MINNESOTA
OFFICE OF CANNABIS MANAGEMENT

Impact of Medical Cannabis on Minnesota Cancer Patients

Sept. 10, 2026

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Report highlights

- Large study conducted with data from more than 6,000 Minnesota medical cannabis patients diagnosed with cancer.
- Patients reported decreased nausea, vomiting, anxiety, and depression scores within four months of starting medical cannabis.
- Patients reported improved sleep scores within four months of starting medical cannabis.
- Patient purchasing records show diverse medical cannabis product use in both product type and THC to CBD ratio.

Executive summary

Cannabis is hypothesized to reduce symptoms of cancer or cancer-related treatments including pain, nausea, vomiting, and lack of appetite through the endocannabinoid system. Between July 1, 2015, and Dec. 31, 2023, 7,762 patients enrolled in Minnesota's medical cannabis program with a cancer-related qualifying condition. Of these patients, 85% (n = 6,621) actually purchased medical cannabis though the program. This report focuses on patients who made at least one medical cannabis purchase.

Gender of patients was evenly divided between male and female. Average age of participants at enrollment was 58 years old, ranging from 1 year old to 100 years old. Eighty-eight percent of patients self-identified as white (n = 5,828), followed by Black, African or African American (n = 213; 3.2%).

Reported benefits

During the study period patients were asked to fill out a patient self-evaluation (PSE) before each medical cannabis purchase. The PSE asks patients to rate the severity of eight standard symptoms in the past 24 hours on a 0-10 numerical rating scale. The standard eight symptoms include anxiety, lack of appetite, depression, disturbed sleep, fatigue, nausea, pain, and vomiting. In this report, a ≥30% decrease in symptom score from baseline score was a clinically significant change.

Eighty-two percent of all cancer patients in the program reported moderate to severe pain scores at enrollment; among those patients, 29.9% (1,631) reported a ≥30% reduction in pain score within four months of first medical cannabis purchase. Among patients who continued in the program, 53% (n = 658) were able to maintain the ≥30% reduction in pain score for an additional four months. Proportions of patients reporting improvement were higher for lack of appetite scores, with 38.2% (n = 1,791) of patients with moderate to severe scores at enrollment reporting a ≥30% reduction in score within four months of first purchase and 62.8% (n = 874) of those patients maintaining the reduction in score.

Relatively fewer patients reported moderate to severe nausea (56.7%; n = 3,743)) and vomiting (27.1%; n = 1,790) symptoms at enrollment. Among those patients, 39.9% (n = 1,493) reported a ≥30% reduction in nausea scores and 47.2% (n = 845) reported a ≥30% reduction in vomiting scores within four months of first medical cannabis purchase. Sixty-five percent (n = 742) were able to maintain the reduction in nausea score, and 74.4% (n = 462) were able to maintain the reduction in vomiting score for an additional four months.

A major limitation in the above analyses is the loss of patients from the program, or loss to follow-up. Proportions of patients who were able to achieve ≥30% symptom relief and maintain it for at least four months is a conservative estimate that does not account for patients leaving the program. For this specific population, patients might participate in the program only when they are undergoing chemotherapy treatment or may already be in hospice care at program enrollment. Length of chemotherapy treatments depend on the patient, stage and type of cancer, but would typically be shorter than our eight-month follow-up window. Minnesota's medical cannabis program does not collect data on patient medical treatments.

Medical cannabis use patterns

Medical cannabis purchasing data were analyzed for each patient during their first year in the program, including 35,859 sales transactions, consisting of 121,865 products purchased. Products are classified by their route of administration (how a product enters the body) and THC and CBD content. Inhalation products, including cannabis flower and vape products, made up 48% of all products purchased. Among inhalation products, high to very high THC:CBD ratio products accounted for 58.9% of products purchased. Enteral products, including gummies and capsules, made up 42.5% of all products purchased. Among enteral products, high and very high THC:CBD ratio products accounted for 82.4% of products purchased.

Adverse side effects

In addition to symptom questions, the PSE also included questions about adverse side effects that patients may experience, ranging from mild to severe. Approximately 15% of patients reported an adverse side effect on their PSE. Of those reported side effects, the majority were mild (60%), 34% were moderate, and only 6.2% were reported to be severe. The most commonly reported side effect reported overall was dry mouth. The most commonly reported severe side effect was fatigue. The PSE may not capture all adverse side effects. If a patient had a side effect after taking medical cannabis and decided not to purchase again, there is no record of the last side effect.

1. Introduction

Minnesota became the 22nd state to create a medical cannabis program in May 2014. Distribution of medical cannabis products to qualified enrolled patients began July 1, 2015. Minnesota's medical cannabis program is distinct from those in nearly all other states because the Minnesota Office of Cannabis Management is required to study and learn from the experience of participants. Minnesota's online patient registry, which integrates information from patients, certifying health care practitioners and manufacturers, continuously captures program data. Data elements from the medical cannabis patient registry have been selected to create a de-identified research dataset for reporting and research. This report draws on aspects of that research dataset to describe the experience of patients newly enrolled in the program for a cancer-related condition between July 1, 2015, through Dec. 31, 2023. Cancer-related conditions including cancer with severe or chronic pain, cancer with nausea or severe vomiting, and cancer with cachexia or severe wasting, have been qualifying conditions since the inception of Minnesota's medical cannabis program.

Patients with cancer may qualify for the medical cannabis program if they have any of the following symptoms: 1) severe or chronic pain; 2) nausea or severe vomiting; or 3) cachexia or severe wasting. This report details patient experience in Minnesota's medical cannabis program.

Medical cannabis and cancer-related symptoms

Cannabis is hypothesized to aid patients with cancer who are having symptoms of illness or treatment for the following:

- Severe or chronic pain
- Nausea or severe vomiting
- Cachexia or severe wasting

Severe or chronic pain

Cannabis is hypothesized to reduce pain experienced by patients through the endocannabinoid system. The endocannabinoid system is a lipid-signaling system that regulates things like mood, appetite, memory, the immune and cardiovascular systems, and pain. The endocannabinoid system functions throughout the body; however, it is most commonly associated with neuronal tissue and the cannabinoid receptors CB_1 and CB_2. These receptors[1] play a role in downregulating pain during an inflammatory response due to injury or neuronal triggers (Pantoja-Ruiz et al., 2021; Steiner & Wotjak, 2008). The most common cannabinoids for these receptors are tetrahydrocannabinol (THC) and cannabidiol (CBD) which are both found in cannabis (Urits et al., 2019).

A recent review identified randomized control trials investigating cannabis-based medicines for adults with cancer-related pain. After review, they concluded there is moderate-certainty evidence that oromucosal nabiximols (medication containing cannabis extract) and THC are not more effective than placebo in relieving moderate-to-severe opioid-refractory cancer pain (Häuser et al., 2023). They also found low-certainty evidence that cannabinoids are ineffective in reducing chemotherapy-associated pain (Häuser et al., 2023). Another systematic review and meta-analysis on clinical trials also found no difference in pain scores between cancer patients given cannabinoids or placebo (Boland et al., 2020).

A pilot randomized control trial using patients in Minnesota's medical cannabis program with Stage IV cancer found a higher proportion of patients in the group who started medical cannabis three months before the control group achieved reduction in opioid use and improved pain control (Zylla et al., 2021).

[1] Receptor (neuronal receptor): refers to a site within bodily cells (neurons) that cannabinoids can bind to – like a key fitting into a specific lock (key = cannabinoid, lock = cannabinoid receptor). Cannabinoids are either produced within the body (endocannabinoids or endogenous cannabinoids) or can be introduced into the body (cannabinoids like THC or CBD from the cannabis plant that a person may smoke, or man-made cannabinoids introduced into the body; exogenous cannabinoids). Receptor agonists cause or increase a biological response within the cell.

In a previous report published by the Minnesota Office of Cannabis Management on pain in patients enrolled in Minnesota's medical cannabis program, 28.3% of patients qualified for cancer-related pain were able to reduce pain symptoms within four months of first purchase. However, only 11.6% of patients were able to both achieve pain relief and maintain it for at least four months (Chronic Pain Patients in the Minnesota Medical Cannabis Program, 2025). These findings were consistent with a previous study among patients in Minnesota's medical cannabis program qualified for cancer-related conditions from 2015 to 2017. Anderson et al. found 30.0% of patients were able to reduce pain symptoms, but only 11.5% of patients were able to achieve pain relief and maintain it for at least four months (Anderson et al., 2019).

Nausea or severe vomiting

Research studies using animal models have shown blocking the cannabinoid receptor CB_1 induces nausea and vomiting. Therefore, it is hypothesized that delta-9-tetrahydrocannabinol (delta-9-THC) may reduce nausea and vomiting symptoms by stimulating the CB_1 receptor (Darmani, 2001; Smith et al., 2015).

Many studies investigating cannabis and nausea and vomiting are of cancer patients, specifically during their chemotherapy treatment. In a meta-analysis of randomized control trials of cancer patients undergoing chemotherapy, researchers found patients given cannabinoids had higher chance of reporting complete absence of vomiting (Risk Ratio (RR): 5.7; 95% CI: 2.6, 12.6) and complete absence of nausea and vomiting (RR: 2.9; 95% CI: 1.8, 4.7), compared to placebo (Smith et al., 2015). In comparison with other anti-emetics, patients did not report a significant difference in nausea (RR: 1.5; 95% CI: 0.67, 3.2), vomiting (RR: 1.1; 95% CI: 0.86, 1.44), or complete absence in nausea and vomiting (RR: 2.9; 95% CI: 0.74, 5.4) (Smith et al., 2015). Patients in these studies reported leaving the study due to side effects more often when given cannabinoids than when given other anti-emetics or placebo (Smith et al., 2015).

