (high score), providing an intuitive overview of guideline comprehensiveness.

Figure 1.3

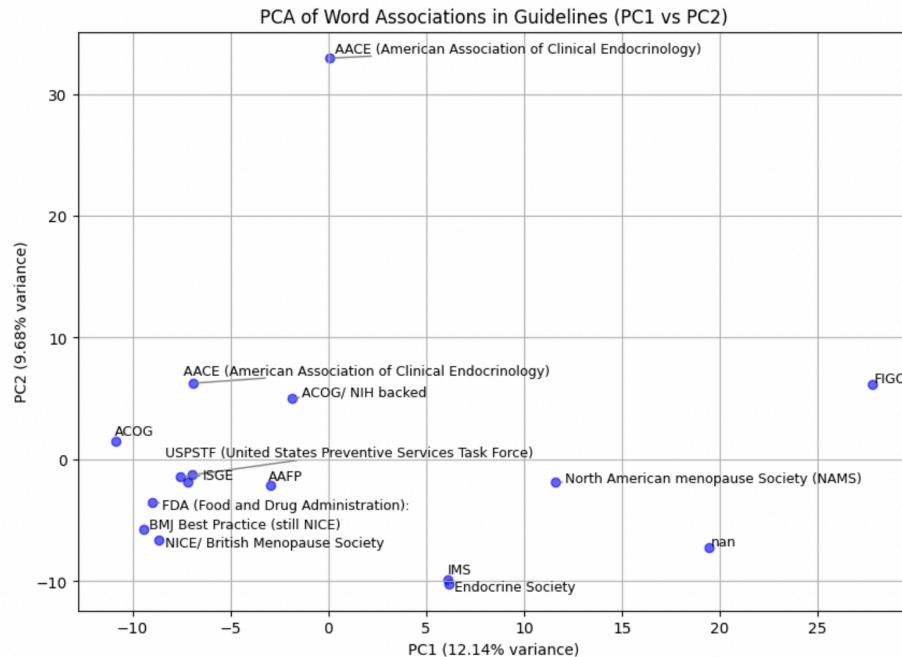


Figure 1.3: The first principal component (PC1) refers to Clinical Outcomes and Hormone Therapy, particularly regarding treatment effects and disease recurrence. This theme consists of the following key words: *standard, significantly, higher, appear, tibolone, recurrent, incidence, EPT, reduces, CEE*. The second Principal Component (PC2) appears to refer to Pharmacological and Psychosocial Considerations, consisting of the following Key Words: *attributed, disruption, agents, issues, progestational, coincides, substantiated, class, el, tumors*. This graph demonstrates NICE/British Menopause Society, BMJ Best Practice, USPSTF, ISGE, FDA, AAFP are closely positioned near the center, likely meaning they share common themes in word associations. AACE (American Association of Clinical Endocrinology) looks to be an outlier along the PC2 theme, suggesting a distinct focus in Pharmacological and Psychosocial Considerations. FIGO and North American Menopause Society (NAMS) are further apart, indicating differences in word associations.

Figure 1.4

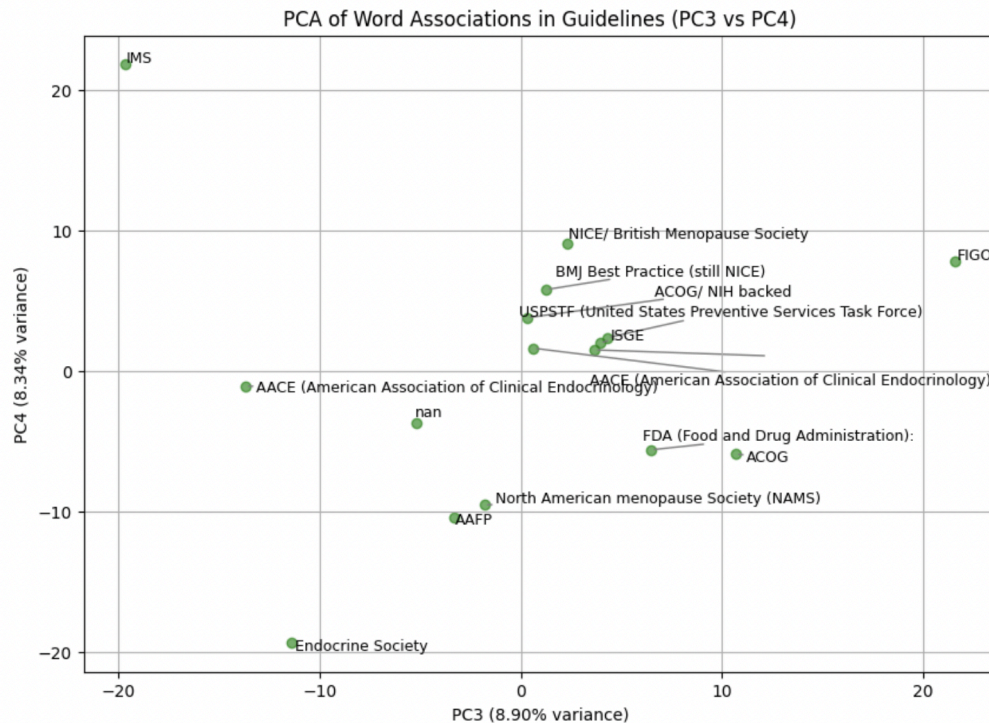


Figure 1.4: The third principal component (PC3) refers to Placebo Effects and Subjective Well-being, particularly in neurological and psychological contexts. This theme consists of the following Key Words: *placebo, recent, new, relaxation, fatigue, treated, brain, probably, encouraged, individually*. The fourth Principal Component (PC4) appears to refer to Musculoskeletal and Women's Health Treatments, consisting of the following Key Words: *prasterone, consistent, musculoskeletal, following, needs, active, nice, commonly, woman, treatments*, reflecting common medical interventions. This graph demonstrates NICE/British Menopause Society, BMJ Best Practice, USPSTF, ISGE, and ACOG remain closely positioned, reinforcing their thematic similarity. However, Endocrine Society and IMS (International Menopause Society) appear distant from others, indicating unique thematic emphases.

Standards for HRT

In the scope of this review, we are interested in gaining a comprehensive assessment of the guidelines' coverage of menopausal symptoms, mental health assessment, stance on hormonal therapy and their risk and prevention assessment of the medications recommended. The guidelines are well-rounded and generally aligned regarding their standards for HRT, with all of them scoring a 4 or above aside from BMJ Best Practice, which had the lowest score of a 3. This column scores full points if the guideline acknowledges that Hormone therapy shows to be the most effective treatment for vasomotor symptoms so far, and that risks are dependent on type, dose, duration of use, route of administration, timing of initiation, and whether a progestogen is used. They cannot score full points if they recommend adding a progesterone for all women, even those who have had a hysterectomy. They must also acknowledge individualization of treatment to best maximize benefits and minimize risks, as well as mentioning periodic reevaluation of the medication. Hormone therapy is also the most effective treatment for Genitourinary symptoms, but in the absence of indications for systemic ET, the lowest-dose topical

vaginal ET is recommended. In general, the therapeutic goal should be to use the most appropriate, often lowest, effective dose of hormones consistent with treatment goals. 4s were often scored if these aspects were addressed but a minor one was missing, or if it did not go into sufficient detail in making the point. 3s were scored if 2+ points were missing, and 2s or 1s were scored if something incorrect was stated, or if the majority of the points were not addressed (or completely left out).

Overall, the articles universally support the following points regarding standards for HRT: (1) MHT is the most effective treatment for moderate to severe vasomotor symptoms (VMS) (2) Use of estrogen alone for women without a uterus and estrogen + progestogen for those with a uterus (3) Individualized decision-making considering age, health status, and personal risk (4) Lowest effective dose for the shortest appropriate duration is widely stated, though newer guidelines support longer duration if benefits outweigh risks. (5) Contraindications include hormone-sensitive cancers and history of thromboembolism (6) Non-hormonal options should be offered to those with contraindications or who decline MHT- with SSRIs, SNRIs, gabapentin, or clonidine offered as alternatives. (7) Local vaginal estrogen is effective and safe for genitourinary symptoms, Annual or periodic re-evaluation of therapy necessity and risks is routinely advised. Points that are not consistently supported include the tailored tapering vs abrupt cessation of MHT, which is discussed in some organizations (NAMS, NICE), but is not universally addressed or recommended.

Criteria that comes up in some of the guidelines which is not routinely mentioned in others include Tibolone as an MHT alternative, which is mentioned in European and Australasian guidelines (e.g., NICE, AMS, IMS) but is not discussed in US guidelines (e.g., FDA, ACOG, USPSTF). Bazedoxifene + conjugated estrogen (CE/BZA) as a uterus-sparing alternative to EPT appears to be a novel medication option, as it is approved by the FDA and supported by NAMS and AACE, but is not always mentioned in older or non-US guidelines. Laboratory testing (lipid profile, liver function, etc.) as a baseline for MHT initiation is also suggested by some (FIGO, AACE, ISGE), but not universally required, with NAMS and other organizations recommending clinical evaluation over required lab work. Similarly, the routine use of mammograms, Pap smears, bone scans before/during therapy are not consistently listed as requirements, but are referenced as the ideal practice by many (AACE, RCOG). None of these points were necessary additions, but interesting observations that reflect the variety in standards between organizations.

Symptom Approaches

On the subject of Vasomotor symptom approaches, there was some degree of overlap with the standards for HRT column as HRT is primarily prescribed for vasomotor symptoms, being considered its most effective treatment. Therefore, the guideline had to mention MHT/HRT is the most effective known treatment so far. The differences in prescribing estrogen+progesterone versus estrogen only in relation to a woman's hysterectomy status must also have been mentioned. Guidelines would get a 5 if they meet the above criteria and also mention additional FDA-approved treatments for menopause such as non hormonal agents or novel hormone treatments. Aside from USPSTF, which consistently gets lower scores due to its alternative scope (prevention treatment), the guidelines addressed the following points effectively: Five guidelines scored a 5.0, eight guidelines scored a 4.0, and one guideline scored a 3.0. Analysis found that aside from just expanding on treatment options, guidelines that scored a 5 also included more tailored clinical decision frameworks that discuss some level of treatment personalization,

addressed broader patient contexts such as patients with premature ovarian insufficiency (POI) and demographic considerations and contraindications, and anchored recommendations in higher levels of evidence. This suggests that vasomotor symptoms were addressed with moderate to high comprehensiveness among most of the guidelines, with room for improvement in including non-hormonal and novel therapies.

Regarding Genitourinary symptom approaches, there was greater variety in scoring from vasomotor symptoms, with more scoring 3s and 5s rather than 4s, as found in VMS. Articles must have mentioned low-dose vaginal estrogen therapy as the standard of care for treatment, emphasizing it over systemic therapy unless medication was prescribed for multiple symptom categories. Vaginal moisturizers and lubricants should be mentioned as a viable option for those who do not want to take hormone therapy, and should be considered first-line for those with mild symptoms. If these two symptoms were addressed, the article would score at least a 3 on their approach to GSM treatment. More detail on contraindications, available treatments, and addressment of type of medication would earn a 4 or a 5. The results show seven ratings of 5.0, three ratings of 4.0, and five ratings of 3.0, which overall does not highlight any major issues or missing aspects of treatments, just a greater variety of detail in treatment description.

Mental Health symptoms show some of the greatest variety in symptom scorings. 40% (6 guidelines) received 3.0s, reflecting a moderate reference towards Mental Health treatment. 4 guidelines scored 2.0s, showing a bleak acknowledgement of this category of symptoms. 4 guidelines (27%) scored 0, signalling no reference of mental health treatment. Only one guideline reached a 4, and none hit a 5- indicating an overall massive lack of depth, nuance, or sophistication in engaging with mental health concerns. The scoring of this criteria was similar to the previous: no mention of mental health treatment would receive a 0, a weak reference of psychiatric symptoms and an acknowledgement of psychiatric symptoms as a side effect of HRT would receive a 1, a reference to estrogen therapies' potential to improve mood disorder, particularly, depression, would earn at least a 2. The criteria for a 3.0 would include the criteria for 2.0+ greater detail and scientific evidence, as well as acknowledgement of the association between Menopausal symptoms and poorer health-related and menopause-specific quality of life and/or suggestion of CBT as a treatment. Scores would receive a 4.0 if they meet the 3.0 criteria and mention CBT and lifestyle factors as options for treatments, a larger discussion of at least one other treatment option available aside from HRT, and greater detail on the etiology of psychiatric symptoms in menopause. None of the guidelines met criteria for a 5.0, as they would have to mention 2+ treatments aside from HRT and plainly, include at least a paragraph describing mental health symptoms as a primary component of menopause, which frankly didn't happen, as there were only a couple sentences referencing this category of symptoms in each guideline. Australian Menopause Society was the only one to score a 4.0, due to its greater detail on the options available for mental health treatment. Overall, most of the sources treat mental health as an afterthought, not a core symptom of Menopause, and do not really mention non-depressive symptoms. Additionally, they barely differentiate between transient mood symptoms and clinical disorders. CBT and psychosocial interventions are somewhat mentioned but not deeply explored, and personalization of treatment is mildly acknowledged, but not operationalized.

“Other” symptoms are classified as symptoms that do not neatly fit into the criteria to be considered vasomotor, genitourinary, or mental health symptoms. These include Fatigue, Menstrual Issues, Headaches, Acne', breast soreness, hair thinning, osteoporosis, 'IBS, and Sexual Issues [see dictionary for more detail on inclusion criteria]. While symptoms like fatigue and cognitive decline may overlap with mental health concerns, we classified them as 'other' due to most often being discussed

outside the context of mood disorders or psychiatric evaluation. Due to the variable nature of this category and the inclusion of symptoms which are not as frequently reported or are less bothersome on a day-to-day scale, greater variation in scores and likely less addressment towards this category of problems was expected. For this category, a guideline would score at least a 1.0 if they mention a symptom that does not fit into GSM, VMS or MH. They would receive a 2 if they mentioned multiple symptoms from the “other” category that do not fit into the other ones. A score of 3.0 would be given if it meets 2.0 criteria and if treatment options are provided or discussed for these symptoms on some level. A 4.0 score means the guideline went into greater detail intentionally rather than incidentally, Mentioning a range (at least 3) of non-core symptoms and linking them to specific interventions, with some level of mention of the mechanisms behind it. A 5.0 would meet 4.0 criteria, as well as addressing a wider range of non-core symptoms and their treatments than a 4.0 would. Results showed high variability, with no guidelines achieving a perfect score. Of the set, four scored 4.0, three scored 3.0, three scored 2.0, and five scored 0. Notably, no guidelines received a 1.0.. Among the variety of “other” symptoms referenced or addressed, sleep, fatigue and sexual issues got the most highlighted. Osteoporosis was also frequently mentioned, but typically in the context where it was framed as an HRT benefit. On the other hand, symptoms like headaches, acne, hair thinning, menstrual issues, breast soreness, gastrointestinal symptoms, and cognitive decline got barely, if any, mention. These things suggest a definite gap in a more comprehensive symptom-targeted analysis, but also an understandable limitation as the majority of the guidelines are limited in the scope of what they are addressing. These symptoms of menopause are admittedly a lesser category, affecting less people on average as compared to vasomotor hot flashes or GSM (Nelson et Al, 2005). Still, this does not invalidate the experiences of those who do suffer from the above, and only a few texts clearly integrate treatments with specific “other” symptoms, and a great number still ignore the broader symptom landscape in menopause.

Prevention Medicine and Risk Management

The scoring for how well guidelines addressed prevention medicine are as follows: a 0 would be addressed if there was no mention of preventive medical treatments (e.g., prescribing HRT or other medications) for menopausal-related conditions. It would automatically be rated a 1 or lower if the guideline suggests prescribing HRT for cognitive function, dementia, breast cancer, or cardiovascular disease prevention (cardioprotection) as these are not medically backed, even if other preventive effects are mentioned. It would score a 2 as long as it does not suggest prescribing HRT for cognitive function, dementia, breast cancer, or cardiovascular disease prevention and mentions that HRT prevents bone loss and reduces fracture risk in otherwise healthy postmenopausal women, but does not specify it should be prescribed for this purpose or lacks further preventive context. A 3 meets criteria for 2, plus explicitly states that postmenopausal osteoporosis is the only appropriate preventive indication for prescribing HRT. A 4 meets criteria for 3, plus references additional conditions (e.g., type 2 diabetes) that HRT may positively influence, but clearly states these effects are not government approved or are not reasons to prescribe HRT. A 5 would be given if it met criteria for 4, plus discusses other preventive measures (e.g., calcium/vitamin D supplementation, lifestyle changes), or provides detailed risk-benefit analysis and recommendations for specific populations (e.g., early menopausal women, osteopenia cases). Of the set, five scored 5.0, seven scored 4.0, one scored 2.0, and two scored 0s. Most of the menopausal care guidelines err on the conservative side, focusing primarily on osteoporosis prevention with HRT, and their broader benefits may be acknowledged without endorsing them as indications. Only a few integrate HRT

use with additional preventive measures such as supplements or lifestyle changes and detailed risk-benefit analyses for specific populations- most do not yet fully integrate these broader strategies and holistic recommendations.