Other studies published after the above-mentioned meta-analysis see similar results. In a randomized control trial of patients with gynecologic cancers, patients given a 1:1 THC:CBD extract oil had significantly lower nausea scores compared to the placebo group (Sukpiriyagul et al., 2023). Another randomized control trial found oral 1:1 THC:CBD cannabis extract was associated with less nausea and vomiting, but increased side effects compared to placebo. However, 83% of patients in the trial preferred cannabis treatment to placebo (Grimison et al., 2020).

A previous study among patients in Minnesota's medical cannabis program qualified for cancer-related conditions from 2015 to 2017 found 40.5% of patients were able to reduce nausea and 49.8% were able to reduce vomiting symptoms within four months of first purchase. Fewer patients reported achieving and maintaining reduced symptom scores for an additional four months, 20.2% for nausea and 28.0% for vomiting symptoms (Anderson et al., 2019).

Cachexia or severe wasting

Cachexia, also known as wasting syndrome, is defined as weakness and wasting of the body caused by severe chronic illnesses such as cancer. Cachexia is associated with prolonged hospital admission, decreased psychological wellbeing and quality of life. Multiple biological pathways have been identified in the pathophysiology of cachexia, leading to loss of appetite, dysfunction of muscle

production, and uncontrolled weight loss (Hammond et al., 2021; Suzuki et al., 2013). Cannabis and cannabinoids are thought to interfere in these biological pathways via stimulation of the CB_1 receptor (Hammond et al., 2021).

Little research has been conducted investigating the effect of medical cannabis on cachexia, weight gain, or appetite in cancer patients. A meta-analysis found no significant difference between cannabinoids and placebo in improving caloric intake or improving appetite in cancer patients (Mücke et al., 2018). A systematic review on cannabinoid interventions and cachexia-related outcomes in cancer patients found little evidence for cannabinoids improving appetite or weight gain in both randomized and non-randomized studies (Simon et al., 2022). Both above reviews mention a need for more research into this topic. A study of patients with cancer-related conditions in Minnesota's medical cannabis program from 2015 to 2017 found 38.8% of patients were able to improve their lack of appetite, however among all patients with moderate to severe lack of appetite only 18.7% were able to improve lack of appetite and maintain it for four months (Anderson et al., 2019).

2. Description of patients enrolled

Qualifying condition

Between July 1, 2015, and Dec. 31, 2023, 7,762 patients enrolled in Minnesota's medical cannabis program with a cancer-related qualifying condition. The cutoff of Dec. 31, 2023, was selected to allow for at least eight months of follow-up to investigate the benefits of medical cannabis use. Of those patients, 6,621 (85.3%) actually purchased medical cannabis. The report focuses on these patients.

In Minnesota's medical cannabis program, cancer patients may qualify for three symptom-based qualifying conditions: 1) cancer with severe or chronic pain, 2) cancer with nausea or severe vomiting, or 3) cancer with cachexia or severe wasting. Patients may qualify for more than one qualifying condition; therefore, patients may qualify for more than one cancer-related condition. Most patients qualified for cancer with severe or chronic pain (n = 4,581; 69.2%), followed by nausea or severe vomiting (n = 3,264; 49.3%), and cachexia or severe wasting (n = 1,973; 29.8%) (Table 2.1). Minnesota's medical cannabis program does not collect data on type of cancer or stage.

Table 2.1. Number of patients qualified for cancer-related conditions

Cancer qualifying conditions	n	%
Any cancer condition	6,621	N/A
Cancer with severe or chronic pain	4,581	69.2%
Cancer with nausea or severe vomiting	3,264	49.3%
Cancer with cachexia or severe wasting	1,973	29.8%

Additional qualifying conditions

Patients may enroll in the program with multiple qualifying conditions. In this patient group, pain-related conditions were the most prevalent condition; 7.5% also qualified for chronic pain, and 5.7% also qualified for intractable pain (Table 2.2). Intractable pain, a sub-condition of chronic pain, is defined in the program as pain whose cause cannot be removed. Many patients are qualified for both chronic and intractable pain.

Table 2.2. Number of patients qualified for other qualifying conditions

Qualifying conditions	n	%
Chronic pain	496	7.5%
Intractable pain	378	5.7%
Terminal illness with severe or chronic pain	257	3.9%
Terminal illness with nausea or severe vomiting	191	2.9%
Terminal illness with cachexia or severe wasting	147	2.2%
Severe and persistent muscle spasms, incl. multiple sclerosis	132	2.0%
Post-traumatic stress disorder	73	1.1%
Seizures, incl. those characteristic of epilepsy	41	0.6%
Obstructive sleep apnea	28	0.4%
Inflammatory bowel disease, incl. Crohn's disease	22	0.3%
Glaucoma	10	0.2%
Other qualifying condition	8	0.1%

Gender and age

Nearly half of patients identified as female (n = 3,334; 50.4%), and nearly half as male (n = 3,251; 49.1%) (Table 2.3). The average age at enrollment was 58 years old (Standard deviation: 15.6 years), ranging from 1 year old to 100 years old (Figure 2.1). Patients qualified for cancer are older on average compared to the overall medical cannabis program, 58 years compared to 47 years old (*Minnesota Medical Cannabis Dashboard*, 2024).

Figure 2.1. Age and gender distribution of patients

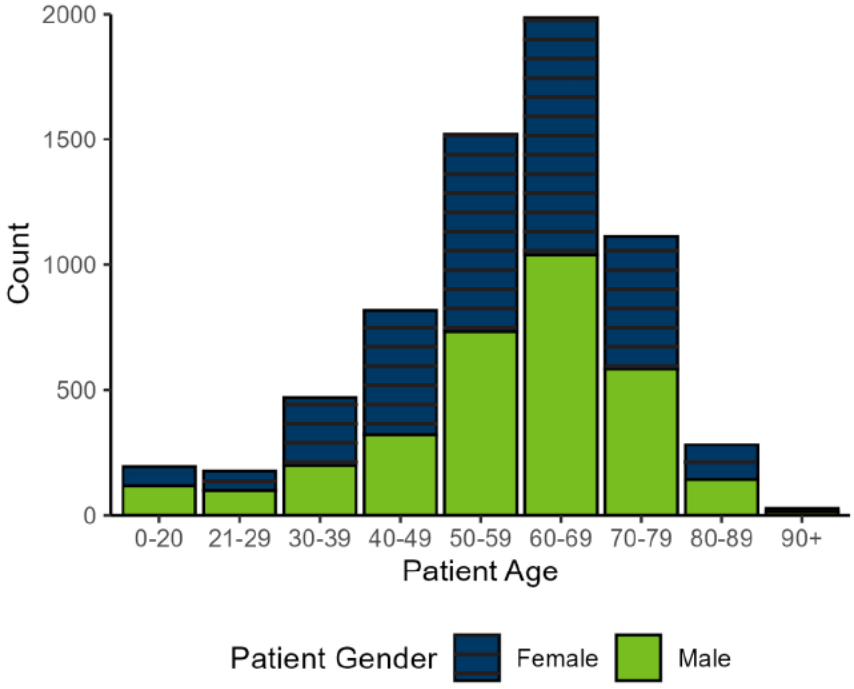


Table 2.3. Demographic characteristics of patients by gender

Gender	n	%
Male	3251	49.1%
Female	3334	50.4%
Prefer not to answer	36	0.5%
Total	6621	100%

Race and ethnicity

Patients primarily identified as white (n = 5,828; 88.0%), followed by Black, African, or African American (n = 213; 3.2%), Asian (n = 112; 1.7%), and two or more races (n = 90; 1.4%) (Table 2.4). The race breakdown of cancer patients included in this report contains more patients identifying as white (88.0%) than in the overall medical cannabis program (79.8%), and the census bureau estimate for the state of Minnesota (82.6%) (*Minnesota Medical Cannabis Dashboard*, 2024).

Table 2.4. Demographic characteristics of patients by race

Demographic characteristics	n	%
White	5828	88.0%
Black, African, or African American	213	3.2%
American Indian or Alaska Native	72	1.1%
Asian	112	1.7%
Hawaiian or Other Pacific Islander	8	0.1%
Two or more races	90	1.4%
Other race	62	0.9%
No answer or unknown	217	3.3%
Total	6621	100%

Table 2.5. Demographic characteristics of patients by ethnicity

Ethnicity	n	%
Hispanic	142	2.1%
Non-Hispanic	6279	94.8%
No answer or unknown	181	2.7%
Total	6621	100%

Geographic distribution

When registering for Minnesota's medical cannabis program, patients provide their home address to verify Minnesota residency. The general geographic distribution of patients was examined using patient-reported ZIP codes; the first three digits of ZIP codes compose a prefix which corresponds to an approximate geographic region. The U.S. Postal Service assigns to each prefix labels that match the major city within the region and approximate surrounding cities; these region labels are shown in Table 2.6, along with the count of patients living in the corresponding ZIP codes. The majority of patients with cancer-related qualifying conditions are located in the Twin Cities metro ZIP region, Minneapolis (42.5%) and St. Paul (30.4%); 6.1% live in the St. Cloud region, and 4.0% in the Mankato region (Table 2.6).