The scoring for how well guidelines addressed risk management in treatment are as follows: a 0 would be addressed if they do not address the risks of MHT or other therapies they recommend. A 1 would be given if they mention only general statements about risks or benefits of MHT, such as "MHT has more benefits than risks" or vice versa, with little to no detail. A 2 would be addressed if they mention some specific risks (e.g., breast cancer, VTE, stroke) without elaboration or stratification by factors such as age, timing, route, or type of MHT. A 2 score may list risks but does not contextualize or provide alternatives or contraindications. A 3 meets criteria for a 2 and also states some version of "for most symptomatic women, the benefits of MHT outweigh the risks," and/or advises clinicians to individually assess risks and benefits before initiating treatment. A 3 may name common risks but offers minimal risk stratification. A 4 meets all criteria for a 3 plus: explicitly names and differentiates estrogen risks (e.g., stroke, endometrial cancer) and progesterone risks (e.g., breast cancer), and/or discusses differences for women with vs. without uterus, and/or identifies route-dependent risks (e.g., oral vs. transdermal). A 5 meets all criteria for a 4 plus providing detailed stratification by age, timing of MHT initiation, route of administration, type of hormone, and comorbidities (e.g., VTE risk, breast cancer risk, CVD), offers specific contraindications and evidence-based alternatives, or discusses rare risks, risk-reduction strategies, and/or shared decision-making frameworks. Of the set, eight scored 5.0, six scored 4.0, and one scored a 3.0 (SOGC). No guidelines scored any lower! This highlights that the risks of medications such as HRT are taken relatively seriously in the guidelines, and are largely in agreement with one another. This alignment is likely influenced by the 2002 and 2004 WHI Hormone Therapy Trials, which significantly shaped how risks associated with hormone therapy are communicated and evaluated in clinical practice. Most of the articles do tend to focus on risk management when taking HRT rather than differing novel hormone therapies, and tend to mention those more as options when one is contraindicated for MHT. This is understandable, given HRT's position as the gold standard treatment.

Alternative Medicine and Lifestyle Modifications

The scoring for how well guidelines addressed risk management in treatment are as follows: 0: the article does not mention any lifestyle or non-pharmacological treatments for menopausal symptoms. The article would score a 1 if there was minimal mention, such as a brief reference of alternative treatments but without any evaluation or commentary on their efficacy or safety. A 2 would be scored if the guideline acknowledges concerns with compounded hormones- particularly, including a clear disclaimer about their limited support or potential risks. A guideline would score a 3 if it was Evidence-aware but limited, meeting criteria for 2, and additionally mentioning at least one evidence-informed non-hormonal treatment (e.g., CBT, hypnosis, lifestyle changes), but with minimal detail or clinical backing. A 4 would mention clinically supported alternatives, meeting criteria for a 3 and explicitly recommending cognitive behavioral therapy (CBT) and/or hypnosis as effective alternatives, supported by clinical evidence or guidelines. A 5 meets criteria for 4 with more comprehensive, evidence-based explanation, providing specific lifestyle recommendations (e.g., exercise, sleep hygiene), a discussion of supplements with some clinical backing, caveats about the quality of evidence or safety

concerns, or if it just generally presents a broad and nuanced view of alternatives across different symptom categories. Of the set, three scored 5.0, eight scored 4.0, two scored a 3.0, one scored a 2.0 (NAMS) and one scored a 1.0 (USPSTF). The spread from 1 through 5 shows varying degrees of engagement with alternative treatments, from superficial mention to full, evidence-based incorporation. With eleven scoring a 4 or 5, most guidelines do provide a moderate to strong coverage of non-hormonal and lifestyle interventions, recognizing and recommending clinically supported alternatives like CBT, hypnosis, or lifestyle modifications with at least moderate detail and evidence. The one scoring 1 and the one scoring 2 indicate that some guidelines either barely mention alternatives or limit themselves to disclaimers about compounded hormones, missing broader non-pharmacological treatment discussions. This shows room to enhance coverage of nonpharmacological treatment options when it comes to lifestyle and behavioral therapies to meet evolving patient care needs.

Patient-centered approach and counseling women

This section assessed to what extent a guideline emphasized the need for counseling women on the evidence behind treatment recommendations; essentially, whether they took a more patient-centered approach as opposed to drawing broader generalizations about what options are most effective. The scoring was as follows: A 0 would be assigned if there was nothing included indicating an expectation to take a patient-centered approach or educating women on the treatment options they have available. No mention of counseling or patient preference. A 1 would be given if the guideline recommends a “one-size-fits-all” approach to education, counseling, and treatment, not taking patient preference and individualism into account. A 2 would be assigned if it recommends individualizing treatment mainly based on clinical risk/benefit assessment or symptom severity, but does not mention patient preference or shared decision-making. For example, advising customized testing or treatment primarily based on risk factors and symptom frequency/severity without patient involvement. The guideline scores a 3 if it recommends individualizing treatment including patient preference, considering factors like dosage, duration, and route, alongside risk–benefit ratio. Acknowledges patient acceptance and prior experience as important in decisions, but with limited detail on holistic counseling. A score of 4 meets criteria for 3+, but explicitly lists multiple patient-centered factors influencing treatment choice, such as contraceptive needs, symptom type/severity, personal/family history, and emphasizes individualized evaluation and shared decision-making. Further, a 5 will meet criteria for 4+, but taking an even broader holistic, patient-centered counseling approach, including one or more of the following: recommending explaining symptom duration and variability to patients, and/or sharing menopause information with patients and their family/carers, and/or advising on contraception related to menopause, and/or providing bone health advice and discussing it in follow-ups, and/or explaining the importance of physical activity for muscle strength, and/or offering support and information about menopause and fertility, especially related to medical or surgical causes of menopause. Of the set, three scored 5.0, five scored 4.0, four scored 3.0, two scored 2.0, and one scored a 0. About half the guidelines promote strong patient-centered care, with a minority showing moderate to limited emphasis on patient preference and counseling. This suggests patient preference and education are becoming standard in many MHT guidelines, but there is still a degree of variability: the 2s and 3s show some guidelines still focus primarily on clinical risk-benefit, and the lone 0 indicates a need for improvement in at least one source. While many guidelines recognize the importance of patient-centered care, they do not necessarily fully integrate all aspects like symptom

education, family involvement, or lifestyle advice. This distribution suggests an ongoing shift in menopause care from more rigid medical management toward more holistic, patient-centered counseling.

Concordance and Conclusion

Upon a closer look at the guidelines, and how they compare to one another in their stances on HRT, mental health, prevention and risk benefit, we find broad general alignment and a shared conservative approach on recommending medications or non-pharmacological options without a significant degree of clinical evidence, with differences on the extent of detail delivered. There is a visible shift towards an increasing emphasis on patient-centered care and individualizing treatment occurring in the background, with room for improvement on educating patients and their families about general symptom management. So while most guidelines align in their moderately cautious evidence-based approach to menopausal care- particularly in their endorsement of HRT for vasomotor symptoms and emphasis on individualized treatment- there is still a significant amount of variability when it comes to the depth of coverage across symptom categories and treatment types.

Overall, the PCA (**Figures 1.3 and 1.4**) shows that most guidelines do cluster around shared themes- particularly those related to clinical outcomes of hormone therapy (PC1) and standard treatment practices, which highlights general alignment when it comes to more conservative, evidence-based approaches in treatment. This is highly reflected in the guidelines closest in similarity, which demonstrate to be often prioritizing well-established treatments with clearly defined clinical outcomes as opposed to more experimental, or more novel drugs. Overall, the most similar guidelines were NICE/British Menopause Society, BMJ Best Practice, USPSTF, ISGE, FDA, AAFP, softly followed by ACOG. The more distinct guidelines themes included FIGO, NAMS, Endocrine Society, and AACE, with distinctive thematic emphases in areas like pharmacological nuance, psychosocial aspects, or broader women's health treatments. It is worthwhile to note that their difference does not necessarily suggest an inaccuracy on their end, nor an extreme divergence of opinion- rather, their differences could be due to a number of factors: including FDA concordance when it comes to organizations originating in America, different choices in wording as opposed to stances, preference for alternative approaches or differing regulations and medication approvals by country, or the scope of the publishing journal-s as an endocrinologist may approach the problem of menopause differently from an OB/GYN, and a global perspective may take a broader, more general approach than a more local source.

Taken together, the content analysis and PCA reveal a careful, classic, and consistent foundation across most guidelines in their approach to MHT, especially in emphasizing well-established clinical outcomes like osteoporosis prevention and vasomotor symptom relief. This is reflected both in their explicit recommendations and in their shared language patterns around hormone therapy (PC1). However, the PCA also highlights meaningful thematic divergences- particularly in psychosocial, pharmacological, and broader women's health considerations- that mirror the variability in how guidelines treat mental health, non-hormonal therapies, and individualized care. These findings underscore the need to bridge remaining gaps in Menopausal care, especially as patient-centered care continues to gain importance in the field , thus requiring greater attention to mental health, non-hormonal therapies, and holistic management strategies to sufficiently meet the diverse needs of menopausal individuals.

Part 2: Symptoms and Treatments: Frequency of Mentions

These guidelines showcased a strong emphasis on Vasomotor Symptoms and Genitourinary syndrome as key components of menopause, with more variability regarding suggestions for mental health and “Other” symptoms. Given these differences, we wanted to know whether the symptom and treatment information that is provided to clinicians and to the public, aligns proportionately with what the public is actually experiencing. More broadly we want to assess how women are responding to the resources they are provided by their doctors, and whether these clinical guidelines are sufficiently addressing their symptoms. Sentiment analysis is a particularly powerful tool to judge whether the way people are discussing a given subject is positive or negative, corresponding to real-world resources they are provided. To do this, we scraped data off of several public forums: Reddit, Patient.Info, and Menopause Mandate. Reddit is a social news aggregation website that is made up of a collection of communities, labeled r/community. We scrapped the data from r/menopause, a forum where users are permitted to post content such as links, text posts, images or videos, which are then voted up or down by other members which subsequently increases the post’s popularity. Patient.info differs slightly as a health discussion platform for sharing experiences, symptoms, and insights, while moderators provide educational resources and guidelines. Menopause Mandate is a website created to advance interest and understanding surrounding menopause as well as to improve the level of support women receive from their providers, promoting the sharing of experiences through their page inviting users to share their stories, from which we scrapped the data.

This leads us to **Figures 2.1, 2.2, and 2.3**, which illustrate the network of mentions of the symptoms and treatments described in each forum respectively. Through a natural language processing-based thematic content analysis, in combination with sentiment analysis and ranking-based visual summaries, these visualize the relationship between menopausal symptom categories and corresponding treatment strategies that users mention in the text. The weight of the nodes in this chart represents the amount of times a given symptom or treatment is referenced in the data, with the thicker arrows indicating greater connections. First, the process for this included a keyword-based search across all patient posts, identifying any instance of predefined symptom-related terms (e.g., "hot flash," "hot flush") irrespective of context. This method allowed for a broad estimation of symptom prevalence; for example, "hot flashes/flushes" were mentioned in 1133 posts. Second, a structured symptom categorization framework was applied, wherein symptoms were classified into clinical categories based on curated keyword mappings. For the clinical categories, two dictionaries were defined for (1) the symptoms (*see Dictionary in Supplementals for more details*) and (2) for the treatments (*see Dictionary in Supplementals for more details*), using inclusion criteria based on the medically confirmed affiliated conditions relating to the onset of Menopause (*Nelson et Al 2005; (North American Menopause Society [NAMS], 2022; Endocrine Society, 2015; BMJ Best Practice, 2023; United States Preventive Services Task Force [USPSTF], 2022; National Institute for Health and Care Excellence [NICE]/British Menopause Society, 2024; Journal of Menopausal Medicine, 2020; American College of Obstetricians and Gynecologists [ACOG], 2014, 2023; Hormone Therapy in Menopause, 2021; International Federation of Gynecology and Obstetrics [FIGO], 2024; American Academy of Family Physicians [AAFP], 2016; IMS, 2023; International Society for Gynecologic Endocrinology [ISGE], 2022; American Association of Clinical Endocrinology [AACE], 2011, 2017; Food and Drug Administration [FDA], 2023; Royal College of Obstetricians and Gynaecologists [RCOG], 2018; Australasian Menopause*

Society [AMS], 2023; Society of Obstetricians and Gynaecologists of Canada [SOGC], 2022)) The symptoms were divided into 4 categories: vasomotor, genitourinary, mental health, and other changes related to the hormonal shift. These categories cover the full range of menopausal symptoms. The treatments were categorized into Classic MHT, Novel Hormone Treatments, Antidepressants, Lifestyle Modifications and Herbal Treatments. Under this framework, only posts with explicit, category-matched terminology were counted: symptoms and treatment words were extracted from the text (the patient-reported posts) using a predefined set of keywords (*see Dictionary in Supplementals*) and the occurrences of each symptom, sub-symptom and treatment were counted. The results were compiled for ranking, grouped by category and sorted by the count to get the top 14 symptoms experienced within the given forum. The percentages for each category were also displayed. Upon getting these results, the top 5 treatments for each symptom were extracted. Using this information, these graphs were constructed.

Figure 2.1: Reddit: Symptom/Treatment Frequency of Mentions

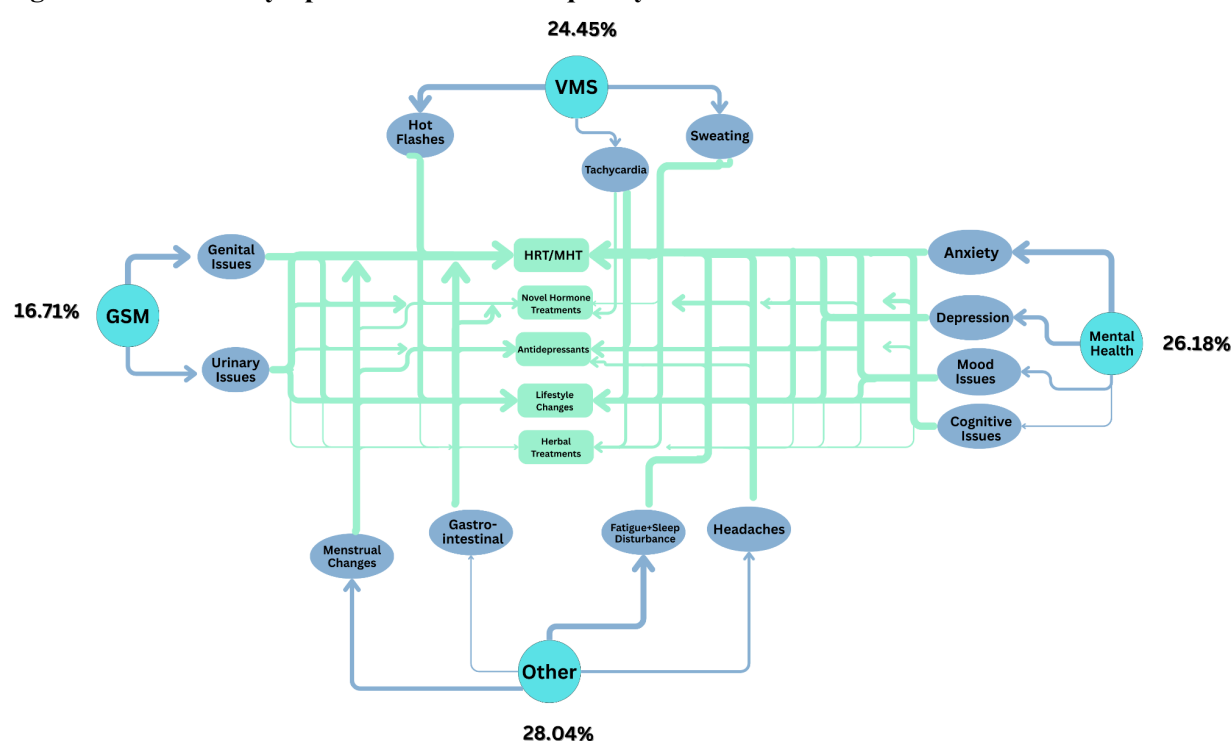


Figure 2.1: This graph illustrates the network of mentions of the symptoms and treatments in the Reddit dataset, scraped from r/Menopause. The weight of the nodes in this chart represents the amount of times a given symptom or treatment is referenced in the data, with the thicker arrows indicating greater connections. The symptom categories illustrated in the light blue circles are as follows: VMS (Vasomotor), GSM (Genitourinary), Mental Health, and Other. The most highly mentioned sub-symptoms within each category are illustrated in dark blue: VMS- hot flashes, tachycardia, sweating; GSM- genital issues, urinary issues; Other- menstrual changes, gastrointestinal, fatigue and sleep disturbances, headaches; mental health- anxiety, depression, mood issues, and cognitive issues. The top treatment categories are shown in green: HRT/MHT, Novel hormone treatments, antidepressants, lifestyle changes, and herbal treatments. See Dictionaries in appendix to get a full description of what these treatment categories encompass.

Figure 2.2: Menopause Mandate: Symptom/Treatment Frequency of Mentions

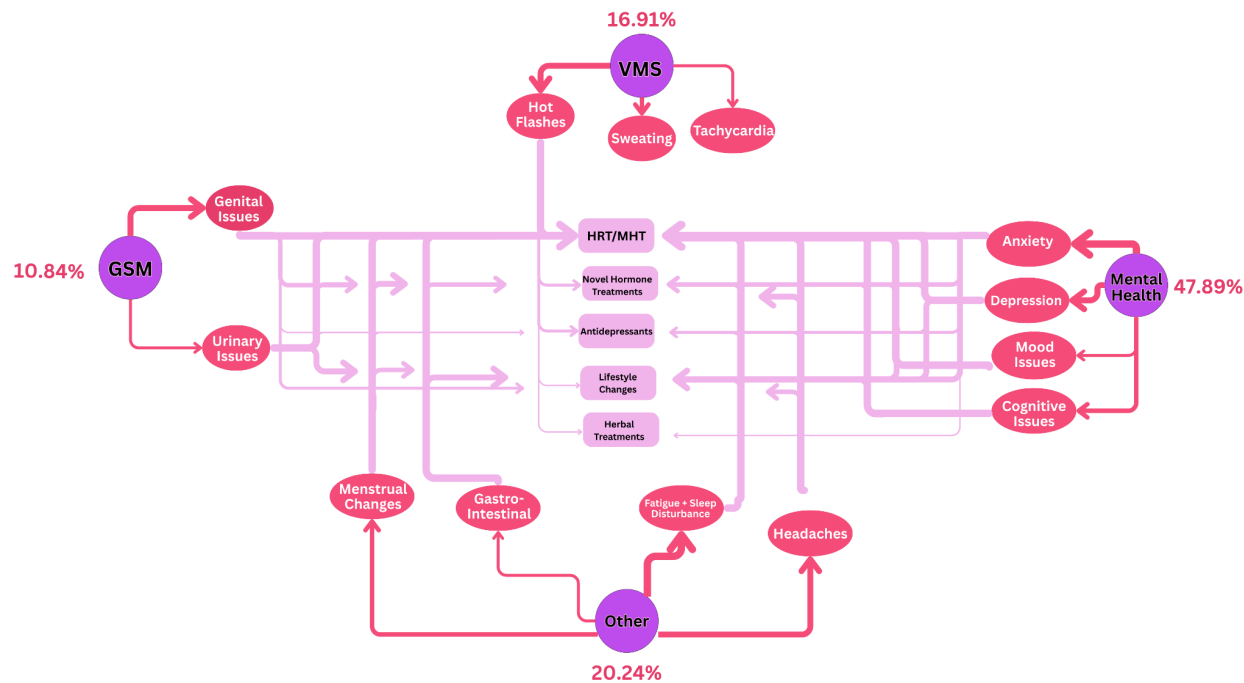


Figure 2.2: This graph illustrates the network of mentions of the symptoms and treatments in the Menopause Mandate dataset. The weight of the nodes in this chart represents the amount of times a given symptom or treatment is referenced in the data, with the thicker arrows indicating greater connections. The symptom categories illustrated in the purple circles are as follows: VMS (Vasomotor), GSM (Genitourinary), Mental Health, and Other. The most highly mentioned sub-symptoms within each category are illustrated in red: VMS- hot flashes, tachycardia, sweating; GSM- genital issues, urinary issues; Other- menstrual changes, gastrointestinal, fatigue and sleep disturbances, headaches; mental health- anxiety, depression, mood issues, and cognitive issues. The top treatment categories are shown in light pink: HRT/MHT, Novel hormone treatments, antidepressants, lifestyle changes, and herbal treatments. See Dictionaries in appendix to get a full description of what these treatment categories encompass.

Figure 2.3: Patient.Info: Symptom/Treatment Frequency of Mentions

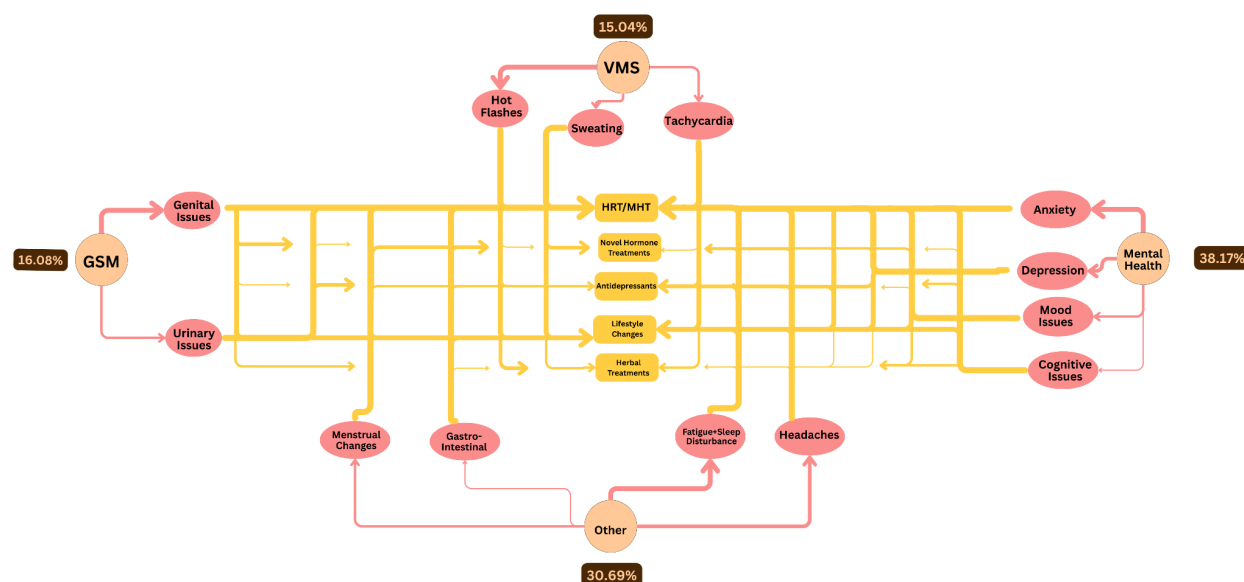


Figure 2.3: This graph illustrates the network of mentions of the symptoms and treatments in the Patient.Info dataset. The weight of the nodes in this chart represents the amount of times a given symptom or treatment is referenced in the data, with the thicker arrows indicating greater connections. The symptom categories illustrated in the orange circles are as follows: VMS (Vasomotor), GSM (Genitourinary), Mental Health, and Other. The most highly mentioned sub-symptoms within each category are illustrated in red: VMS- hot flashes, tachycardia, sweating; GSM- genital issues, urinary issues; Other- menstrual changes, gastrointestinal, fatigue and sleep disturbances, headaches; mental health- anxiety, depression, mood issues, and cognitive issues. The top treatment categories are shown in yellow: HRT/MHT, Novel hormone treatments, antidepressants, lifestyle changes, and herbal treatments. See Dictionaries in appendix to get a full description of what these treatment categories encompass.

Most Mentioned Categories

Mental health took up the overwhelming majority of symptom category discussions throughout the forums, being the most highly referenced category everywhere except Reddit, where it came in second at 26.18% behind “other” symptoms (28.04%), which can be explained by fatigue as a trans-categorical symptom which may truly apply in either context, but in this study, was classified into “other” along with sleep symptoms. Vasomotor symptoms were highly addressed throughout each forum, but fell into the third most referenced category among all 3 forums. This indicates that these symptoms are an extremely common issue, but perhaps the treatment is more straightforward and people struggle with addressing it less than they do with their mental health and “other” symptoms.

Most Mentioned Sub-Symptoms

“Vasomotor”, or VMS symptoms on these graphs consist of hot flashes, tachycardia, and sweating as the most highly referenced symptoms within the category. Among each forum, hot flashes were the most highly referenced, followed by sweating, and then tachycardia. While there were other symptoms in the dictionary that are linked to VMS, these 3 were the most highly mentioned across forums. The Mental Health category consisted of Anxiety, Depression, Mood and Cognitive issues. Similarly, anxiety

symptoms were ranked the highest, followed by depression in each forum. There was a little variation in whether mood issues or cognitive issues followed next between charts, with the Menopause Mandate group counting cognitive issues as higher while the other 2 referenced mood more. “Other” symptoms were made up of fatigue/sleep disturbance, headaches, menstrual changes and gastrointestinal symptoms, which was universal among all 3 forums regarding which unclassified symptoms were brought up most frequently. Fatigue and sleep disturbances made up the largest percentage of this category in all 3 forums, followed by headaches or menstrual changes (*headaches=2nd: patient.info, menopause mandate, menstrual issues=2nd: Reddit*), with gastrointestinal symptoms taking up the smallest amount of references, but still beating out other unclassified symptoms such as acne, breast soreness, etc (*see Dictionary in Supplementals*). Within the Genitourinary symptom category, genital issues were referenced at a higher percentage than urinary issues across all 3 forums as well.

Top Treatments Discussion

MHT/HRT remains the most highly mentioned across symptoms, sub-symptoms, and forums, with lifestyle modifications coming in as the second most frequently referenced. Within the Vasomotor symptom category, MHT/HRT is followed by Lifestyle Modifications within the Reddit and Patient.Info datasets for all the subsymptoms (hot flashes, sweating, tachycardia). This is followed by antidepressants for all 3 vasomotor sub-symptoms within the Reddit category, with a little more variation in the Patient.Info dataset. Novel hormone treatments and herbal treatments consistently take last place with variation by sub-symptom across each forum. Within MenopauseMandate, novel hormone treatments, antidepressants, and lifestyle modifications take a backseat to MHT/HRT, with only about 1-3 mentions each. Within the Genitourinary Syndrome category, MHT/HRT is followed by lifestyle modifications across genital issues, urinary issues, and across all 3 forums once again. Novel hormone treatments takes third place, except for urinary issues in patient.info exhibiting a higher correlation with antidepressants. Antidepressants typically follow after this, and herbal treatments come in mainly last, with some variation; Herbal treatments are not referenced in correlation to genital or urinary issues at all within Menopause Mandate. They are not referenced in relation to urinary issues within patient.info either. Within the Mental Health category, MHT/HRT is followed by lifestyle modifications across all 3 forums and 4 sub-symptoms. Antidepressants generally rank 3rd (especially in treating Depression and Mood Issues). Novel Hormone Treatments are most commonly in 4th place, though they are mentioned more frequently in forums discussing Hormone Therapy and Cognitive Issues. Herbal treatments remain on the lower end of treatment frequency but still appear across sub-symptoms, particularly in the Reddit forum, where alternative medicine discussions tend to thrive. The Menopause Mandate dataset (middle, pink) heavily weights Mental Health symptoms (with a 47.89% prevalence), showing slightly greater integration of antidepressants and alternative treatments than the other two datasets. Within the “Other” symptoms category, lifestyle modifications continue to take majorly second place, except for “headaches” and “menstrual changes” within the Menopause Mandate dataset, for which novel hormone treatments come in second instead. Novel hormone treatments often take third place, although in some symptoms, particularly “headaches” and “menstrual changes” in the Menopause Mandate dataset, they move up to second place. Antidepressants sometimes switch places with novel hormone treatments for third or fourth place, depending on the symptom and dataset (e.g., they seem relatively more discussed for mental health symptoms like mood issues and cognitive concerns). Herbal treatments consistently remain in last place in

terms of references across symptoms and forums, indicating a lower level of clinical endorsement or patient discussion.

Overall, Menopausal Hormonal Therapy, or Hormone Replacement Therapy (MHT/HRT) is reinforced as the gold standard treatment through its frequent, unanimous mention across symptoms and forums as the most relevant treatment. However, the common mention of lifestyle modifications as a secondary treatment, in almost every symptom and forum, suggests users also seek non-pharmacological ways to manage symptoms. Antidepressants as a treatment category show variable prominence based on forum type, seemingly mainly relevant for mental health and vasomotor symptoms, but they don't actually take up a very high ranking among mental health symptoms despite that. Novel hormone treatments gain slightly more traction in newer, alternative-focused discussions, but generally remain lesser mentioned. Herbal treatments, despite some attention on Reddit, have minimal overall impact across the datasets, indicating limited mainstream acceptance or emphasis. Overall, the consistency across platforms and symptom types suggests that while patients are exploring alternative options, standard hormone therapy and lifestyle changes remain the dominant themes across menopause symptom management discussions.

Flowchart Takeaways

Overall, Mental Health symptoms are shown to dominate the majority of the discussions across the forums, aside from Reddit in which case the "other" symptom category slightly surpassed them, likely due to a strong influence from sleep and fatigue issues as a symptom that may span multiple categories. Vasomotor symptoms appear to be an ongoing aspect of discussion, as they are widely referenced but generally rank 3rd overall, suggesting they are common but perhaps more straightforward to manage than mental health or fatigue-related symptoms. Within each of these four bigger symptom categories, *hot flashes* make up the majority of the vasomotor discussions, *anxiety* ranks highest as a symptom within mental health conversations, and *fatigue/sleep disturbances* were the top "other" symptoms across all datasets. Genital issues were more frequently discussed than urinary issues within the genitourinary category. Regarding treatments, *MHT/HRT* was consistently the most mentioned intervention across symptoms, sub-symptoms, and forums, with *lifestyle modifications* firmly in second place. *Antidepressants* usually ranked third, especially for some mental health and some vasomotor symptoms, despite the convention that they may be more directly relevant in mental health discussions. Novel *hormone treatments* and *herbal treatments* were referenced much less frequently, but novel hormone treatments showed more variation, and higher mentions in Menopause Mandate.

Differences in the datasets indicate that Reddit features a greater alternative treatment community, while Menopause Mandate particularly appears to emphasize mental health more heavily than the other forums, with slightly more mention of antidepressants and novel therapies. Herbal treatments consistently remained the least discussed across all symptoms and forums, which likely stems from a lack of clinical approval and/or patient knowledge about available options. Overall, the findings reflect the guidelines' hesitance regarding alternative therapies, a reliance on HRT as the primary treatment for essentially any of the symptoms, and support the dominance of VMS in the standard of care for treatment discussion, as it is consistently brought up across forums. However, Vasomotor symptoms are not actually the most frequently mentioned by the users posting on these forums as it is by clinicians; rather, there is a staggering gap where the data highlights a strong patient focus on mental health and fatigue during

menopause, but this focus was barely found through the analysis of the guidelines, with low ratings all around for the majority of approaches to mental health symptoms and treatment.

Part 3: Temporal Analysis

Now, we have a clearer picture of both the guidelines and the landscape around symptom and treatment discussions within the 3 forums we have chosen to analyze, and our results most staggeringly point to patients experiencing mental health symptoms which are not adequately addressed in the medical standard of care. To build upon this, we will examine whether users' posts reflect this- as in, analyzing user sentiment over time and posts to get an idea of whether posts get more positive or negative over time, whether people who come back continuously to post again find solutions to their struggles or if it continues to lack as they post more and as time goes on independently of how much more they post. Additionally, while the symptom/treatment reference flowcharts show us the distribution of references among these clinical factors, we would like to take a closer look at some of the themes that are being discussed independently of that scope, as well as how the themes may change over time; whether shifts in real-world events may correlate with changes in the user landscape and outlook towards specific symptoms, treatments, or general attitudes towards aging and menopause.

Methods:

I aimed to analyze how sentiment changed in menopause forums across time using two datasets. Given that post volume varies drastically by year, I implemented a few measures to account for this discrepancy. For sentiment analysis, I used TextBlob, filtering out years with outlier post volumes: years under 2016 in Reddit (with fewer than 93 posts) and years under 2014 in the patient.info dataset. To account for increasing post volume over time, I employed a weighted sentiment calculation using the inverse of the post volume for each month. Since the weights are inversely related to post volume, years with higher post volumes had each individual post contribute less to the monthly sentiment score. This method prevents high post volume years from disproportionately influencing the sentiment analysis.

Next, I standardized the sentiment scores before applying the weights to ensure that sentiment scores were normalized across all years, regardless of post volume. To smooth out any spikes or anomalies resulting from sudden increases in post volume, I applied a 3-month rolling window. Additionally, I conducted a cumulative analysis of repeat posters to further balance the dataset. By focusing on repeat authors, I minimized the effect of varying post volumes across years, as the sentiment trends for repeat authors tend to be smoother and less influenced by the volume of posts.

Figure 3.1: Dataset Distribution

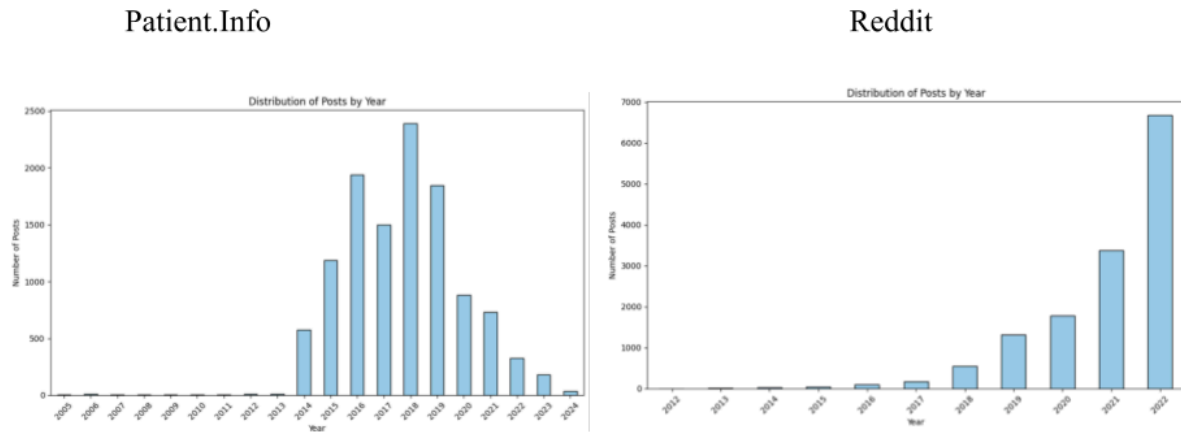


Figure 3.1: Data distribution shows the annual post volume distribution for the *Patient.Info* and *Reddit* datasets. This figure displays the number of posts per year across both platforms, highlighting trends in discussion frequency over time.