Table 2.6. Patients by ZIP code region (first three number prefixes)

ZIP region	ZIP prefixes	Count (%)
St. Paul	550,551	2,015 (30.4%)
Minneapolis	553,554,555	2,814 (42.5%)
Duluth	556,557,558	246 (3.7%)
Rochester	559	260 (3.9%)
Mankato	560,561	266 (4.0%)
Willmar	562	137 (2.1%)
St. Cloud	563	402 (6.1%)
Brainerd	564	154 (2.3%)
Detroit Lakes	565	173 (2.6%)
Bemidji	566	64 (1.0%)
Grand Forks	567	61 (0.9%)

3. Medical cannabis use patterns

Description of purchased products

Purchasing data for medical cannabis are captured by Minnesota's medical cannabis program. For this report, purchasing data were extracted for all patients with a cancer-related qualifying condition enrolled for the first time between July 1, 2015, and Dec. 31, 2023. This report describes all purchases made within their first year in the program. The query provided a dataset containing 35,859 sales transactions, consisting of 121,865 product purchases, which represented 6,621 patients.

Products included in this dataset were categorized according to their route of administration and ratio of THC to CBD contained in the product. Routes of administration include enteral, inhalation, oromucosal, and topical routes of entry into the body. THC:CBD ratios ranged from products very high in THC to CBD to those very high in CBD to THC, as well as everything in between. As of this report, products that include raw cannabis flower (e.g. ground flower, flower, preroll products) do not include THC or CBD concentration in milligrams and cannot be classified by THC:CBD ratio in the same way as other products. They are instead classified by relative values of THC and CBD by percent of product weight.

Box 3.1. Categories to describe medical cannabis products purchased by patients

Medical cannabis products categorized by THC:CBD content ratio:

- **Very high THC to CBD:** 100:1 or higher
- **High THC to CBD:** greater than 4:1 up to 99:1
- **Balanced:** 1:1 up to 4:1
- **High CBD to THC:** less than 1:1 up to 99:1
- **Very high CBD to THC:** 100:1 or higher

Medical cannabis flower products categorized by relative values of THC and CBD (values measured as % by product weight):

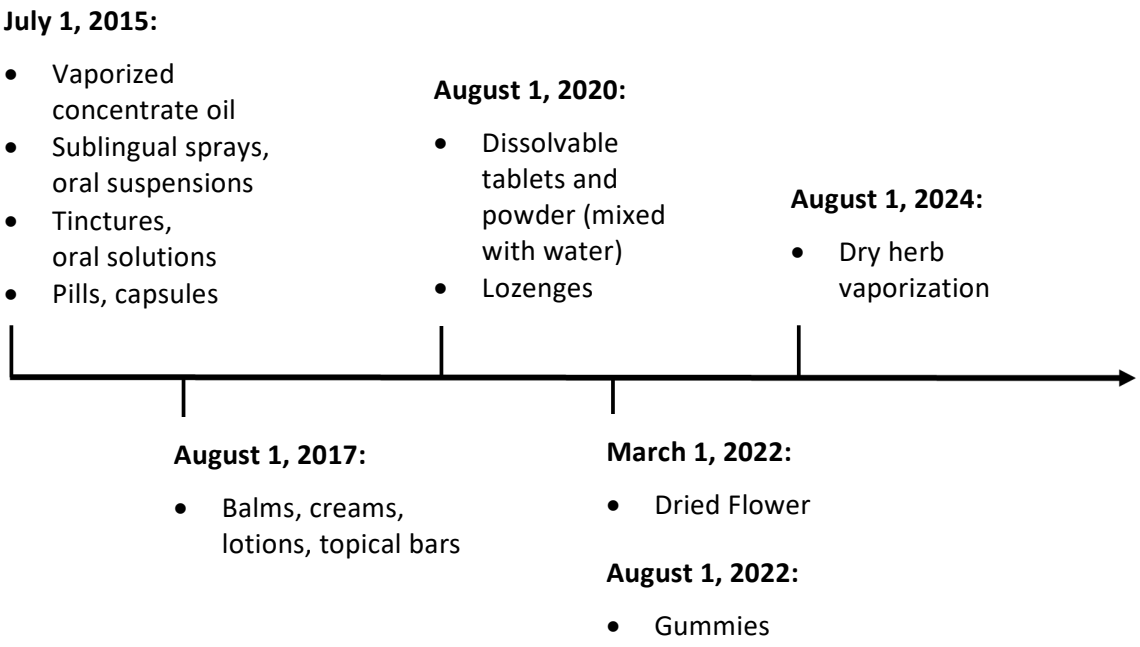
- **High THC:** greater than 15%
- **Medium THC:** 5 to 15%
- **Low THC:** less than 5%
- **High CBD:** greater than 10%
- **Medium CBD:** 1 to 10%
- **Low CBD:** less than 1% or trace amount

Product routes of administration (ROA):

- **Enteral:** entry through the gastrointestinal tract via swallowing (i.e., capsules, oral solutions)
- **Inhalation:** entry through lungs (i.e., vaporized oils, smoked flower)
- **Oromucosal:** sublingual sprays and tinctures absorbed through cheek/oral mucosa
- **Topical:** applied to body surface (i.e., balms)

Product delivery methods available through Minnesota's medical cannabis program have historically been approved by the Minnesota Department of Health, and now the Office of Cannabis Management, through a petition process. Therefore, medical cannabis product availability has evolved throughout the time covered by this report. During the time covered in this report, topical products, dissolvable tablets and powders, lozenges, dried cannabis flower, and gummies were introduced as available products for patients registered in the medical program. A timeline of products' availability is shown in Figure 3.1.

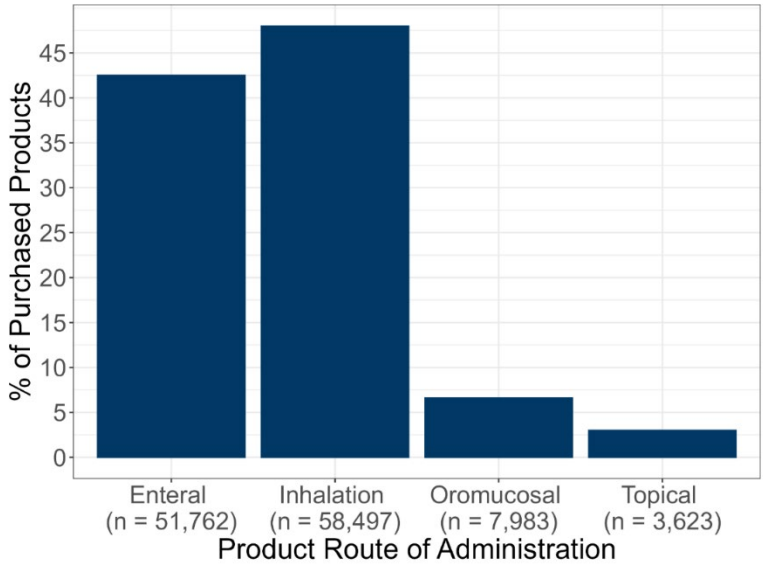
Figure 3.1. Timeline of product availability in Minnesota's medical cannabis program



Routes of administration

Products intended for inhalation, including vape products, raw flower, ground flower, and prerolls, were the most popular with cancer patients accounting for 48.0% of all products purchased. Enteral products, including gummies, capsules, and oral solutions, made up 42.5% of products purchased. Oromucosal and topical products were less popular, accounting for 6.6% and 3.0% of purchased products, respectively (Figure 3.2).

Figure 3.2. Product purchases categorized by product's intended route of administration

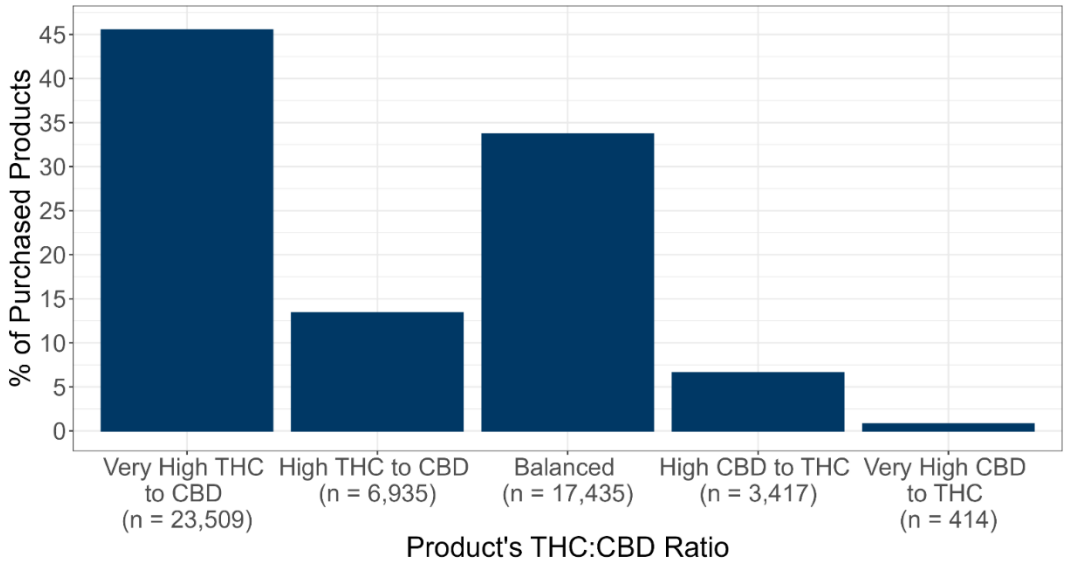


THC:CBD ratio

Enteral products

Capsules and tablets were the most popular enteral products purchased by patients with cancer-related conditions in this report, accounting for 56.4% of products. This is followed by gummies or chews (22.7%), and oral solutions (20.7%). A majority of these products have a very high THC to CBD ratio (n = 23,509; 45.5%), followed by balanced THC to CBD ratio (n = 17,435; 33.7%), and high THC to CBD ratio (n = 6,935; 13.4%). High and very high CBD to THC ratio products accounted for less than 10% of enteral products purchased (Figure 3.3).

Figure 3.3. Enteral product purchases categorized by product's THC:CBD ratio.



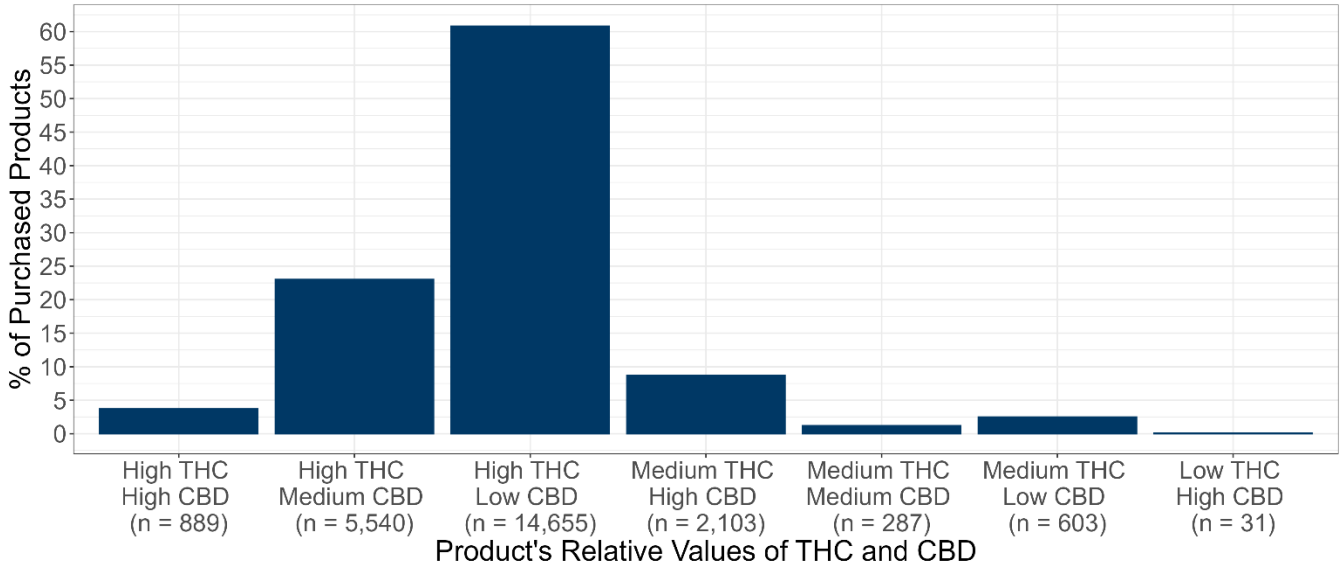
Inhalation products

Inhalation products sold in Minnesota's medical cannabis program fall into two groups, flower products and vaporization products. Dried flower products were added as an approved delivery method March 1, 2022, (Figure 3.1) and make up 41.2% of all inhalation products purchased by patients with cancer-related qualifying conditions. Flower products include flower (72.6%) and prerolls (27.4%).

Manufacturers do not report milligrams of THC and CBD in their flower products, instead they report an approximate percentage of THC and CBD by product weight. Therefore, these products could not be categorized by THC:CBD ratio and are instead categorized by relative values of THC and CBD (Box 3.1).

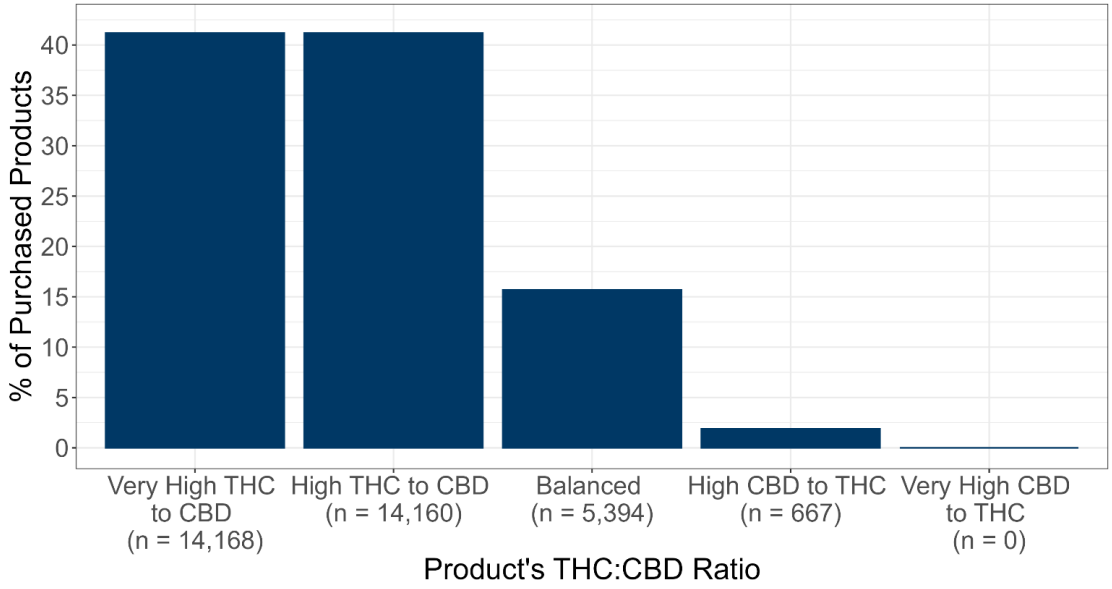
A majority of flower products purchased had high THC/low CBD (60.8%), followed by high THC/medium CBD (23.0%) and medium THC/high CBD (8.7%) products (Figure 3.4).

Figure 3.4. Inhalation flower product purchases organized by relative values of the THC and CBD



Vaporization products include vape cartridges, distillate oils, and distillate syringes. A majority of vaporization products purchased by patients in this report had a high THC:CBD ratio (41.2%) or very high THC:CBD ratio (41.2%). 15.7% of products purchased were balanced, and less than 2% were high or very high CBD:THC (1.9%) (Figure 3.5).

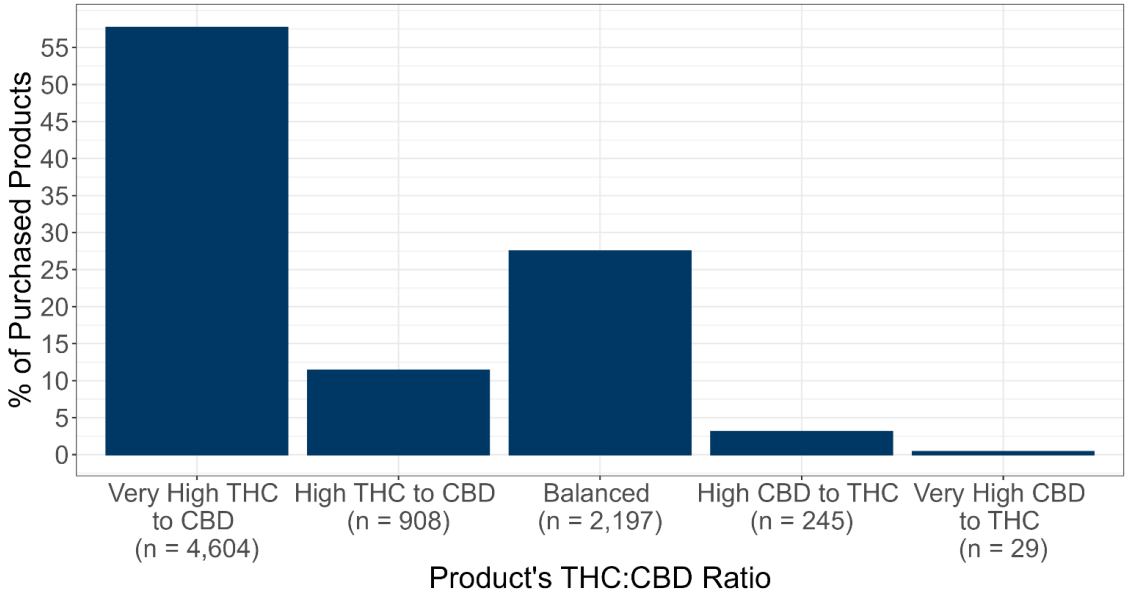
Figure 3.5. Inhalation vaporization product purchases organized by product's THC:CBD ratio



Oromucosal products

Oromucosal products include lozenges (15.7%), sublingual sprays (59.5%), and tinctures (24.8%). A majority of oromucosal products were very high THC:CBD ratio (57.7%), followed by balanced (27.5%) and high THC:CBD ratio (11.4%) products. Majority CBD products made up less than 4% of all oromucosal sales (Figure 3.6).