Datasets: Reddit and Patient.Info Descriptive Statistics

In the Patient.info dataset, 11,590 posts were analyzed. In the Reddit Dataset, 13,961 posts were analyzed. After standardization, the mean for the patient.info dataset is near zero. The mean of the standardized sentiment of the reddit dataset is also extremely close to zero ($1.53e-17$), with a standard deviation of 1. This suggests that, after standardization, the overall sentiment across all posts is neutral. Within both datasets, sentiment scores range from very negative to very positive ($Min = -5.09$, $Max = 5.08$ and -6.69 and 6.1 , respectively). In both datasets, 25% of posts have sentiment scores lower than this, meaning a good portion is negative; the median sentiment is very slightly negative, suggesting more negative posts overall; and 75% of posts have sentiment scores lower than this, showing that while some are positive, sentiment is quite mixed. (*Patient.Info*: 25th percentile ($Q1$)= -0.49 , $Q2=-0.005$, and $Q3=0.50$. *Reddit*: 25th percentile ($Q1$)= -0.334 , $Q2=-0.213$, $Q3=0.471$). Patient.Info is slightly left-skewed, meaning there are more extreme negative values than extreme positive ones, but not dramatically ($skew=-0.139$). Reddit indicates a slight tendency for posts to have more positive sentiment than negative. The skew is relatively mild, so it's not a strong indicator of a major shift in sentiment towards positivity ($skew=0.2$). Patient.info Kurtosis is 3.902, suggesting a leptokurtic distribution with more extreme sentiment values than a normal distribution. Kurtosis in the reddit dataset is 5.712, suggesting that the sentiment distribution has more extreme values than a normal distribution as well.

The overall emotional trend of posters over time

Figure 3.2: All Posters: Weighted and Standardized Average Sentiment over Time

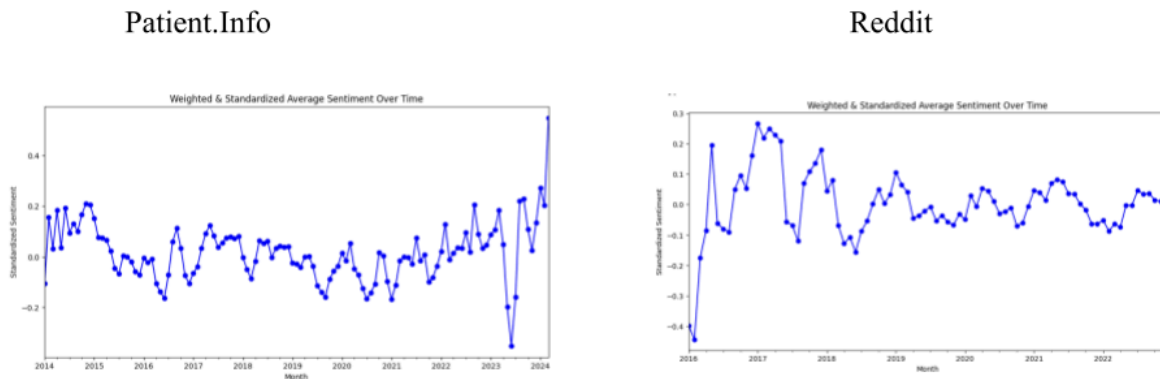


Figure 3.2: This figure shows the weighted and standardized average sentiment over time for the *Patient.Info* and *Reddit* datasets. Sentiment values were adjusted for post volume to provide a normalized view of how emotional tone changed over time within each platform. This visualization allows for direct comparison of sentiment trends across forums despite differences in user activity levels.

To effectively visualize how sentiment changed in menopause forums across time and correct for post volume differences, I created several graphs using the weighted and standardized sentiment that takes post volume into account. Figure 3.2 demonstrates the Weighted & Standardized Average Sentiment Over Time; Patient.Info's dataset shows that the Sentiment fluctuates over time but shows an increasing trend from 2021 onwards, with a significant peak at the end of 2023. Reddit demonstrates a more stable Sentiment, with initial fluctuations around 2016-2017, then a steadier pattern without major shifts. Additionally, to visualize whether sentiment is increasing, decreasing, or staying stable over time, we conducted an additional linear regression calculation of the sentiment trend for both datasets (SUPP. FIGURE A.3). Within Patient.info, the slope came out to essentially 0, meaning there is no real trend in sentiment over time. The sentiment variance is not explained by time at all ($R^2=0.00$). There is no statistical evidence that the sentiment has changed over time, suggesting it has remained stable with no clear increasing or decreasing trend (P-Value = 0.144). Within Reddit, the slope of the linear regression is also 0, indicating no significant linear trend in sentiment over time. The R^2 value is also near 0, meaning that the model does not explain any of the variation in sentiment with respect to time. The p-value is greater than the common significance threshold (0.05), indicating that the linear regression model is not significant ($p=0.7435$), meaning that there is no statistically significant relationship between time and sentiment of posts in the Reddit forum.

We were also interested in assessing whether the sentiment was persistent, or if it changes randomly. To measure that, we could look at how past sentiment scores influence future scores through an autocorrelation of sentiment test for both datasets (SUPP. FIGURE A.3). The autocorrelation values show how the sentiment at time t is related to the sentiment at previous time points. At Lag 1, both datasets show little correlation, meaning sentiment in one post barely influences the next (*Patient.info*=0.0136, *Reddit*=0.0123). Lags 2-4 in both datasets feature values close to 0, meaning no strong patterns (*Patient.info* (-0.0049), Lag 3 (0.0041), Lag 4 (-0.0062), *Reddit* -0.0003 to -0.0030). Therefore, the

sentiment for either dataset does not exhibit strong persistence—users' sentiment scores are random, and do not follow a predictable pattern over time.

Overall, Reddit and Patient.info show close similarities in their sentiment distribution, trend, and autocorrelation. The sentiment across posts is roughly centered around neutral, but with some outliers of highly negative and positive posts. The overall sentiment in the dataset does not show a clear trend over time, and there isn't much predictability in the sentiment based on previous posts. However, the presence of extreme sentiment values indicates that, while most posts are neutral to slightly positive, there are still some posts expressing extreme opinions or emotions. Differences between the datasets lie mainly in the details rather than the big picture.

The overall emotional trend of Repeat posters over real-world time — are they getting more positive or negative as months go on?

Figure 3.3: Repeat Posters and their Cumulative Sentiment Trend Over Time

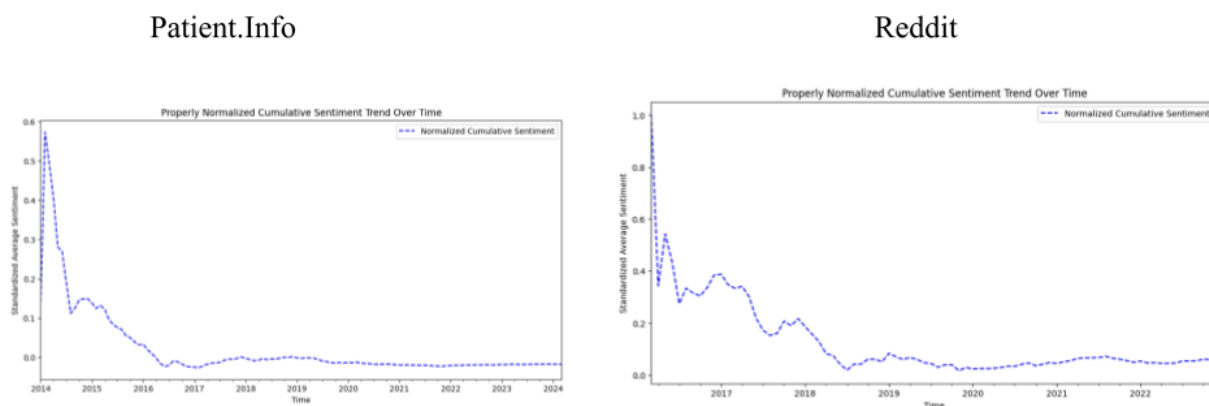


Figure 3.3: This figure shows the cumulative weighted sentiment over time for repeat posters in the *Patient.Info* and *Reddit* datasets; illustrating longitudinal sentiment trends by aggregating and normalizing monthly sentiment scores across users who posted multiple times. The use of cumulative averaging reduces noise caused by small sample sizes and highlights broader emotional trajectories over time. This method captures whether repeat posters, on average, tend to express increasingly positive or negative sentiment as time progresses, independent of individual posting frequency or monthly variation.

This analysis aims to find out whether as time goes on, independent of how many times they have posted, if users show change in either direction. For the whole population of all posters, a monthly average of standardized sentiment was calculated, adjusted by post volume (weighted), then smoothed using a rolling average to show the general sentiment trend fluctuates over time. For repeat posters, these graphs come from the computation of how the sentiment trend aggregates month over month. This is different in order to observe longitudinal sentiment- seeing how sentiment evolves across multiple posts per user. Cumulation aggregates that signal to smooth noise, showing whether these users are on average

trending more positively or negatively over time. Additionally, it is more stable- since repeat posters are fewer and their monthly post count is smaller, a rolling or per-month average may be too noisy. Cumulative sentiment also shows whether engagement from repeat posters is increasingly positive or negative overall, as opposed to fluctuating monthly emotion.

When Properly Normalizing the Cumulative Sentiment Trend Over Time for repeat posters, Patient.Info shows a sharp drop in cumulative sentiment from 2014 to ~2016, indicating that repeat posters started off with a higher sentiment, which then declined (Figure 3.3). After 2017-2018, sentiment plateaus at a consistently low level, suggesting repeat users maintain a more neutral or slightly negative sentiment over time. Reddit also shows an initial drop (2016-2017) but stabilizes slightly higher than Patient.Info post-2018, retaining a slightly higher cumulative sentiment level over time. Unlike Patient.Info, sentiment appears to recover slightly after 2018, suggesting repeat posters on Reddit maintain a more balanced emotional tone. There is more fluctuation in sentiment compared to Patient.Info, meaning Reddit discussions might involve stronger emotional variation.

Overall, this suggests that Repeat users on both platforms started off with higher sentiment, which declined over time. Patient.Info repeat users show a long-term plateau at a lower sentiment level, suggesting possible frustration or lack of resolution. Reddit's repeat users show more fluctuations and slightly higher sentiment recovery, indicating a potentially more dynamic or supportive discussion environment.

Do users' sentiments improve or worsen the more they post?

Figure 3.3: Repeat Posters' Smoothed Average Sentiment Over Time

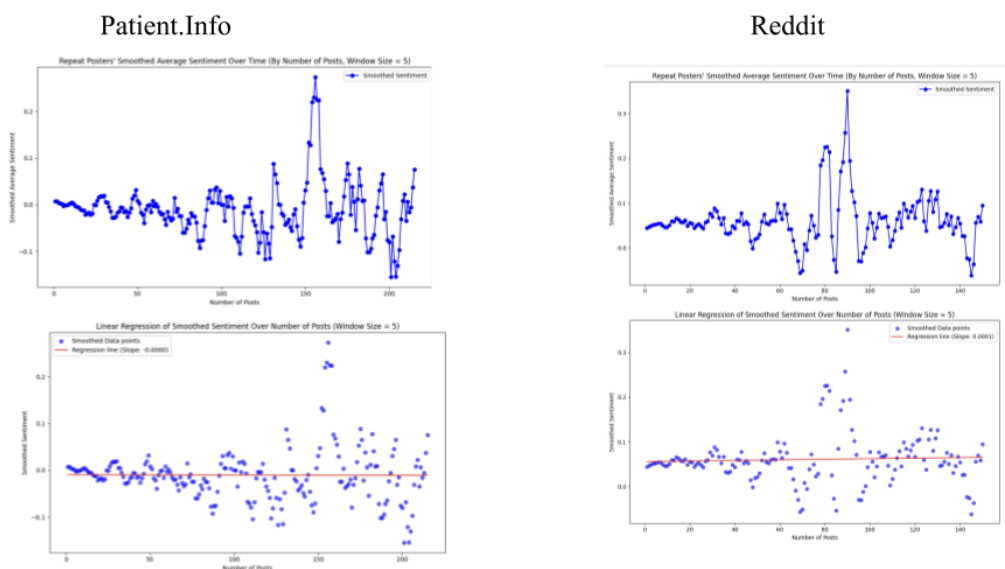


Figure 3.3: This figure shows the smoothed average sentiment by cumulative post number and corresponding linear regression for repeat users in the Patient.Info and Reddit datasets.

The first panel shows the rolling average of sentiment scores by cumulative post number, illustrating the general emotional trajectory as users post more frequently. A smoothing window of five posts was applied to reduce short-term noise. The second panel presents the linear regression model (x = post number, y = sentiment score), used to test whether sentiment becomes significantly more positive or negative with increased engagement. Together, these plots examine whether repeat users experience shifts in sentiment as they continue participating in menopause-related forums.

This analysis aims to find out if users' sentiments may change as they post more. To do so, we first computed the cumulative post count, and then averaged the sentiment scores across all users for each post number. To smooth short-term fluctuations in average sentiment across post counts, we applied a rolling average with a window size of 5, producing a smoothed sentiment trajectory. A linear regression (x =*number of posts*, y =*smoothed sentiment score*) was then conducted to statistically test whether sentiment increases or decreases over time. The distribution of sentiment in the Patient.Info dataset varies slightly with post count but fluctuates randomly, without a clear upward or downward trajectory. In comparison, the distribution of sentiment in Reddit shows fluctuation around a mild positive baseline, with some mid-range noise. There is no clear increase or decrease in sentiment with increased posting. Overall, both datasets show relatively stable sentiment over time, with occasional spikes. Sentiment is slightly more erratic in Reddit, indicating some emotionally charged discussions. To further quantify the relationship between post count and sentiment and determine if the relationship is positive, negative, or neutral, a linear regression was conducted on top of the original sentiment analysis (Figure 3.3). The linear regression of sentiment vs. number of posts in Patient.Info showed an essentially flat, but very slight negative trend (slope=-0.000), with a p-value of 0.9127, meaning there is no evidence sentiment does not significantly change with more posts. Reddit has a slightly more positive slope than Patient.Info (slope=0.001), implying repeat users may express slightly more positive sentiment over time in comparison. However, as this slope is not statistically significant either (P-value: 0.5498), this could easily occur by chance- a more accurate interpretation would be that sentiment remains relatively flat, and the users' emotional tone does not systematically change the more they contribute to the platform. This lack of significant change in sentiment among repeat posters suggests that those who stay engaged over time may not necessarily find the solutions they seek, but their experience does not necessarily get worse over time either. Rather, the data suggests more stagnation embedded in their experience.

Thematic Analysis of Discussion Topics

Figure 3.4: Themes and their Frequencies in the Patient Communities

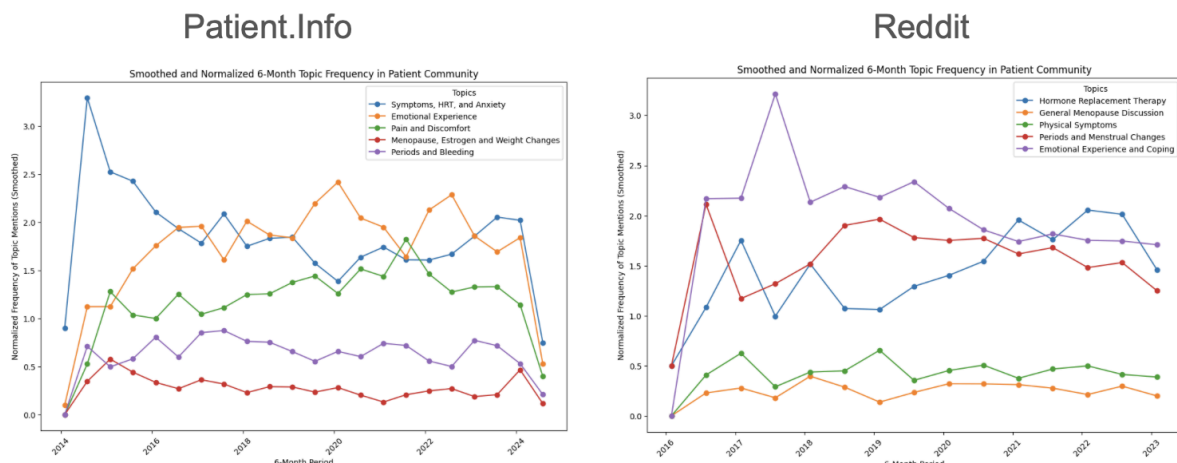


Figure 3.4: This figure shows the trajectories of the most frequently discussed themes over time in the *Patient.Info* and *Reddit* datasets. Each line represents a thematic category extracted using Latent Dirichlet Allocation (LDA) topic modeling, based on a five-topic model trained on preprocessed post text. Topic frequencies were normalized by post volume, smoothed using a rolling average, and plotted to reveal long-term trends. The five most prominent themes in *Reddit* include “Symptoms, HRT, and Anxiety”, “Emotional Experience”, “Pain and Discomfort”, “Menopause, Estrogen, and Weight Changes”, and “Periods and Bleeding”; in *Patient.Info*, it is “Hormone Replacement Therapy”, “General Menopause Discussion”, “Physical Symptoms”, “Periods and Menstrual Changes”, and “Emotional Experience and Coping”. Colors correspond to these topics, as indicated in the legend.

Thematic analysis shows hormonal replacement therapy, emotional experiences, menstrual changes, and physical discomfort as largely common themes across both datasets (Figure 3.4). First, months with a low threshold of posts (10 or less) were excluded to minimize noise from small sample sizes. Then, the text was preprocessed by removing common HTML artifacts, URLs, non-alphanumeric characters, and stopwords, as well as tokenizing the text and filtering out short words. Then, to extract the themes, we applied a Latent Dirichlet Allocation (LDA) topic model with five topics, trained using 10 passes and a fixed random state for reproducibility. Each post was then assigned to its most likely topic based on the highest probability score from the LDA model, and the topics were labeled by their most frequent terms. To analyze how these topics evolved over time, we calculated the monthly topic distribution and normalized topic counts by the total number of posts per month to control for fluctuations in posting volume. The data was further smoothed via a rolling mean to smooth the monthly topic trends, which helps mitigate fluctuations due to short-term spikes in post volume. To account for varying post volumes, the topic trends were then normalized by dividing them by the smoothed post counts, ensuring that trends reflect relative rather than absolute topic frequencies. After smoothing and normalizing, the data was resampled to 6-month periods to further reduce noise and examine longer-term trends in topic discussions.

Identified topics in the Patient.Info dataset revealed the following combinations of terms: Topic 1: 0.011*"symptoms" + 0.010*"hrt" + 0.009*"help" + 0.009*"years" + 0.009*"anxiety", Topic 2: 0.027*"feel" + 0.027*"like" + 0.014*"feeling" + 0.012*"get" + 0.009*"going", Topic 3: 0.027*"pain" + 0.018*"anyone" + 0.013*"like" + 0.012*"else" + 0.011*"back", Topic 4: 0.014*"menopause" + 0.009*"women" + 0.008*"estrogen" + 0.008*"said" + 0.006*"weight", and Topic 5: 0.034*"period" + 0.020*"days" + 0.017*"periods" + 0.016*"last" + 0.014*"bleeding". We translated these, respectively, into the themes of “Symptoms, HRT, and Anxiety”, “Emotional Experience”, “Pain and Discomfort”, “Menopause, Estrogen, and Weight Changes”, and “Periods and Bleeding”. *Symptoms, HRT, and Anxiety* demonstrated an early spike that peaked around 2015, then steadily declined until 2019. It had a mild rebound from 2020–2023, and noticeably declined towards the end. This suggests an early period of high concern or awareness about HRT and anxiety symptoms, and its later rise could be tied to renewed HRT conversations or anxiety-related concerns during the COVID-19 pandemic. Its drop several years after could reflect shifting priorities in discussion, or lower forum engagement in this topic. *Emotional Experience* had a steady upward growth from about 2014–2019, peaking around 2020. This indicates rising interest or concern about the emotional toll of menopause, and its multiple local maxima from 2020–2023 suggest renewed attention or specific events triggering discussion. However, similarly to the prior topic, it also declines at the end, which could be an artifact of lower post volume or saturation of the topic. *Pain and Discomfort* shows moderate growth with fluctuations from 2015–2021, which could indicate a growing willingness to discuss physical symptoms. However, after a peak around 2021, the topic stabilizes a bit and then drops, mirroring the trends in related symptom discussions. *Menopause, Estrogen, and Weight Changes* has a consistent low and flat trend, suggesting that physiological and metabolic concerns are less central to the community's discussions in comparison to the more frequently mentioned topics. However, this could also be due to a broader collection of terms being encompassed in this theme, and that the forum simply does not have very strong thematic mentions past the first three. *Periods and Bleeding* contains a moderate discussion volume from 2015–2018, initially rising and then plateauing for a bit. This likely reflects perimenopausal concerns. Through 2024, it remains a flat, stable presence, suggesting it's a persistent but secondary theme as compared to the others.

Identified topics in the Reddit Dataset revealed the following combinations of terms: Topic 1: 0.020*"progesterone" + 0.019*"estrogen" + 0.017*"hrt" + 0.014*"patch" + 0.012*"night", Topic 2: 0.021*"menopause" + 0.017*"women" + 0.005*"people" + 0.005*"health" + 0.005*"one", Topic 3: 0.013*"like" + 0.013*"hair" + 0.012*"hot" + 0.008*"get" + 0.007*"one", Topic 4: 0.017*"period" + 0.011*"days" + 0.010*"last" + 0.010*"years" + 0.009*"periods", and Topic 5: 0.015*"like" + 0.011*"feel" + 0.009*"get" + 0.009*"know" + 0.007*"years". We translated these, respectively, into the themes of “Hormone Replacement Therapy”, “General Menopause Discussion”, “Physical Symptoms”, “Periods and Menstrual Changes”, and “Emotional Experience and Coping”. The topic of *Hormone Replacement Therapy (HRT)* grew gradually from 2016 onward, with peaks around 2021–2022, then a slight drop in 2023. This increase correlates with greater UK media coverage in 2021–2022, Growing public literacy about HRT’s nuances after decades of misinformation, and greater anxiety surrounding the COVID-19 pandemic, which may have driven people to seek solutions or report worsening symptoms. *Emotional Experience and Coping* had generally high levels, peaking around 2017 with consistently high levels until about 2020, where it began to gradually decline. This early high prevalence likely reflects the strong emotional toll menopause takes, especially in anonymous or supportive spaces like Reddit. Over time, this might have diversified into more specific symptom or treatment discussions, or migrated to

other platforms. Its dominant presence early on really highlights how emotional validation and peer support appear to be major drivers for forum use. *Periods and Menstrual Changes* also had a sharp increase in between 2016 and 2017, dropped, rose a little again and then remained relatively stable with a slight downward trend. These inconsistencies might reflect perimenopausal uncertainty, as users attempt to understand irregular or unexpected cycle changes. The stability of the topic throughout this time implies sustained relevance as a marker of transition. *Physical Symptoms* stays a consistently low and relatively flat topic, with small bumps over time. This is likely under-discussed in comparison to the other topics, which could also be due to users framing their experiences in more emotional or systemic terms rather than purely physical symptoms. Therefore, physical symptoms could be distributed across other categories and themes. Lastly, the *General Menopause Discussion* theme also prevails, remaining Low and stable throughout the timeline. This in combination with the other themes' prevalence suggests that posts may focus more on specific aspects rather than abstract or general menopause talk, potentially looking for targeted advice as opposed to overviews.

What do these results mean, together?

Overall, the steadily high presence of emotional and anxiety-related discussions on both Patient.Info and Reddit reflects broader societal trends in destigmatizing mental health. On Patient.Info, this increase becomes especially prominent around 2020, likely amplified by the COVID-19 pandemic, which intensified health-related anxiety. Similarly, Reddit shows a strong and sustained emphasis on emotional experience and coping throughout the observed period, suggesting that users seek peer support and shared narratives as they navigate menopause. These emotional trends across both platforms highlight the growing importance of mental health in public discourse and patient-led communities. Additionally, the spikes in HRT discussions appear to moderately coincide with media coverage and changes in clinical guidelines. Around 2015, a renewed interest in HRT emerged, driven by academic reanalyses of the Women's Health Initiative (WHI) results, which initially led to sharp declines in HRT use due to concerns about cancer and cardiovascular risks (Guay 2007, Rossouw 2002). Subsequent reassessments showed that these risks vary by age and timing of initiation, prompting greater consideration of HRT's benefits for recently menopausal women (Manson et al., 2013). Media coverage at the time also began challenging the earlier stigmatization of HRT: articles in outlets like The New York Times, The Guardian, and BMJ rekindled public debate, emphasizing that HRT had been unfairly demonized ((Davis, 2015; Belluck, 2013; Manson et al., 2013)). Further, platforms like the Davina McCall Documentaries (UK): The 2021 and 2022 Channel 4 documentaries ("Sex, Myths and the Menopause") had a massive public impact in the UK, leading to spikes in menopause-related searches and forum discussion, as well as connection to an HRT medication shortage (Jermyn, D. (2024)

A second spike from 2020 to 2022 aligns with guideline updates from the British Menopause Society (BMS) and the National Institute for Health and Care Excellence (NICE), which emphasized individualized care, bioidentical hormones, and nuanced risk assessment. While Patient.Info showed earlier and steadier HRT discussion, Reddit saw a more delayed but noticeable rise, possibly reflecting increased public visibility of HRT in documentaries, news stories, and discussions of medication shortages. The decline in 2024 on both platforms is unexpected, and may reflect discussion saturation or a migration to other forums, rather than a decrease in public interest. Generally, Reddit users appear to prioritize emotional coping, menstrual confusion, and HRT exploration, with less focus on general menopause education or isolated physical symptoms. The platform's community-based, narrative-driven

format encourages real-time, peer-oriented dialogue, especially around personal experiences and public events. Patient.Info, by contrast, emphasizes symptom tracking, treatment experiences, and a more evenly distributed set of themes: likely reflecting its medically informed user base. Taken together, the trends in HRT discussion across both platforms suggest a meaningful link between media attention, clinical updates, and spikes in online discourse. And most importantly to this review, the consistent display of emotional experience as a key component of menopause narratives further builds onto the emerging storyline of mental health as a huge area of improvement for the guidelines to address.

New versus Returning Posters: Themes and Frequencies

Figure 3.5: New vs. Returning Forum Users and Topic Distributions

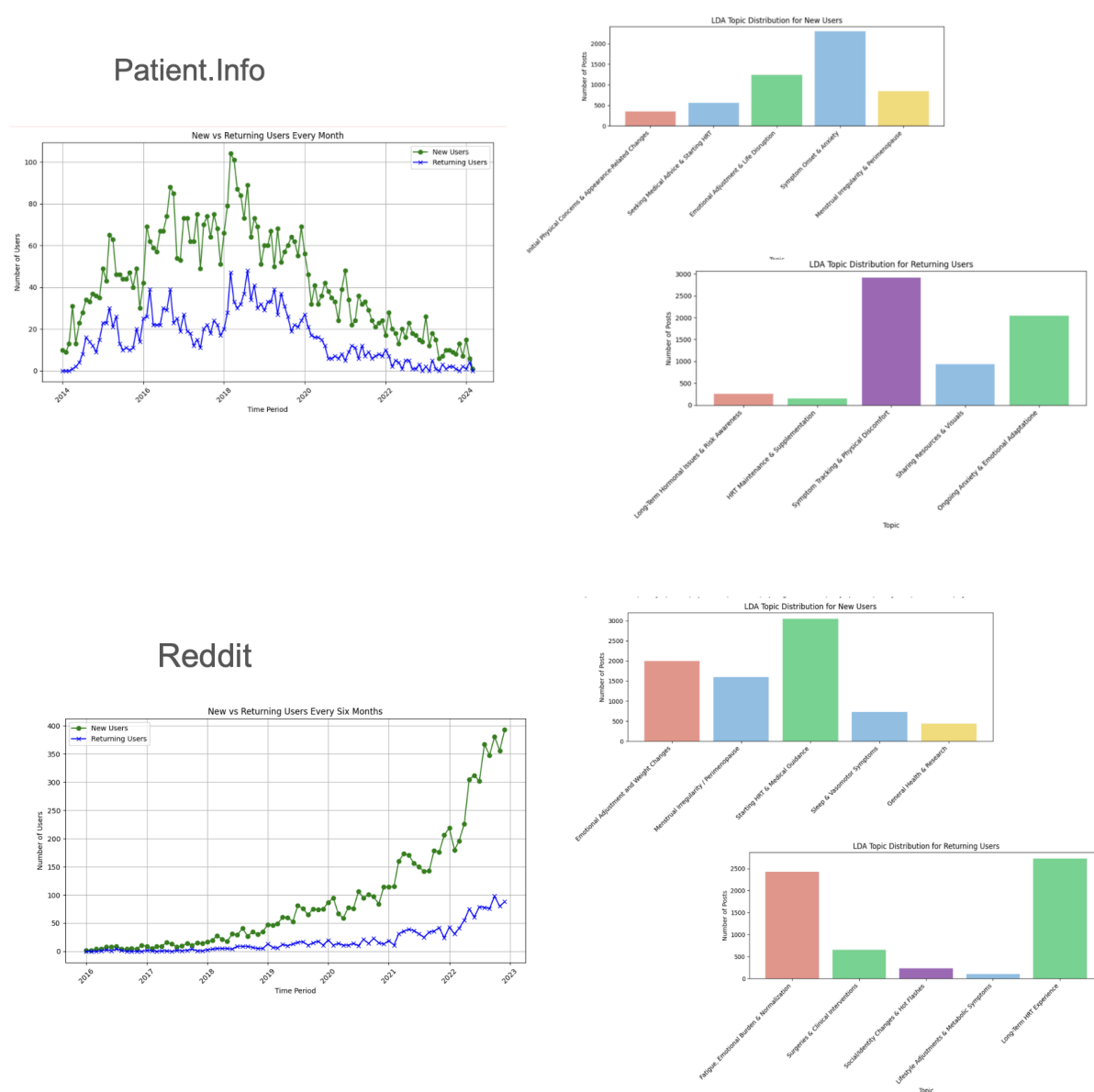


Figure 3.5: This figure presents monthly posting activity from 2014–2024 on Patient.Info and from 2016–2023 on Reddit, comparing new users (green) and returning users (blue). The line plots in the bottom panel show temporal trends, with posting peaking in the late 2010s and declining thereafter; new users consistently outnumber returning users across both platforms. The accompanying bar charts display LDA topic distributions by user type, revealing distinct thematic patterns between first-time and repeat posters.

To analyze user engagement and topic trends whilst differentiating by user type, we began by processing time stamped post data to classify users as either *new* (posting once per period) or *returning* (posting multiple times). We visualized trends in new vs. returning users over time to understand posting behavior. Text from posts was preprocessed through tokenization, lowercasing, stopword removal, and cleaning of web artifacts. Posts were then separated by user type, and Latent Dirichlet Allocation (LDA) topic modeling was applied to identify dominant discussion themes within each group. We extracted the top words for each topic, and manually categorized themes using color-coded plots for interpretability. This revealed that repeat posters most frequently discuss ongoing symptom tracking, persistent physical discomfort, and emotional adaptation, while new posters focus more on symptom onset, initial anxiety, and seeking medical advice- particularly around starting hormone replacement therapy. This suggests that people generally enter the forums with questions about treatment, initial confusion around symptoms, and emotional factors, but a significant portion of users don't find full resolution, as shown by their continued posting around the same subjects that also dominate among new users.

Using Latent Dirichlet Allocation (LDA), we extracted dominant themes from posts made by new and returning users in a menopause-focused Reddit forum. For new users, five primary topics emerged: Emotional Adjustment and Weight Changes, Menstrual Irregularity / Perimenopause, Starting HRT & Medical Guidance, Sleep & Vasomotor Symptoms, and General Health & Research. (*Topic 1: like, feel, get, know, really, years, time, even, want, weight* *Topic 2: period, days, periods, last, like, years, months, menopause, day, bleeding* *Topic 3: hrt, symptoms, estrogen, menopause, anyone, years, progesterone, started, hot, doctor* *Topic 4: hot, sleep, night, flashes, hair, get, menopause, help, like, anyone* *Topic 5: menopause, women, would, symptoms, hrt, health, anyone, research, find, help*). Among these, the most prominent was *Starting HRT & Medical Guidance* (~3000 posts), followed by *Emotional Adjustment and Weight Changes* (~2000), suggesting that new users most frequently join the forum to seek information about hormone replacement therapy (HRT)- widely considered the gold standard treatment- and to find emotional validation from others experiencing similar transitions. Notably, changes in weight surfaced frequently, indicating a common concern tied to both physical and emotional adjustment. In contrast, returning users most frequently discussed Long-Term HRT Experience, followed by Fatigue, Emotional Burden & Normalization, Surgeries & Clinical Interventions, Social/Identity Changes & Hot Flashes, and Lifestyle Adjustments & Metabolic Symptoms (*Topic 1: like, know, get, feel, menopause, time, tired, want, much, things*, *Topic 2: removed, doctor, women, one, estrogen, menopause, said, cancer, left, going*, *Topic 3: like, get, people, one, hot, feel, new, old, want, last*, *Topic 4: anyone, menopause, hot, weight, find, dry, healthy, diet, use, awful*, *Topic 5: like, days, hrt, period, still, progesterone, symptoms, anyone, started, years*). Long-Term HRT Experience is the most frequently expressed theme among returning users as well (~3000 posts), and this prominence suggests persistent information-seeking behavior and potential dissatisfaction or ambiguity surrounding HRT efficacy, side effects, or ongoing management. The sustained emotional tone, captured through fatigue and normalization themes, further highlights

menopause as a prolonged psychosocial challenge rather than a short-term transition. Taken together, these patterns indicate that while Reddit users initially enter the forum to explore treatment options and understand emerging symptoms, many remain active in continued pursuit of more nuanced guidance or validation.