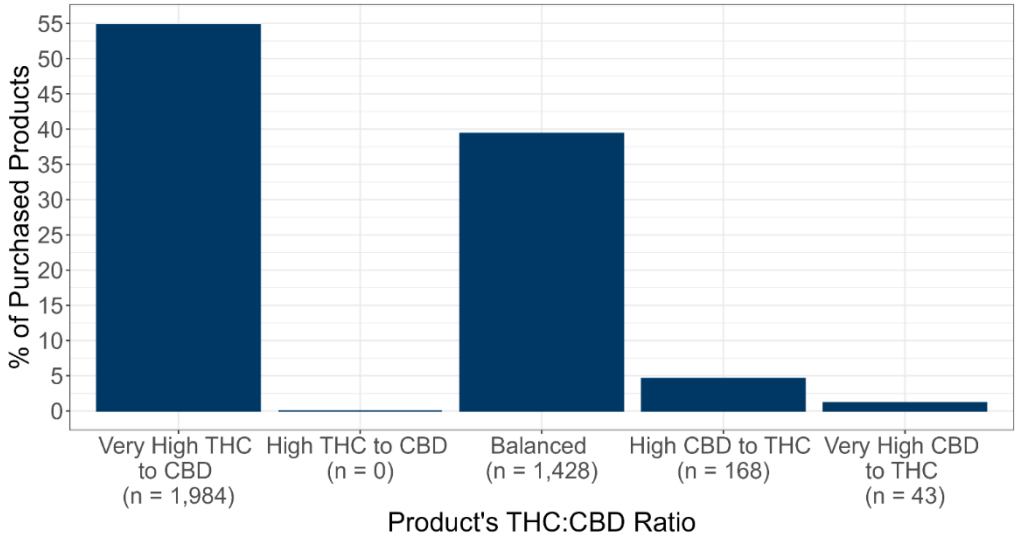
Figure 3.6. Oromucosal product purchases categorized by product's THC:CBD ratio



Topical products

Topical medical cannabis products include balms (43.4%), bars (21.1%), and gel creams (35.5%). A majority of purchased topical products had a very high THC:CBD ratio (54.8%), followed by balanced products (39.4%). Majority CBD products accounted for 5.8% of all topical products purchased (Figure 3.7).

Figure 3.7. Topical product purchases categorized by product's THC:CBD ratio



4. Reported benefits

Benefit received from medical cannabis

During the period discussed in this report, all patients enrolled in Minnesota's medical cannabis program completed a patient self-evaluation (PSE) before each medical cannabis purchase. The PSE asks patients about their symptoms and concerns about medical cannabis to facilitate a discussion with their medical cannabis pharmacist before making their next purchase. Patients are asked about new medications, a set of eight standard symptoms, side effects, and any perceived benefits from using medical cannabis.

Below are a sample of quotes from patients qualified for a cancer-related condition and caregivers in Minnesota's medical cannabis program when asked about the benefits of medical cannabis.

- "Improves my quality of life immensely. Helps with pain, has a calming effect on my anxiety improves my moods when the clouds of cancer return. I have Stage IV terminal cancer; but I'm relatively happy!"
- "Relief from pain, neuropathy, and help with sleep at night."
- "Much less anxious and able to deal with things so much easier, it helps a lot with pain so I don't have to take as much other stuff, it really helps with falling asleep and staying asleep longer."
- "Lessening degree of pain, increase desire to eat."
- "Most useful medication that I have for nausea, anxiety (since prognosis worsened)."
- "Help with appetite, nausea, and peace of mind and motivation"

Standard eight symptoms

All patients, regardless of their certified condition(s), receive a set of eight symptom questions from the PSE which are answered on a 0-10 numerical rating scale (NRS), with 0 indicating absence of the symptom to 10 indicating that the symptom is as bad as the patient can imagine (see Box 4.1). Therefore, higher scores indicate greater symptom severity. Scores greater than or equal to 4 indicate moderate to severe symptoms. Patients are asked to rate symptom severity over the *past 24 hours*.

Box 4.1. Listing of the standard eight symptom measures that all patients answer, including the responses options available to patients

Standard eight symptom measures:

- Anxiety
- Lack of appetite
- Depression
- Disturbed sleep
- Fatigue
- Nausea
- Pain
- Vomiting

Response options (0-10 NRS):

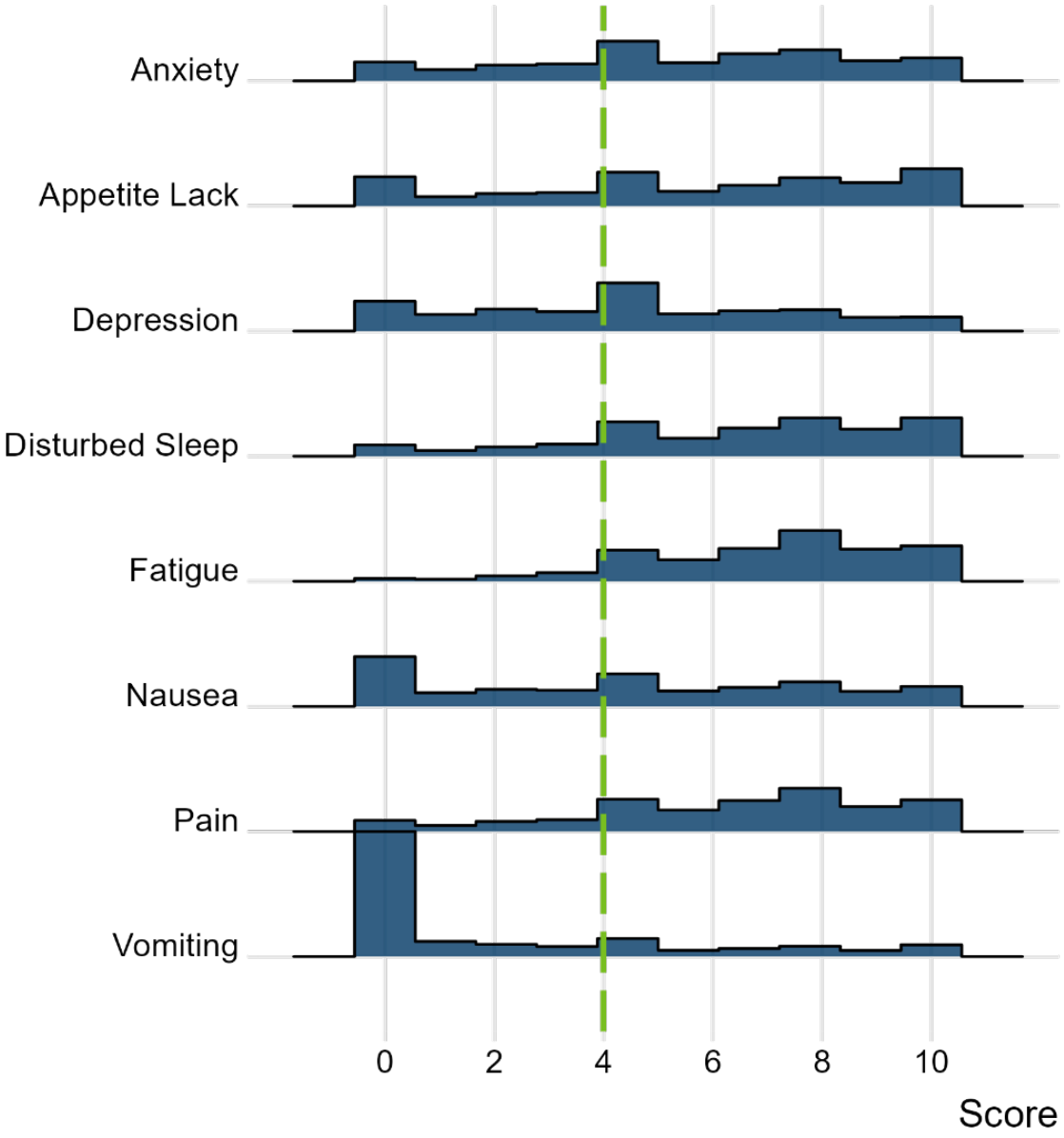
0	1	2	3	4	5	6	7	8	9	10
Symptom not present										Symptom as bad as one can imagine

The threshold of ≥30% reduction on a 0-10 point scale was chosen for the standard eight symptoms because this threshold has been documented in clinical trials to represent clinically meaningful change – especially for pain reduction. Examples of ≥30% change include moving from a score of 10 to a score of 7, from 9 to 6, from 8 to 5, from 7 to 4, etc.

Symptoms at enrollment in Minnesota's Medical Cannabis Program

Among all patients qualified for a cancer-related condition, 82.7% reported moderate to severe pain, 71.0% reported moderate to severe lack of appetite, 56.7% reported moderate to severe nausea, and 27.1% reported moderate to severe vomiting (Table 4.1A). Notably, a majority of patients also reported moderate to severe levels of anxiety (71.7%), depression (60.5%), disturbed sleep (82.8%), and fatigue (91.5%) at baseline (Table 4.1, Figure 4,1). Averages at program enrollment for all standard eight symptoms are found in Table A1.

Figure 4.1. Distribution of standard eight symptom scores at enrollment. A score of four or greater indicates that a symptom is of moderate to severe intensity



Changes in symptoms

Patients are qualified for cancer and treatment-related symptoms including pain, nausea and vomiting, and wasting, therefore this report will focus on those symptoms.

Pain

Among all patients qualified for cancer related conditions with moderate to severe pain at baseline, 29.9% (n = 1,631) reported a ≥30% reduction in pain score within four months of first medical cannabis purchase (Table 4.1A). Among the patients who saw improvement in score within four months and remained in the program, 53.1% (n = 658) were able to maintain that improvement for at least four months after the initial improvement. Overall, 12.1% of patients were able to both achieve and maintain a ≥30% reduction in baseline pain score (Table 4.1A). Looking only at patients qualified for cancer with severe or chronic pain, 11.8% of patients were able to achieve and maintain ≥30% reduction in pain score (Table 4.1B).

Nausea and vomiting

Among all patients qualified for cancer-related conditions with moderate to severe nausea at baseline, 39.9% (n = 1,493) reported a ≥30% reduction in nausea score within four months of first medical cannabis purchase (Table 4.1A). Among the patients who saw improvement in score within four months and remained in the program, 65.4% (n = 742) were able to maintain that improvement for at least four months after the initial improvement. Overall, 19.8% of patients were able to both achieve and maintain a ≥30% reduction in baseline nausea score (Table 4.1A). Looking only at patients qualified for cancer with nausea or severe vomiting, 16.9% of patients were able to achieve and maintain ≥30% reduction in nausea score (Table 4.1C).