For new users within the Patient.Info forum, the five primary topics showed to be initial Physical Concerns & Appearance-Related Changes, Seeking Medical Advice & Starting HRT, Emotional Adjustment & Life Disruption, Symptom Onset & Anxiety, and Menstrual Irregularity & Perimenopause (*Topic 1: hair, menopause, ladies, anyone, symptoms, weight, know, also, skin, like; Topic 2: hrt, taking, menopause, anyone, take, help, would, years, low, doctor; Topic 3: feel, like, get, going, know, time, years, really, want, life; Topic 4: like, anyone, feel, get, symptoms, feeling, pain, last, anxiety, else; Topic 5: period, bleeding, days, months, last, periods, years, blood, started, normal*). The most prominent topic was Symptom Onset & Anxiety (~3000 posts), indicating that new users most often join to make sense of distressing symptoms and seek reassurance. This was followed by Emotional Adjustment & Life Disruption (~1200 posts), with fewer posts in the other categories, suggesting that early engagement is driven by acute discomfort and a desire for validation. For returning users within Patient.Info, the themes came out to be Long-Term Hormonal Issues & Risk Awareness, HRT Maintenance & Supplementation, Symptom Tracking & Physical Discomfort, Sharing Resources & Visuals, and Ongoing Anxiety & Emotional Adaptation (*Topic 1: menopause, women, symptoms, levels, years, blood, estrogen, may, hormone, cancer; Topic 2: vitamin, hrt, hair, take, estrogen, taking, use, hot, also, premarin; Topic 3: like, feel, period, anyone, feeling, days, pain, get, back, else; Topic 4: would, view, click, image, hrt, know, ladies, take, symptoms, taking; Topic 5: feel, symptoms, get, anyone, ladies, know, like, anxiety, going, peri*). The most referenced returning-user topic was Symptom Tracking & Physical Discomfort (~3000 posts), followed by Ongoing Anxiety & Emotional Adaptation. The shift in focus from initial symptom confusion (among new users) to chronic symptom management and emotional burden (among returning users) suggests that many concerns remain unresolved over time.

This aligns with patterns observed in Reddit data: users frequently continue to post about discomfort, uncertainty, and the need for peer support despite long-term engagement. These results reinforce the idea that current medical guidance may be falling short in addressing both the physiological and psychological dimensions of menopause, and that peer forums serve as important outlets for ongoing support and experiential knowledge-sharing. Despite differences in their platforms, both Reddit and Patient.Info show strong thematic consistency in highlighting long-term physical discomfort, emotional distress, and gaps in treatment satisfaction. However, it's worth mentioning that there are more new users than returning users across both platforms- and therefore, the continued presence of unresolved issues among returning users does not necessarily mean that all users face long-term problems- some may find the support or information they need early and never return. Conversely, it's also possible that some users leave without finding adequate help. That said, the presence of over 3,000 posts expressing discomfort in each forum is still highly significant. This indicates a persistent unmet need, especially in areas like HRT (hormone replacement therapy) and symptom tracking, which appear repeatedly as central concerns across platforms.

Another particularly striking pattern is the consistent mention of emotional and psychological burden, ranking among the top two themes in both new and returning user data. This again points to a need for addressing anxiety, distress, and emotional adaptation in the context of menopause, and further

points to gaps in clinical care and unmet needs around menopause management regarding emotional burden and long-term treatment planning. The presence of these discussions truly underscores the value of digital health forums as dynamic spaces for care navigation, peer support, and learning. However, it is also important to consider that physical symptoms and mental health are deeply intertwined; while some psychiatric symptoms may arise directly from hormonal changes (e.g., estrogen decline), others are secondary effects of physical suffering, such as sleep disruption, pain, or genitourinary symptoms that erode quality of life over time. As demonstrated through this analysis, it is rarely one or the other; rather, it is a biopsychosocial interplay that requires a more comprehensive, integrative approach to care for.

Part 4: Framework and Advocating for platforms such as Menolearn

Figure 4.1: Socio-Ecological Determinants of Mental Health in Menopause.

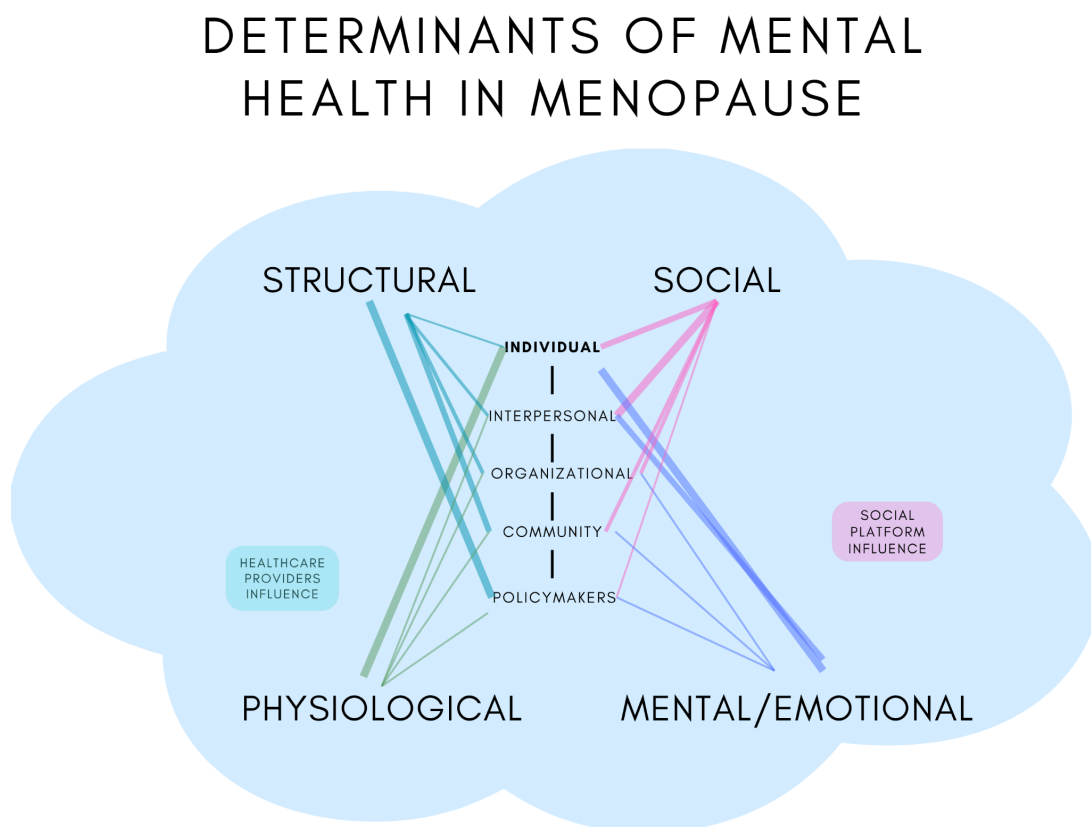


Figure 4.1: This figure adapts the socio-ecological model to illustrate the complex, bidirectional interactions among structural, social, physiological, and mental/emotional factors that influence mental health during menopause. The model is layered across individual, interpersonal, organizational, community, and policy levels. Line thickness represents the relative strength or prominence of each influence based on existing research and thematic patterns observed in user discourse. Notably, healthcare providers and social platforms are highlighted as key mediators within the structural and social domains, respectively.

Figure 4.2: Table of Factors Falling into the Categorical Determinants of MH Outcomes in Menopause

	Structural: macro	Structural: micro	
	Healthcare System and Access	Healthcare Access and Quality	
	Healthcare System and Access	Insurance Coverage Gaps	
	Healthcare System and Access	Health Care Provider Influence	
	Healthcare System and Access	Fragmentation of Medical Care	
	Healthcare System and Access	Representation and bias in Clinical Guidelines	
	Healthcare System and Access	Underrepresentation in Clinical Research	
	Education and Health Literacy	Education Access and Quality	
	Education and Health Literacy	Menopause and Mental Health Literacy	
	Living Environment and Housing	Housing Instability or Insecurity	
	Living Environment and Housing	Urban vs. Rural Health Disparities	
	Living Environment and Housing	Regional Funding Gaps	
	Living Environment and Housing	Climate Change & Heat Exposure	
	Living Environment and Housing	Environmental Stressors	
	Legal and Policy-Level	Menopause-Inclusive Public Health Policy(?)	
	Legal and Policy-Level	Mental Health Parity Gaps	
	Legal and Policy-Level	Paid Leave and Flexible Work Policies	

Physiological: Macro	Physiological: Micro	
Hormonal and Reproductive Factors	Type and Timing of Menopause	
Hormonal and Reproductive Factors	Hormonal Fluctuations / Estrogen Withdrawal	
Hormonal and Reproductive Factors	Progesterone and Androgen Levels	
Symptoms	Vasomotor	
Symptoms	Genitourinary	
Symptoms	Mental health	
Symptoms	Other symptoms: poor sleep, sexual issues, headaches, IBS, breast pain, musculoskeletal	
Lifestyle-Linked	Sedentary Lifestyle	
Lifestyle-Linked	High BMI / Obesity	
Lifestyle-Linked	Smoking Status	
Lifestyle-Linked	Alcohol Use	
Medication and Treatment Factors	Side Effects of Medications	
Medication and Treatment Factors	Use of multiple medications in midlife	
Biological Markers	Chronic Inflammation and Cytokine Activity	
Biological Markers	Thyroid Function	
Biological Markers	Genetic and Epigenetic Risk	
Biological Markers	HPA Axis Dysregulation	

Mental/Emotional: macro	Mental/Emotional: micro
Psychiatric and Psychological History	Lifetime History of Depression
Psychiatric and Psychological History	History of Anxiety Disorders
Psychiatric and Psychological History	Postpartum Depression or PMDD History
Psychiatric and Psychological History	Substance Use History
Psychiatric and Psychological History	Cognitive Vulnerability Patterns
Early-Life and Developmental Experiences	Childhood Trauma or Abuse
Personality and Coping Style	Personality Traits
Personality and Coping Style	Emotion Regulation Skills
Personality and Coping Style	Coping Style
Personality and Coping Style	Self-Compassion and Body Image Acceptance
Psychological Menopausal Symptoms	anxiety, depression, mood or cognitive changes brought on by menopausal onset
Mental Health Medication and Treatment Factors	Medication Side Effects
Mental Health Medication and Treatment Factors	Non-Adherence to Mental Health Treatment
Mental Health Medication and Treatment Factors	Attitudes Toward Therapy and Mental Illness

Social: macro	Social: micro	
Social Media Influence	Social media as support and community vs toxic standards and comparison	
Social Media Influence	Social media as education or misinformation source	
Social Media Influence	Social media as empowerment/advocacy vs toxic wellness culture	
Social Media Influence	Platform bias: influencers, overexposure to polarizing content	
Social Norms and Perceptions	Attitudes: Societal, cultural, individual, familial, and peer towards menopause and m	
Social Norms and Perceptions	Stigma around aging, menopause, or mental illness	
Social Connectedness	Lack of social support	
Social Connectedness	Stressful life events	
Cultural and Ethnic Identity	Acculturation Stress for Immigrants	
Gendered work/home expectations		
Digital Infrastructure and Tech Equity	Digital Divide	
Digital Infrastructure and Tech Equity	Misinformation Algorithms	
Social Roles and Identity	Gendered work/home expectations	
Social Roles and Identity	Minority status	
Relational and Community	Midlife Social Isolation & Loneliness	
Relational and Community	Community Involvement	
Family Structure and Dynamics	Intergenerational Stress	
Family Structure and Dynamics	Marital/Partnered Status & Relationship Quality	
Cultural and Ethnic Identity	Acculturation Stress for Immigrants	
Cultural and Ethnic Identity	Language and Communication Barriers in Social Spaces	

Figure 4.2: This table supplements Figure 4.1 through providing a larger and more expansive list of the specific factors that may fall under the given categories of type of impact (i.e Structural, Social, Physiological, or Mental/Emotional).

Discussion

To summarize, there is a gap in the national guidelines when it comes to addressing treatment for mental health symptoms, and additional space for counseling women and taking on a more personalized, patient-driven approach, as well as for addressing smaller branches of menopausal symptoms that are broad or secondary effects from medication and estrogen decline. For the most part, these guidelines are pretty aligned, especially when it comes to their approach to MHT, emphasizing caution and well-established clinical outcomes like osteoporosis prevention and vasomotor symptom relief. The areas of thematic divergence between the guidelines center around psychosocial, pharmacological, and broader women's health considerations, which is consistent with the variability discovered in how these treat mental health, non-hormonal therapies, and individualized care.

However, while the guidelines most strongly emphasize Vasomotor Symptoms and Genitourinary syndrome as key components of menopause, this does not align proportionately to what the public is actually experiencing when comparing symptom and treatment categories mentioned in 3 online forums. variability regarding suggestions for mental health and “Other” symptoms. Given these differences, we wanted to know whether the symptom and treatment information that is provided to clinicians and to the public, aligns proportionately with what the public is actually experiencing. In contrast to the guidelines, Mental health took up the overwhelming majority of symptom category discussions throughout the forums. Although Vasomotor symptoms were highly addressed throughout each forum, they fell into the third most referenced category among all 3. Additionally, Menopausal Hormonal Therapy had the most frequent mention across symptoms and forums, consistent with the guidelines emphasis of it as a gold standard treatment, but the high number of mentions of lifestyle modifications as a secondary treatment

suggests users also seek non-pharmacological ways to manage symptoms. Despite variable prominence based on forum type and the nature of the medication, Antidepressants don't actually take up a very high ranking as a treatment for the highlighted mental health symptoms, suggesting a need for different approaches regarding MH in menopause.

In examining the dominant discussion themes and emotional trends, we find that the main themes being discussed in Reddit and Patient.info center around hormonal replacement therapy, emotional experiences, menstrual changes, and physical discomfort. Trends in posts centering around HRT appear to correlate lightly with media attention and clinical updates. The consistency of references of emotional experiences as an ongoing theme further drives the message of mental health struggles as a key component of menopause that could have more space to be addressed. Among the full populations in each dataset, the overall sentiment across posts is roughly centered around neutral, with no clear trends over time, and the presence of extreme outliers indicates strong emotions involved in the writing. Users' sentiments also do not show a consistent trajectory as they post more, indicating stagnation in their discussions and medical issues. Regarding repeat posters, the two populations differ slightly in fluctuations in sentiment value over time, but ultimately both still show a decline. Their differences are likely indicative of the discussion platform environment. Repeat posters most frequently discuss ongoing symptom tracking, persistent physical discomfort, and emotional adaptation, while new posters focus more on symptom onset, initial anxiety, and seeking medical advice- particularly around starting hormone replacement therapy, which suggests that the questions people enter these forums with center around symptom-physical and psychological- and treatment confusion, but repetitive posting around these themes combined with the overall lack of positive sentiment suggests a lack of resolution to these problems.

Synthesizing the results, throughout this review we find multiple indications of a problem space around psychological symptoms among menopause experiencers, with limited to no improvement in treatment over time; an inevitable result of inconsistencies and discrepancies in mental health throughout the menopausal guidelines provided by national organizations. Mental health symptoms in menopause appear as frequently- and as urgently- if not more than vasomotor or genitourinary ones, and yet they remain under-addressed, under-treated, and under-researched. Given the background surrounding menopause, women's health, and mental health research, there are a variety of contributors as to why this gap exists. Mental health in menopause is influenced not only by biological factors like hormone loss, but by social, structural, and emotional conditions; ranging from healthcare access, to social isolation, to provider bias, these determinants inevitably interact. Therefore, an issue in one of these aspects affects the entire system. Ideally, by comparing existing guidelines with a framework incorporating all of these variables, we can distinguish the different factors which feed into the various levels of society in order to identify and propose enhancements to better address individual, family, and community-level mental health needs.

Adapting the Socio-Ecological Model to Assess the Determinants of Menopausal Mental Health and Finding a Space for Solutions

The socio-ecological model is a widely-used framework in public health used to highlight a number of different factors that create health outcomes, and to identify ways to address the contributing

conditions at each layer. The purpose of this model is to demonstrate that individual, interpersonal, community, organizational, and policy factors are all interconnected, combining to influence health outcomes and behaviors (Wisconsin Department of Health Services, 2023). The socioecological framework is made up of these six levels, which all refer to some degree of societal manifestation. The individual level of the socioecological framework is pretty straightforward, referring to a singular person, and encompasses the individual characteristics that influence behavior, such as knowledge, attitudes, beliefs, and personality traits. Essentially, motivating change in individual behavior by influencing any of these factors. The interpersonal level goes a step up, targeting family members and peers recognizing that these groups provide social identity, support, and role definition. The community level describes the coordination of the efforts of the members of a community- these can take the form of social networks and norms, or standards, which exist as formal or informal from citizens, community leaders, and organizations to bring change. The organizational level refers to changing the policies, practices, rules, informal structure or physical environment of an organization to constrain or promote behavioral change. In our scope, this reflects healthcare centers. The Public Policy level describes the development and enforcement of local, state and federal state policies and laws that regulate or support menopausal medication, treatment, detection, control or management (Wisconsin Department of Health Services, 2023). This model applies to our study as we are interested in mapping these different levels of society, and the contributing determinants to mental health outcomes in the menopausal population.

Mental health determinants in menopause have been assessed in previous studies: Brown et al. (2024) highlight menopause-specific factors as consisting of type and timing of menopause, menopausal symptoms, hormonal factors, and attitudes. Additionally, they cite established psychosocial stressor criteria such as financial problems, unemployment, poor social support, and stressful life events as important predictors of depressive symptoms during the menopause transition. Similarly, adverse childhood experiences, being from a minority ethnic group, higher BMI, neuroticism, and lifestyle behaviours such as smoking and lack of physical activity are also associated with increased risk. These, among others, are included in our table (**Figure 4.2**) highlighting the various factors that go into the structural, social, physiological and psychological categorical determinants by order of relevance or importance to MH in Menopause. It is important to note that these factors may affect individuals differently, and their relative influence can vary based on personal context.