Among all patients qualified for cancer-related conditions with moderate to severe vomiting at baseline, 47.2% (n = 845) reported a ≥30% reduction in vomiting score within four months of first medical cannabis purchase (Table 4.1A). Among the patients who saw improvement in score within four months and remained in the program, 74.4% (n = 462) were able to maintain that improvement for at least four months after the initial improvement. Overall, 25.8% of patients were able to both achieve and maintain a ≥30% reduction in baseline vomiting score (Table 4.1A). Looking only at patients qualified for cancer with nausea or severe vomiting, 23.2% of patients were able to achieve and maintain ≥30% reduction in vomiting score (Table 4.1C).

Lack of appetite

Among all patients qualified for cancer-related conditions with moderate to severe appetite lack at baseline, 38.2% (n = 1,791) reported a ≥30% reduction in appetite lack score within four months of first medical cannabis purchase (Table 4.1A). Among the patients who saw improvement in score within four months and remained in the program, 62.8% (n = 874) were able to maintain that improvement for at least four months after the initial improvement. Overall, 18.6% of patients were able to both achieve and maintain a ≥30% reduction in baseline appetite lack score (Table 4.1A). Looking only at patients qualified for cancer with severe wasting or cachexia, 16.1% of patients were able to achieve and maintain ≥30% reduction in appetite lack score (Table 4.1D).

Other symptoms

A majority of patients qualified for cancer-related conditions also reported moderate to severe scores for anxiety (71.7%), depression (60.5%), disturbed sleep (82.8%), and fatigue (91.5%) (Table 4.1A). Among patients with moderate to severe scores, 20.2% with anxiety, 22.4% with depression, 18.2% with disturbed sleep, and 10.8% with fatigue were able to achieve and maintain ≥30% reduction in symptom score (Table 4.1A).

Table 4.1. Standard eight symptoms benefits in patients with cancer related qualifying conditions. A. Among all patients (n = 6,605). B. Patients qualified for cancer with severe or chronic pain (n = 4,570). C. Patients qualified for cancer with nausea or severe vomiting (n = 3,258). D. Patients qualified for cancer with severe wasting or cachexia (n = 1,966).

Table 4.1A. All patients qualified for a cancer related condition (n = 6,605)

Standard eight symptom measure	n (%) of patients reporting at moderate to severe levels at baseline	n (%) of patients with >=30% symptom improvement within four months, among those who had moderate to severe levels at baseline	# of patients with data in four-month period following initial ≥30% symptom improvement	n (%) of patients who achieved ≥30% symptom improvement that maintained it for at least four months	% of patients that both achieved ≥30% symptom improvement and retained that degree of improvement for at least four months
Anxiety	4,733 (71.7)	1,897 (40.1)	1,480	957 (64.7)	20.2%
Appetite Lack	4,691 (71.0)	1,791 (38.2)	1,392	874 (62.8)	18.6%
Depression	3,993 (60.5)	1,741 (43.6)	1,348	895 (66.4)	22.4%
Disturbed Sleep	5,466 (82.8)	2,103 (38.5)	1,646	996 (60.5)	18.2%
Fatigue	6,043 (91.5)	1,700 (28.1)	1,345	651 (48.4)	10.8%
Nausea	3,743 (56.7)	1,493 (39.9)	1,134	742 (65.4)	19.8%
Pain	5,460 (82.7)	1,631 (29.9)	1,240	658 (53.1)	12.1%
Vomiting	1,790 (27.1)	845 (47.2)	621	462 (74.4)	25.8%

Table 4.1B. Patients qualified for cancer with severe or chronic pain (n = 4,570)

Standard eight symptom measure	n (%) of patients reporting at moderate to severe levels at baseline	n (%) of patients with >=30% symptom improvement within four months, among those who had moderate to severe levels at baseline	# of patients with data in four-month period following initial ≥30% symptom improvement	n (%) of patients who achieved ≥30% symptom improvement that maintained it for at least four months	% of patients that both achieved ≥30% symptom improvement and retained that degree of improvement for at least four months
Anxiety	3,255 (71.2)	1,363 (41.9)	1,056	685 (64.9)	21.0%
Appetite lack	3,041 (66.5)	1,214 (39.9)	950	597 (62.8)	19.6%
Depression	2,744 (60.0)	1,224 (44.6)	938	616 (65.7)	22.4%
Disturbed sleep	3,849 (84.2)	1,564 (40.6)	1,234	751 (60.9)	19.5%
Fatigue	4,177 (91.4)	1,236 (29.6)	986	472 (47.9)	11.3%
Nausea	2,387 (52.2)	1,002 (42.0)	770	494 (64.2)	20.7%
Pain	4,097 (89.6)	1,213 (29.6)	925	485 (52.4)	11.8%
Vomiting	1,110 (24.3)	551 (49.6)	408	307 (75.2)	27.7%

Table 4.1C. Patients qualified for cancer with nausea or severe vomiting (n = 3,258)

Standard eight symptom measure	n (%) of patients reporting at moderate to severe levels at baseline	n (%) of patients with >=30% symptom improvement within four months, among those who had moderate to severe levels at baseline	# of patients with data in four-month period following initial ≥30% symptom improvement	n (%) of patients who achieved ≥30% symptom improvement that maintained it for at least four months	% of patients that both achieved ≥30% symptom improvement and retained that degree of improvement for at least four months
Anxiety	2,424 (74.4)	917 (37.8)	700	433 (61.9)	17.9%
Appetite Lack	2,564 (78.7)	925 (36.1)	701	431 (61.5)	16.8%
Depression	2,044 (62.7)	843 (41.2)	626	423 (67.6)	20.7%
Disturbed Sleep	2,726 (83.7)	950 (34.8)	730	430 (58.9)	15.8%
Fatigue	3,006 (92.3)	738 (24.6)	577	279 (48.4)	9.3%
Nausea	2,314 (71.0)	836 (36.1)	611	390 (63.8)	16.9%
Pain	2,541 (78.0)	746 (29.4)	560	292 (52.1)	11.5%
Vomiting	1,184 (36.3)	538 (45.4)	380	275 (72.4)	23.2%

Table 4.1D. Patients qualified with cancer with severe wasting or cachexia (n = 1,966)

Standard eight symptom measure	n (%) of patients reporting at moderate to severe levels at baseline	n (%) of patients with >=30% symptom improvement within four months, among those who had moderate to severe levels at baseline	# of patients with data in four-month period following initial ≥30% symptom improvement	n (%) of patients who achieved ≥30% symptom improvement that maintained it for at least four months	% of patients that both achieved ≥30% symptom improvement and retained that degree of improvement for at least four months
Anxiety	1,343 (68.3)	499 (37.2)	384	257 (66.9)	19.1%
Appetite Lack	1,679 (85.4)	557 (33.2)	421	270 (64.1)	16.1%
Depression	1,172 (59.6)	490 (41.8)	371	255 (68.7)	21.8%
Disturbed Sleep	1,534 (78.0)	555 (36.2)	410	257 (62.7)	16.8%
Fatigue	1,829 (93.0)	421 (23.0)	319	158 (49.5)	8.6%
Nausea	1,137 (57.8)	420 (36.9)	296	205 (69.3)	18.0%
Pain	1,518 (77.2)	410 (27.0)	289	169 (58.5)	11.1%
Vomiting	560 (28.5)	248 (44.3)	169	119 (70.4)	21.3%

Limitations

A major limitation in the above analyses is patient loss to follow-up. As discussed above, proportions of patients who were able to achieve ≥30% symptom relief and maintain it for at least four months is a conservative estimate that does not account for patients leaving the program. The above proportions are calculated assuming no loss to follow-up, using the number of patients with moderate to severe scores at baseline as the denominator. Medical cannabis patients may leave the program at any time by either formally removing themselves from the registry or not renewing their medical cannabis certification. In addition, patients may simply stop purchasing medical cannabis at any time.

Patients cite the cost of medical cannabis, inaccessibility of medical cannabis dispensaries, and ineffectiveness of symptom management as major reasons for leaving the program.

Among all patients qualified for a cancer-related condition, 25% (n = 1,668) only purchased medical cannabis one time. Additionally, only 39% of patients purchased medical cannabis for more than eight months, which is the length of follow up time in our report (Table 4.2). Length of time in the medical cannabis program is consistent among cancer-related qualifying conditions, except for cancer with cachexia or severe wasting. A larger proportion of patients qualified for cancer with cachexia or severe wasting only purchased one time (32%) compared to all patients (25%), and fewer patients remained in the program for more than eight months compared to all patients (28% vs 39%) (Table 4.2). For additional context, in a previous report published by OCM on medical cannabis patients with chronic pain, 66.4% purchased for more than eight months (*Chronic Pain Patients in the Minnesota Medical Cannabis Program*, 2025). For this specific population, drop out before eight months may be because patients are only purchasing medical cannabis for chemotherapy-related symptoms and stop purchasing after they finish chemotherapy treatment. Length of chemotherapy treatments depend on the patient, stage and type of cancer but would typically be shorter than our eight-month follow-up window. Minnesota's medical cannabis program does not collect data on patient medical treatments. Additionally, patients may also be using medical cannabis while they are near or already in hospice care.