By adapting the socioecological model to specifically address the determinants of mental health in the context of Menopause, we open the door to solution-oriented frameworks that can help bridge existing gaps. Within this framework, the different levels making up the typical socio-ecological model are bidirectional; the individual level feeds into the interpersonal (i.e an individual's knowledge and behavior towards menopause will influence their family's perception of the condition and vice versa). The interpersonal shapes the organizational level; for example, a woman experiencing perimenopausal depression might struggle to find the language to talk to her partner about it. If her healthcare provider, working within a well-trained clinic, provides educational materials and empathetic counseling, this strengthens the interpersonal bond at home, and her partner, in turn, may advocate for better mental health coverage at their workplace, feeding back into organizational change. The organizational level then drives the communal tier, given how healthcare systems shape community access and norms. Health systems, clinics, and pharmacies determine what care is locally available, directly shaping how entire communities perceive and experience menopause. On the other hand, high public demand, such as from

advocacy groups or online forums, may push local health centers or insurers to respond with new services. The community henceforth streamlines into the policymakers decisions; community groups, patient advocates, and professionals may form coalitions that petition governments, testify at hearings, or create media campaigns. A real-world example would be the Menopause Mandate, one of the sources from our symptom-treatment frequency analysis, in the UK, which grew from community voices and advocacy into national political pressure for better hormone therapy access and public education (Menopause Mandate, n.d.). On the flip side, policy also determines access to resources: government decisions on what's covered by insurance directly shape community access and outcomes, and the national guidelines we have been discussing influence what care providers in these communities are expected to deliver.

When we look through this lens we can see that the majority of these levels, and the determinants which guide them are currently broken or unfulfilled. Due to the bidirectional quality of the societal levels as well as the determining factors of the four categories, this causes a structural breakdown where problems don't stay limited to just one scope- rather, they leak into the rest of the system, causing disharmony and disarray. There are multiple variables in this system that can be assessed as a potential problem or a solution contributing to the system, such as how stigma around women's health leaks into provider care, but to build an adequate history of where a problem so broad began to take a downturn, we would have to trace back through history to the origins of misogyny, which is outside the scope of this paper. We can, however, examine the problem space through the current landscape: beginning with just the guidelines. As structural frameworks that govern clinical decision-making, provider training, and system reimbursement, national guidelines fall into the public policy or societal level, but also exert pressure on every lower level of the socioecological model. They determine what treatments are considered standard, influencing what is covered by insurance, what primary care providers are able to prescribe, what patients can access without referral, training curricula for medical schools and continuing education, clinical algorithms for diagnosis and treatment, and outline which symptoms are important, evidently underrepresenting a huge portion of the population via their choices. Our data shows an extremely limited addressment of mental health, leading to a downstream effect that essentially works in a self-completing cycle blocking the completion of more clinical trials and therefore, treatment options. Henceforth, this effect on treatment leaks into the personal experience of physiological and psychological symptoms, and social attitudes and support.

Providing Solutions: Trained Online Platforms

How can this be addressed? As the model shows, there are steps that are able to be taken at every level. On the individual level, one can take the time to educate themselves on menopause and its care. On the policy level, targeted funding could be allocated for research on menopause-related health issues, such as mental health, cardiovascular risks, bone health, and symptom management. This section proposes a solution on the organizational level; specifically, spotlighting platforms that rally the community and take steps to implement modern technology to help menopause sufferers find adequate relief without the social or structural roadblocks that come with accessing healthcare. Such an approach has the potential to bridge the current educational gap to create a more informed and supportive atmosphere for menopausal individuals within both the public and medical communities.

One promising example is Menolearn- an AI-powered chatbot designed to serve as an accessible, user-friendly resource delivering accurate information on menopause symptoms, medication considerations, lifestyle modifications, evidence-based education, and therapeutic options, all integral to enhancing women's emotional well-being, quality of life, and longevity. Menolearn will be integrated with MyMenoPlan, a platform developed by the MsFLASH Investigators, which serves as a trusted source of up-to-date, science-based, unbiased, and personalized information to help women understand which treatments are effective and which are not. Its goal is to empower women to make informed decisions about managing their menopause experience. This initiative is created and supported by doctors, university-based menopause researchers, and the University of California, San Diego. It was funded by U.S. taxpayer dollars through the National Institutes of Health, with the website supported by a grant from the National Institute on Aging. MyMenoPlan summarizes evidence that has been acquired from numerous US international research networks for over 25 years to provide an easy-to-understand and use digital resource for women, their families, and health care providers.

Examining Menolearn through the re-adapted socio-ecological model for the mental health determinants of menopause: how will this help to bridge the educational gap, and specifically, address the limited mental health knowledge circulating the problem space? Stemming from the organizational level, Menolearn is a platform ultimately managed by the WHI, representing a structured intervention meant to educate patients, standardize symptom reporting, guide treatment choices or referrals, and train providers. This is a tool that reflects and reinforces the policies, clinical standards, and goals of the organizations that develop or fund them. However, Menolearn has several aspects to it which distinguishes it from other tools that aim to resolve these problems from the community or public policy level. The resource connection components will allow women to share their stories and connect with trusted or communal resources to feel less alone, with quick access to evidence-based services, references, and tools to help with symptom management. Further, the platform benefits from community-based research feeding into it, acknowledging symptoms and gaps that may be missing from the organizations supporting it. Despite originating at the organizational level as structured interventions, upon being made public-facing, Menolearn works across organizational and community levels, bridging expert knowledge with population-level health engagement. Menolearn will interconnect policymakers with the community health environment, influencing knowledge, norms, and health behaviors spanning the structural, social, physiological and psychological categories across broader populations, down to influencing the very individual looking to find support.

Limitations

Artificial intelligence technology is still a long way from replacing doctors, and nor is this review advocating for full replacement- rather, to develop its use to support medical accessibility for those who may not otherwise have it. Although, several studies have been conducted showing that AI is capable of providing higher quality care suggestions than medical providers. Ayers et al (2023) found that in their study of 195 randomly drawn patient questions from a social media forum, chatbot responses were preferred over physicians from a team of licensed health care professionals responses, and were even rated significantly higher for both quality and empathy. Further, multiple studies found AI rating higher on empathy than clinicians (Ayers et Al 2023, Harvard Health Shmerling 2024), and a study by Goh et Al

(2024) even discovered that an LLM alone demonstrated higher performance than two physician groups- and making the LLM available to said physicians as a diagnostic aid actually did not significantly improve clinical reasoning compared with conventional resources. However, artificial intelligence is still trained on data that's inherently biased in their lack of clinical representation of underrepresented populations and minority groups. While Menolearn does offer advantages over potentially biased human clinicians due to its broad access to information, it still presents a comparable challenge. To address this, clinicians must actively ensure the inclusion of diverse populations in upcoming clinical trials and scientific studies, thereby enhancing the effectiveness and fairness of artificial intelligence tools. Diversity, equity, and inclusion (DEI) remain critical components of medical research, not only for menopause, but across virtually all health conditions as an ongoing commitment within the research community. For now, regardless of its accuracy, Menolearn will carry a prominent disclaimer because, until society reaches a point where AI is widely accepted as superior to clinicians or is fully integrated into clinical decision-making practices, it is not a clinically validated tool for obtaining medical results. Menolearn's role remains that of an educational platform, and, similar to medication advertisements seen on television, users are advised to consult their healthcare provider before making any decisions based on the information provided.

Regarding the analysis throughout this review, there are also several limitations to address. First of all, this study is inherently broad and exploratory in its scope, which may limit the depth of analysis and the generalizability of findings. As such, the results should be interpreted as indicative rather than definitive. Given the limited prior research in this area, a broad, qualitative, and exploratory approach is necessary to capture a wide range of experiences and perspectives if we intend to gather a richer understanding of emerging patterns. Further, the time span of forums collected is limited to 2000-2024, therefore there isn't any information available as to before these years to assess how attitudes around hormone replacement therapy and menopause may have been prior to the WHI study. However, prior research has assessed these changes, with statistically significant results showing MHT initiation dropped from 8.6% pre-WHI to 2.8% post-WHI across a range of participant subgroups, being especially large in subgroups for whom MHT is often recommended such as younger women and those with more vasomotor symptoms (Crawford et Al, 2018). Questionnaires from these years also supplement that the reason behind this was public perception of greater risk around HRT (Hoffmann, 2005; Buhling et Al 2012; Schonberg et Al 2005). These findings provide information for these years that this analysis does not cover. Our analysis is also limited to guidelines from national organizations in English-speaking countries, and therefore the results cant necessarily be generalized further to other countries or cultures, which have been shown to contain differences, especially due to variability in symptoms by race or ethnicity (Avis et Al 2001; Green et Al 2009; Montgomery Rice 2005) as well as cultural attitudes towards women, menopause, and aging (Kowalcek, I et Al 2005; Montgomery Rice 2005; Sommer et Al 1999). Additionally, the datasets collected are from three different forums- Reddit, Menopause Mandate, and Patient.Info, which are all limited in their scope and shaped by the form of media that it takes. Social media is known for encompassing more polarizing opinions and extreme emotions than may be found in a real-world, in-person sample. However, whether this is due to people being more honest behind an anonymous profile, or the effects of group polarization, can't fully be uncovered. The forums also featured different post volumes by year due to the platform's own development and popularity, however this was corrected via standardization and normalization of data points whenever conducting temporal analysis. Additionally, although musculoskeletal pain is occasionally reported during menopause, it was

not included in the ‘other symptoms’ category in this analysis. This decision reflects its less frequent appearance in the context of menopause-specific discussions within our dataset, as well as the scope of this paper focusing on the exclusion of mental health representation. However, its omission may limit the breadth of symptom representation and should be considered in future, more expansive analyses. Further, it is important to keep in mind that this analysis does not aim to provide clinical recommendations or medical conclusions; as a non-clinical, exploratory analysis of user-generated content, this study cannot offer treatment guidance. Rather, this aims to explore patient-reported experiences to inform future research and healthcare discourse. Clinical interpretation should be undertaken by qualified medical professionals.

Conclusion/Significance

Mental health symptoms in menopause are a significant and well-documented issue. Scientific evidence affirms it, and those experiencing menopause report it consistently; yet, clinical guidelines most often fail to adequately address it. The findings in this analysis consistently highlight this disconnect, and further drive evidence for a critical gap in menopausal care. Gaining information from the unfiltered population on the subjects of concern they experience surrounding menopause provides an extremely valuable perspective that is difficult to achieve with typical data-gathering techniques such as questionnaires or surveys, which rely on a structure to gather information.

At the organizational level, community-driven platforms that leverage modern technology offer a promising solution. By helping individuals navigate menopause without the social and structural barriers that often interfere with access to quality healthcare, these platforms can work across both the organizational and community spheres to bring together expert knowledge and population-level engagement. As an AI-powered chatbot, *Menolearn* is positioned to help bridge the education gap and build an increasingly more informed and supportive environment for menopausal individuals. It offers a user-friendly, accessible interface that delivers accurate, science-backed information on symptoms, contraindications, lifestyle modifications, therapeutic options, and additional elements essential to women’s emotional well-being and longevity. In the current landscape of rapidly developing intelligent systems, this may be among the earliest examples or trials of artificial intelligence in the medical field and could carry important implications depending on its outcomes.

Bringing these findings into focus: by integrating lived menopausal experiences with clinical evidence through an adaptation of the socioecological framework to menopausal mental health determinants, this study offers a path forward. It combats historical underrepresentation of women in medical research, gender bias in healthcare, and knowledge gaps on women's conditions. It invites physicians and policymakers to meet menopausal individuals where their greatest concerns lie; advancing toward more personalized, inclusive, and socially informed clinical care. In doing so, we move closer to effective treatment, stronger guidelines, and a deeper public understanding of menopause.

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Appendix/Supplemental

Table A.1: Comprehensive summary of approaches to various aspects of the menopausal experience compiled from clinical guidelines. The table includes detailed text-based entries categorized by red flag indicators for guideline exclusion, emphasis on specific studies (such as the WHI and KEEP), publication year and journal, standards for hormone replacement therapy, the extent of counseling and patient education recommended, approaches to managing vasomotor, genitourinary, mental health, and other menopausal symptoms, stance on alternative or natural treatments and lifestyle adaptations, preventative health recommendations, risk management strategies, geographic origin of the guideline, attention to diversity, and other notable comments. This expanded version supplements the summary data provided in the main thesis body (see Table 1.1).

[illegible]

The inclusion criteria for the symptoms:

'VMS':

'Hot Flashes': ['hot flush', 'hot flash'],
'Sweating': ['perspiration', 'sweating', 'night sweats'],
'Blood Pressure': ['high BP', 'high blood pressure', 'hypertension'],
'Tachycardia': ['tachycardia', 'heart racing', 'palpitations', 'high heart rate']

'GSM':

'Genital Issues': ['vaginal dryness', 'itch', 'itching', 'burn', 'burning', 'irritation'],
'Urinary Issues': ['urination', 'peeing', 'urinary urgency', 'incontinence', 'incontinent', 'uti'],

'Mental Health':

'Anxiety': ['anxiety', 'anxious'],
'Depression': ['depressed', 'depression'],
'Mood Issues': ['mood swings', 'moody', 'irritable', 'irritated'],
'Mental Issues': ['difficulty concentrating', 'brain fog']

'Other':

'Menstrual Issues': ['irregular periods', 'bleeding', 'spotting']
'Headaches': ['headache', 'migraine'],
'Acne': ['acne'],
'breast soreness': ['breast soreness', 'breast pain'],
'hair thinning': ['hair thinning', 'hair fall', 'losing hair'],
'Osteoporosis': ['osteoporosis', 'osteoarthritis'],
'Gastrointestinal': ['bloating', 'IBS'],
'Sexual Issues': ['decreased libido', 'low sex drive', 'pain during sex'],
'Fatigue': ['fatigue', 'tired', 'insomnia', 'cant sleep', 'poor sleep', 'bad sleep', 'waking up at night']

The inclusion criteria for the treatments

'Hormone Therapy': 'Classic MHT': ['mht', 'iud', 'hrt', 'estrogen', 'progesterone', 'hormone therapy', 'combined oral contraceptive', 'EPT', 'ET', 'Estrogen Progesterone Therapy'],

'Novel hormone treatments': ['Tibolone', 'livial', 'TSEC', 'Tissue-Selective Estrogen Complex', 'Duavee', 'Ospemifene', 'Lasofloxifene', 'testosterone', 'CE/BZA']

'Non-Hormonal Treatments': {

'Fezolinetan': ['Fezolinetan', 'nk3', 'vezoah', 'neurokinin 3', 'nk3 receptor antagonist'],
'Herbal': ['red clover', 'black cohosh', 'soybean', 'omega-3', 'phytoestrogen', 's-eqol', 'isoflavone', 'LNG-IUS', 'compounded bioidentical hormones', 'natural hormone', 'natural estrogen', 'bazedoxifene']

'Lifestyle':

'Lifestyle Modifications': ['exercise', 'diet', 'CBT', 'cognitive behavioral therapy', 'yoga', 'weight loss', 'meditation']

'Other Prescription Drugs':

'Fezolinetan': ['Fezolinetan', 'nk3', 'vezoah', 'neurokinin 3', 'nk3 receptor antagonist'],
'Clonidine': ['clonidine'],
'Gabapentin': ['gabapentin'],
'Antidepressants': ['antidepressant', 'Brisdelle', 'SNRI', 'SSRI', 'Lexapro', 'Celexa', 'Effexor']

Figure A.3: Sentiment Distribution boxplots

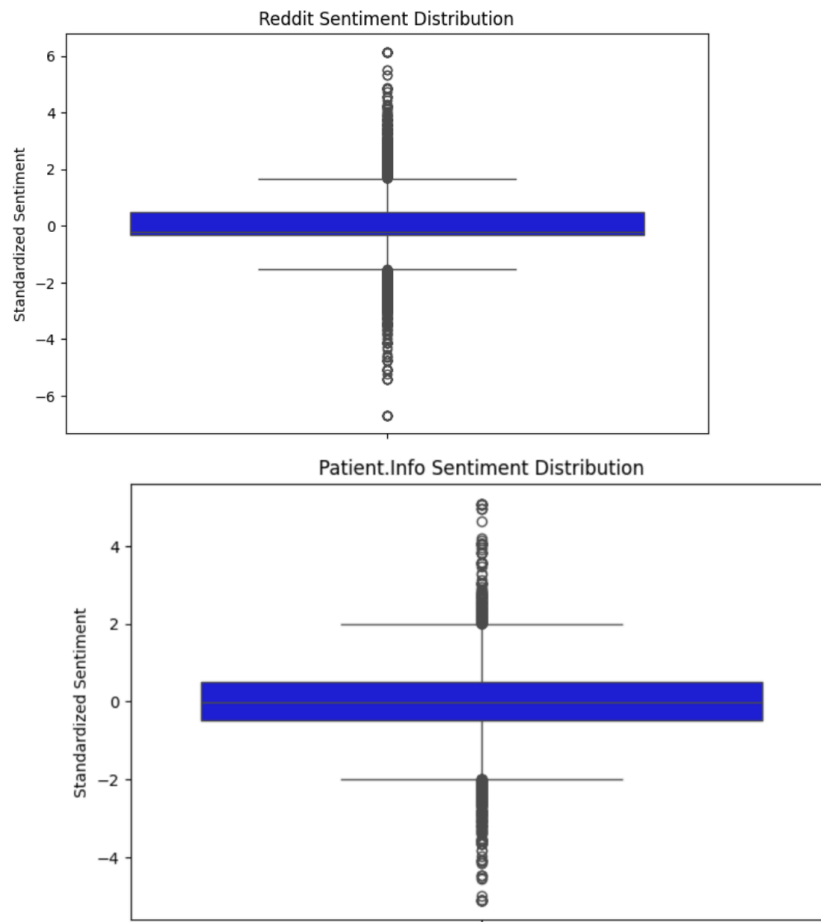


Figure A.3: This figure displays the distribution of sentiment scores in Reddit and Patient.Info posts, The box plots show the range and distribution of weighted and standardized sentiment values over time, corrected for post volume.

Figure A.4.1: Post Volume over Time, Yearly Sentiment Variance, and Sentiment Distribution before and after 2020 for Reddit:

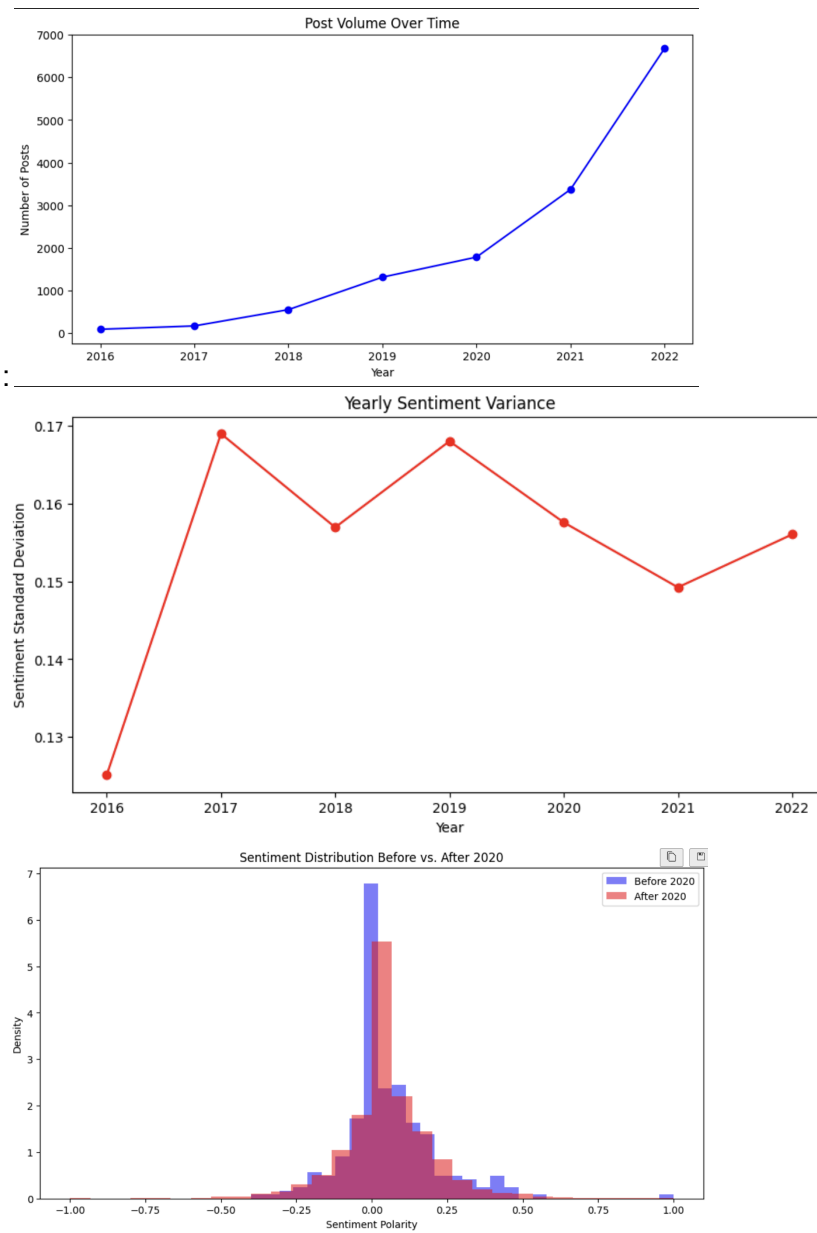


Figure A.4.1: This figure shows the Analysis of Post Volume and Sentiment Trends on Reddit.

Top: The number of user-generated posts on Reddit increased steadily over the years, with a particularly sharp rise beginning in 2021, suggesting growing platform engagement or heightened public interest in health-related discussions.

Middle: Annual sentiment variance, measured by the standard deviation of sentiment polarity scores, fluctuated across the years-peaking in 2017, 2019, and 2022- indicating greater emotional variability in those years. In contrast, sentiment variability declined in 2018, 2020, and 2021.

Bottom: The distribution of sentiment polarity scores- comparing posts before and after 2020- reveals that overall sentiment remained centered near neutral throughout. However, posts before 2020 were slightly more negatively skewed, whereas posts after 2020 showed a subtle shift toward more positive sentiment. This shift is reflected in a small decrease in sentiment variability, with the standard deviation dropping from 0.164 before 2020 to 0.154 after 2020.

Figure A.4.2: Post Volume over Time, Yearly Sentiment Variance, and Sentiment Distribution before and after 2020 for Patient.Info:

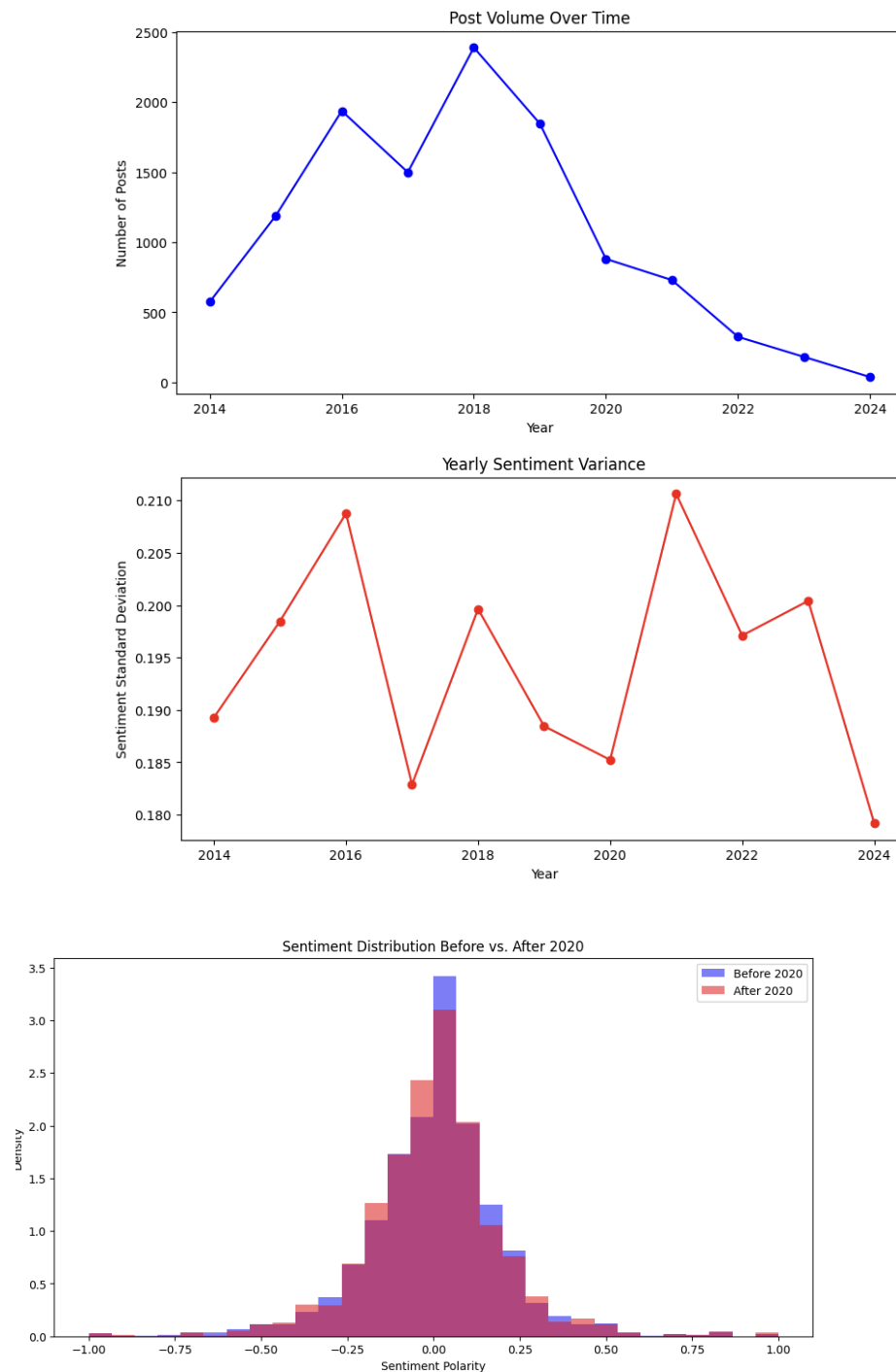


Figure A.4.2: Analysis of Post Volume and Sentiment Trends on Patient.Info:

Top: The volume of health-related posts on Reddit increased from 2014, peaking in 2018, and then steadily declined through 2024. This trend may reflect shifting user engagement patterns or changes in platform relevance over time.

Middle: Sentiment variance, measured by the standard deviation of sentiment polarity, fluctuated modestly year to year. Peaks occurred in 2016, 2018, and especially in 2021, while the lowest variability was seen in 2017, 2020, and 2024.

Bottom: Sentiment polarity distribution shows that Reddit posts were generally centered around neutral sentiment in both time periods. Posts before 2020 exhibited slightly more negative skew, while those after 2020 leaned marginally more positive. Overall sentiment variability remained nearly constant, with a standard deviation of 0.196 before 2020 and 0.197 after 2020.

Figure A.5: Sentiment over time for all individual repeat posters

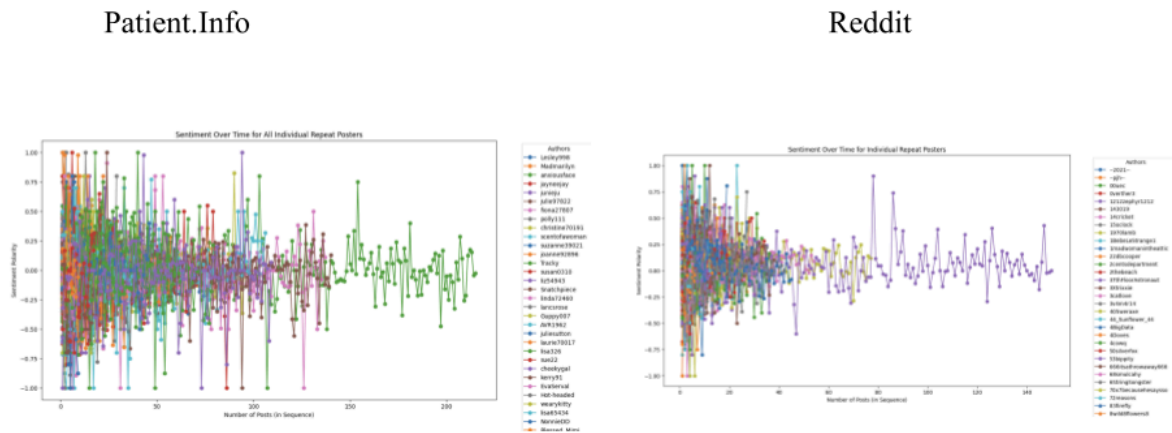


Figure A.5: This figure visualizes sentiment trajectories for individual repeat posters across two platforms: Patient.info (left) and Reddit (right). Each line represents a unique user, plotting sentiment polarity over the sequence of their posts (x-axis), illustrating how their emotional tone evolves over time. Due to the high density of overlapping data and users, the plots appear visually noisy. Nonetheless, general trends can be observed: some users begin with more emotionally varied sentiment in earlier posts, with a gradual convergence toward more neutral sentiment over time. Patient.info includes users with longer post sequences, while Reddit features a higher concentration of users with shorter posting histories. The overall messiness reflects the complexity and variability of individual emotional expression across repeated engagements on both platforms.

Figure A.6: Distribution of time between posts for Repeat Posters

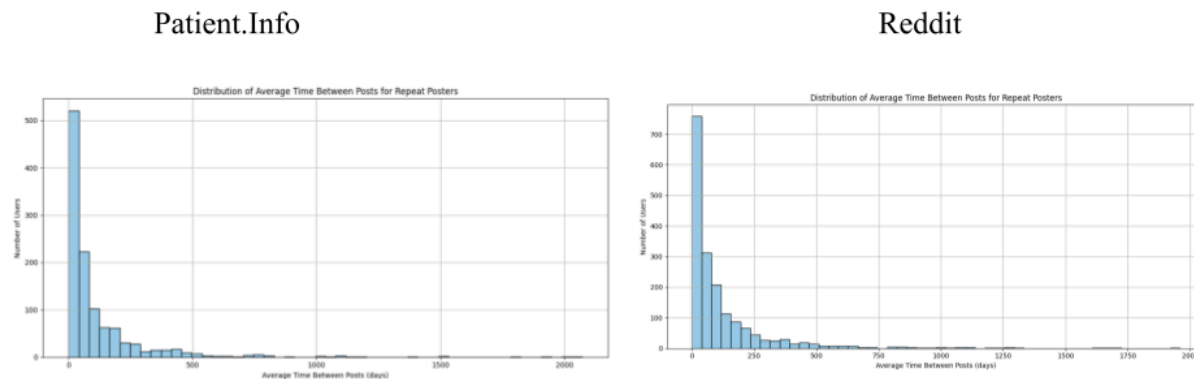


Figure A.6: This figure illustrates the distribution of time intervals between consecutive posts made by repeat posters on both Patient.info and Reddit. The x-axis represents the number of days between posts, while the y-axis indicates the frequency or proportion of repeat posters falling within each interval. The graph highlights differences in posting behavior across platforms- such as whether users tend to return quickly (e.g., within days or weeks) or have longer gaps between activity.

Fluctuation in Sentiment Based on Months and Years

When taking a closer look at how sentiment shifts temporally, Patient.info demonstrates a trend of shifting sentiment across years and months, large variability in early years, and slight improvement in sentiment starting from around 2022. Sentiment seems to fluctuate year to year, with years like 2014 (0.1527), 2017 (0.0667), 2023 (0.1251) showing more positive mean sentiment, while others like 2015 (-0.0020), 2016 (-0.0360), and 2020 (-0.0576) indicate more negative mean sentiment. The variability in sentiment scores is generally high, with 2016 and 2021 showing the largest spread ($\text{std} > 1$), while 2014 and 2023 have lower variability ($\text{std} \sim 0.96$ and ~ 1.02 , respectively). This suggests that sentiment was less consistent in the mid years (2015-2021) but became slightly more stable in later years (2022-2024). The percentiles suggest that the middle 50% of sentiment scores are close to neutral (i.e., around 0), with some years (like 2014, 2017) showing higher 75th percentiles (around 0.645-0.641), indicating more positive sentiment skew for these years compared to others. The monthly sentiment varies greatly, with months like February 2014 and December 2023 having relatively high positive sentiment (mean sentiment > 0.4), and months like March 2014 or February 2024 showing more negative sentiment (mean sentiment around -0.184). This suggests some months have a more optimistic outlook compared to others. However, Months with fewer posts (e.g., March 2024) seem to have more extreme sentiment values, possibly due to the lower number of posts inflating or deflating sentiment scores. High-volume months, in contrast, seem to have more stable and less extreme sentiment. Overall, these metrics suggest that sentiment in posts fluctuates seasonally, with some months tending toward more extreme positive or negative shifts.

The sentiment of Reddit posts has fluctuated between slightly negative and neutral in recent years, with some spikes in positivity during specific months. The increase in post volume is correlated with a stabilization of sentiment, possibly reflecting a broader range of opinions over time. The most recent years (2021-2022) show a shift toward more consistent and neutral sentiment trends, despite larger volumes of posts. Within the Reddit Dataset, the mean sentiment tends to hover close to zero, showing a

fairly neutral sentiment overall. In 2016, the average sentiment was slightly positive (0.0336), but it dipped in 2018 (-0.0352), then fluctuated slightly negative in 2019 to 2021 before slightly recovering in 2022 (0.0047). This suggests a trend of gradually more neutral sentiment over time, potentially indicating a shift in discussion tone. The standard deviation is quite high across all years, with 2021 and 2022 showing slightly lower volatility than the earlier years, reflecting a more stable (though still variable) sentiment. The largest volatility was seen in 2017 (1.0847) and 2018 (1.0073), indicating that sentiment was more varied during those years, yet it became more stable in later years (2021-2022). This could suggest a period of more polarized opinions or contentious discussions. Monthly sentiment trends show significant variability in sentiment. For example, some months like May 2016 had a very high positive sentiment with a 75th percentile of 0.9671 and maximum sentiment of 2.3059. However, months with fewer posts, like 2016-01 and 2016-02, show much lower mean sentiments (-0.3978 and -0.4887 respectively), which may indicate a more negative or less engaging discussion. There is also a correlation between the volume of posts and the distribution of sentiment; 2022 had high post volumes across months, but the mean sentiment was more neutral. High volumes can lead to a wider range of sentiment scores because there is a more diverse pool of opinions.