Table 4.2. Length of time in Minnesota's medical cannabis program by cancer-related qualifying condition

Time between first and last purchase	Any cancer condition (n = 6,621)	Cancer with severe or chronic pain (n = 4,581)	Cancer with nausea or severe vomiting (n = 3,264)	Cancer with cachexia or severe wasting (n = 1,973)
Only purchased one time	1668 (25.2%)	1093 (23.9%)	868 (26.6%)	631 (32%)
Less than one month	645 (9.7%)	453 (9.9%)	343 (10.5%)	231 (11.7%)
One to four months	995 (15%)	711 (15.5%)	486 (14.9%)	337 (17.1%)
Four to eight months	739 (11.2%)	517 (11.3%)	372 (11.4%)	225 (11.4%)
Eight to twelve months	689 (10.4%)	475 (10.4%)	342 (10.5%)	170 (8.6%)
More than twelve months	1885 (28.5%)	1332 (29.1%)	853 (26.1%)	379 (19.2%)

5. Reported adverse side effects

In addition to reporting benefits of medical cannabis and rating condition symptoms, the patient self-evaluation (PSE) is also used to report adverse side effects of medical cannabis use. During the period discussed in this report, patients filled out their PSE before each medical cannabis purchase and included any adverse side effects experienced. Patients can discuss these side effects and any other concerns with the medical cannabis pharmacist or medical cannabis consultant. Patients can choose from 31 side effect options (e.g., anxiety, dry mouth, headache), or an "other" option where they may write their own side effect not listed as an option. Each adverse side effect is rated by the patient as mild, moderate, or severe. Mild symptoms do not interfere with daily activities. Moderate symptoms may interfere with daily activities. Severe symptoms interrupt usual daily activities.

For this report, side effect data from the PSE was extracted for all patients qualified for cancer-related qualifying conditions enrolled for the first time between July 1, 2015, and Dec. 31, 2023. This report describes all purchases that occurred within the first year of enrollment. This query produced:

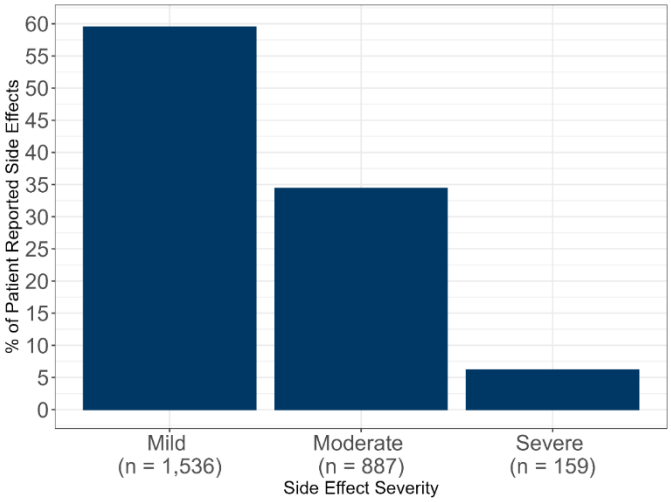
- 2,582 patient-reported side effect responses from
- 962 (14.5%) patients

A major limitation of these data is loss to follow-up. If a patient had a side effect after taking medical cannabis and decided not to purchase again, there is no record of the last side effect. Therefore, there is likely under-reporting of moderate to severe side effects thorough the PSE. Patients, caregivers, and health care practitioners can report side effects directly to the medical cannabis manufacturer. However, these reports are deidentified before they are shared with Minnesota's medical cannabis program.

Of patients reporting side effects in a PSE (n = 962), over half reported one unique side effect (n = 608; 63.2%), with 89.3% reporting three or fewer unique side effects within one year of their first medical cannabis purchase.

A majority of the reported side effects reported were mild (n = 1,536; 59.5%), 34.4% were moderate (n = 887), and only 6.2% were reported to be severe (n = 159) (Figure 5.1).

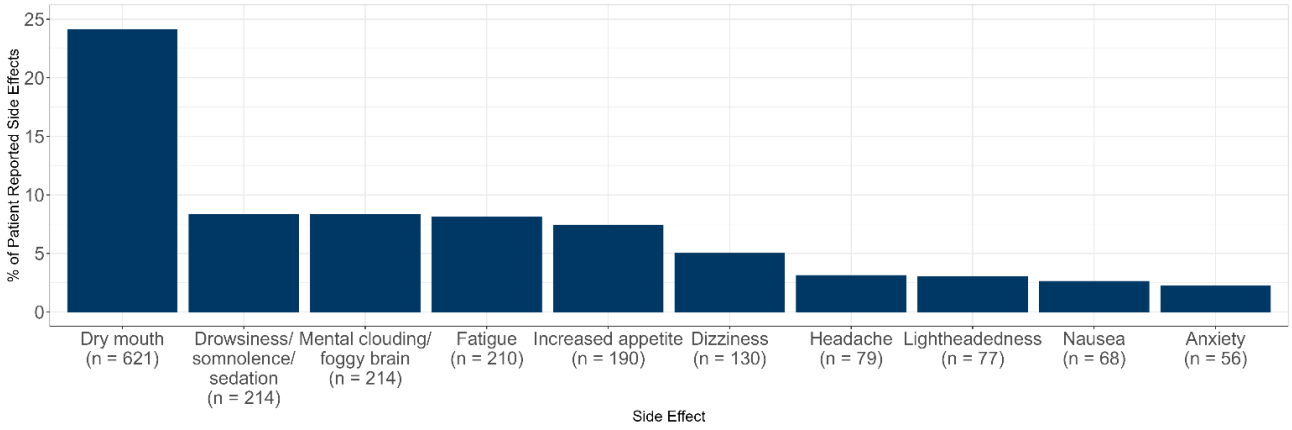
Figure 5.1. Severity of patient-reported side effects



Most commonly reported side effects

The most commonly reported side effects among patients were dry mouth, drowsiness/somnolence/sedation, and mental clouding or "foggy brain" (Figure 5.2). Figure 5.2 illustrates the top 10 reported side effects. "Other" side effect was the second most commonly reported side effect (n = 327), "other" was removed from the below table because the responses were free text and not coded into separate categories of side effects.

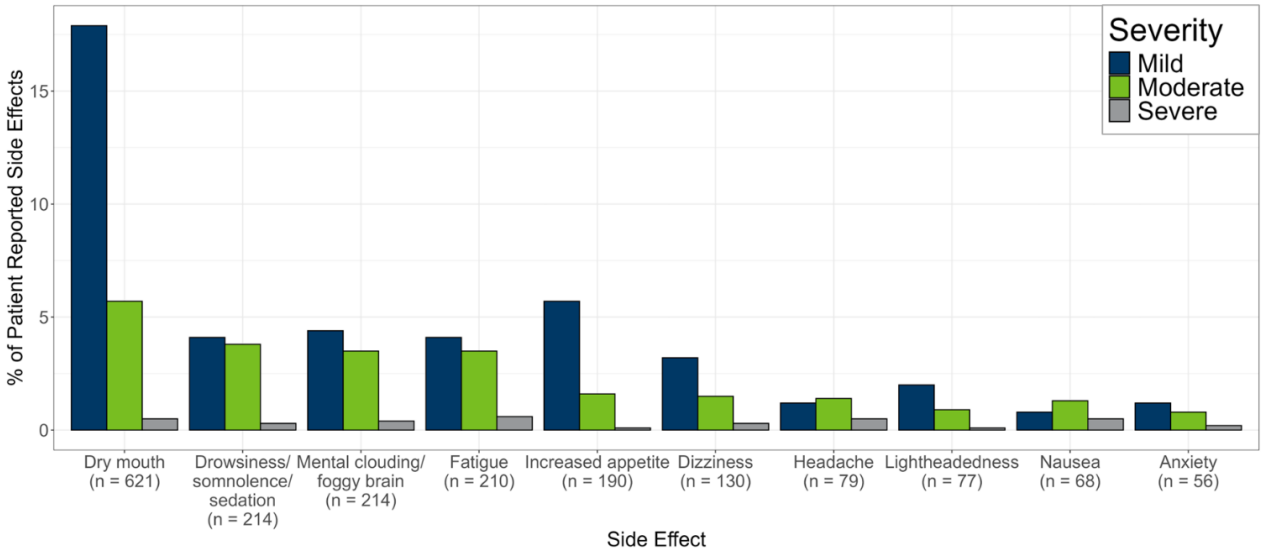
Figure 5.2. Top 10 most commonly reported adverse side effects by patients



Common side effects by severity

Among the top 10 most commonly reported side effects, most were mild, followed by moderate and few were severe (Figure 5.3).

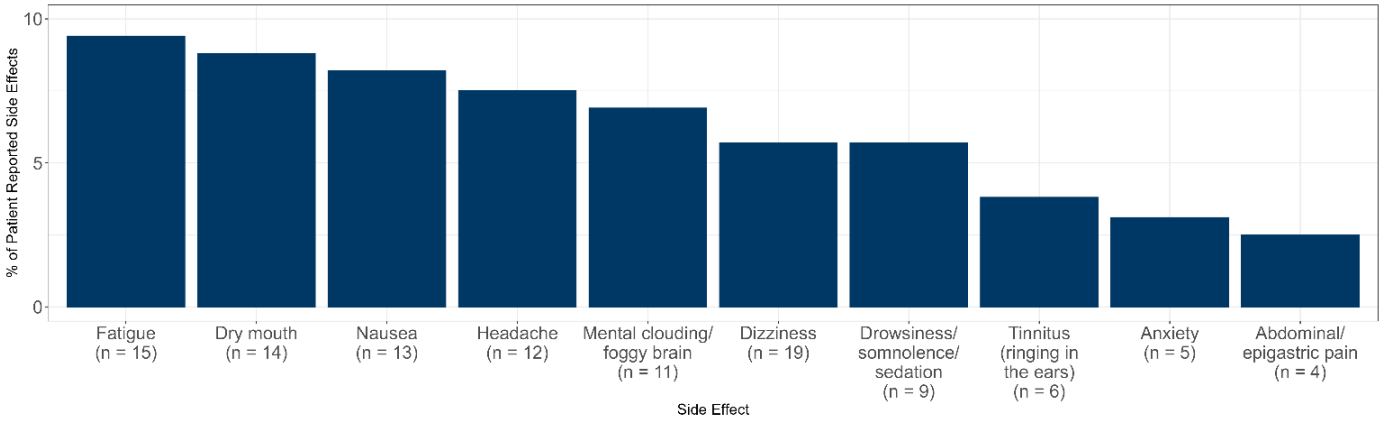
Figure 5.3. Top 10 most reported side effects by severity



Severe side effects

Through the PSE, 159 side effects were reported as severe by 102 patients. Gender and age of patients reporting severe side effects were representative of the full cohort. Fatigue was the most common severe side effect (n = 15, 9.4%), followed by dry mouth (n = 14, 8.8%), nausea (n = 13, 8.2%), and headache (n = 12, 7.5%) (Figure 5.4).

Figure 5.4. Top 10 side effects reported as severe



Conclusion

This report provides insight into medical cannabis purchasing, symptom benefits, and adverse side effects in patients qualified for a cancer-related condition in Minnesota's medical cannabis program. Patients included in this report most commonly purchased high or very high THC:CBD inhalation and enteral medical cannabis products. Using self-reported symptom scores, patients were able to achieve and maintain symptom relief after starting medical cannabis. However, since all patients utilized medical cannabis, this report does not compare the effectiveness in symptom relief to a control or placebo group. Additionally, there was significant loss to follow-up over the study period among patients qualified for cancer-related conditions. More research is needed to further elucidate this relationship. Only 15% of patients reported an adverse side effect of their medical cannabis; of these reported side effects, 60% were mild. This report informs patients, health care practitioners, and other citizens of Minnesota on the impact of medical cannabis on patients with cancer-related symptoms. Additionally, this report adds to the scientific literature and knowledge base on medical cannabis and may be used by lawmakers to make policy decisions.

Appendix Additional Tables

Table A1. Mean (standard deviation) standard eight symptom scores at enrollment by cancer-related qualifying condition

Standard eight symptom measure	All patients (n = 6,605)	Cancer with pain (n = 4,570)	Cancer with nausea/vomiting (n = 3,258)	Cancer with cachexia/wasting (n = 1,966)
Anxiety	5.56 (3.08)	5.52 (3.11)	5.81 (3.01)	5.31 (3.10)
Appetite lack	5.72 (3.42)	5.30 (3.44)	6.41 (3.18)	7.16 (2.96)
Depression	4.58 (3.09)	4.57 (3.13)	4.74 (3.05)	4.56 (3.08)
Disturbed sleep	6.55 (2.89)	6.71 (2.83)	6.60 (2.85)	6.14 (3.04)
Fatigue	7.15 (2.30)	7.13 (2.30)	7.28 (2.25)	7.34 (2.23)
Nausea	4.50 (3.47)	4.11 (3.42)	5.61 (3.31)	4.61 (3.43)
Pain	6.46 (2.82)	7.05 (2.49)	6.07 (2.95)	6.02 (2.99)
Vomiting	2.24 (3.25)	2.00 (3.09)	2.98 (3.56)	2.42 (3.34)

References

Anderson, S. P., Zylla, D. M., McGriff, D. M., & Arneson, T. J. (2019). Impact of Medical Cannabis on Patient-Reported Symptoms for Patients With Cancer Enrolled in Minnesota's Medical Cannabis Program. *Journal of Oncology Practice*, *15*(4), e338–e345. https://doi.org/10.1200/JOP.18.00562

Boland, E. G., Bennett, M. I., Allgar, V., & Boland, J. W. (2020). Cannabinoids for adult cancer-related pain: Systematic review and meta-analysis. *BMJ Supportive & Palliative Care*, *10*(1), 14–24. https://doi.org/10.1136/bmjspcare-2019-002032

Chronic Pain Patients in the Minnesota Medical Cannabis Program. (2025). Minnesota Office of Cannabis Management. https://mn.gov/ocm/assets/chronic-pain-report_tcm1202-667592.pdf

Darmani, N. A. (2001). Delta(9)-tetrahydrocannabinol and synthetic cannabinoids prevent emesis produced by the cannabinoid CB(1) receptor antagonist/inverse agonist SR 141716A. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, *24*(2), 198–203. https://doi.org/10.1016/S0893-133X(00)00197-4

Grimison, P., Mersiades, A., Kirby, A., Lintzeris, N., Morton, R., Haber, P., Olver, I., Walsh, A., McGregor, I., Cheung, Y., Tognela, A., Hahn, C., Briscoe, K., Aghmesheh, M., Fox, P., Abdi, E., Clarke, S., Della-Fiorentina, S., Shannon, J., … Stockler, M. (2020). Oral THC:CBD cannabis extract for refractory chemotherapy-induced nausea and vomiting: A randomised, placebo-controlled, phase II crossover trial. *Annals of Oncology: Official Journal of the European Society for Medical Oncology*, *31*(11), 1553–1560. https://doi.org/10.1016/j.annonc.2020.07.020

Hammond, S., Erridge, S., Mangal, N., Pacchetti, B., & Sodergren, M. H. (2021). The Effect of Cannabis-Based Medicine in the Treatment of Cachexia: A Systematic Review and Meta-Analysis. *Cannabis and Cannabinoid Research*, *6*(6), 474–487. https://doi.org/10.1089/can.2021.0048

Häuser, W., Welsch, P., Radbruch, L., Fisher, E., Bell, R. F., & Moore, R. A. (2023). Cannabis-based medicines and medical cannabis for adults with cancer pain. *The Cochrane Database of Systematic Reviews*, *6*(6), CD014915. https://doi.org/10.1002/14651858.CD014915.pub2

Minnesota Medical Cannabis Dashboard. (2024, September 9). Division of Medical Cannabis. https://mn.gov/ocm/dmc/data-reports/data-projects/cannabis-dashboard.jsp

Mücke, M., Weier, M., Carter, C., Copeland, J., Degenhardt, L., Cuhls, H., Radbruch, L., Häuser, W., & Conrad, R. (2018). Systematic review and meta-analysis of cannabinoids in palliative medicine. *Journal of Cachexia, Sarcopenia and Muscle*, *9*(2), 220–234. https://doi.org/10.1002/jcsm.12273

Pantoja-Ruiz, C., Restrepo-Jimenez, P., Castañeda-Cardona, C., Ferreirós, A., & Rosselli, D. (2021). Cannabis and pain: A scoping review. *Brazilian Journal of Anesthesiology*, *72*(1), 142–151. https://doi.org/10.1016/j.bjane.2021.06.018

Simon, L., Baldwin, C., Kalea, A. Z., & Slee, A. (2022). Cannabinoid interventions for improving cachexia outcomes in cancer: A systematic review and meta-analysis. *Journal of Cachexia, Sarcopenia and Muscle*, *13*(1), 23–41. https://doi.org/10.1002/jcsm.12861

Smith, L. A., Azariah, F., Lavender, V. T., Stoner, N. S., & Bettiol, S. (2015). Cannabinoids for nausea and vomiting in adults with cancer receiving chemotherapy. *The Cochrane Database of Systematic Reviews*, *2015*(11), CD009464. https://doi.org/10.1002/14651858.CD009464.pub2

Steiner, M. A., & Wotjak, C. T. (2008). Role of the endocannabinoid system in regulation of the hypothalamic-pituitary-adrenocortical axis. *Progress in Brain Research*, *170*, 397–432. https://doi.org/10.1016/S0079-6123(08)00433-0

Sukpiriyagul, A., Chartchaiyarerk, R., Tabtipwon, P., Smanchat, B., Prommas, S., Bhamarapravatana, K., & Suwannarurk, K. (2023). Oral Tetrahydrocannabinol (THC):Cannabinoid (CBD) Cannabis Extract Adjuvant for Reducing Chemotherapy-Induced Nausea and Vomiting (CINV): A Randomized, Double-Blinded, Placebo-Controlled, Crossover Trial. *International Journal of Women's Health*, *15*, 1345–1352. https://doi.org/10.2147/IJWH.S401938

Suzuki, H., Asakawa, A., Amitani, H., Nakamura, N., & Inui, A. (2013). Cancer cachexia—Pathophysiology and management. *Journal of Gastroenterology*, *48*(5), 574–594. https://doi.org/10.1007/s00535-013-0787-0

Urits, I., Borchart, M., Hasegawa, M., Kochanski, J., Orhurhu, V., & Viswanath, O. (2019). An Update of Current Cannabis-Based Pharmaceuticals in Pain Medicine. *Pain and Therapy*, *8*(1), 41–51. https://doi.org/10.1007/s40122-019-0114-4

Zylla, D. M., Eklund, J., Gilmore, G., Gavenda, A., Guggisberg, J., VazquezBenitez, G., Pawloski, P. A., Arneson, T., Richter, S., Birnbaum, A. K., Dahmer, S., Tracy, M., & Dudek, A. (2021). A randomized trial of medical cannabis in patients with IV cancers to assess feasibility, dose requirements, impact on pain and opioid use, safety, and overall patient satisfaction. *Supportive Care in Cancer: Official Journal of the Multinational Association of Supportive Care in Cancer*, *29*(12), 7471–7478. https://doi.org/10.1007/s00520-021-06301-x