Identification and Description of Patients with Anhedonia using Patient Voice Available from a Digital Patient Health Community Platform

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Introduction

Anhedonia, or the loss of interest in formerly pleasurable activities, is one of two key symptoms of major depressive disorder (MDD). It is associated with more severe disease and worsened response to standard treatment. Patient identification in claims databases via ICD-10 codes for anhedonia is limited as it is underutilized in clinical practice. The objective of this study is to use unsupervised machine learning and natural language processing to identify anhedonia in posted conversations of an online depression-anxiety patient community and describe healthcare resource utilization (HCRU) and treatment choices for patients with anhedonia.

Methods

- 59,864 user posts from Inspire's depression-anxiety community (11,943 members) underwent topic modeling, a type of statistical modeling that uses unsupervised machine learning to identify clusters or groups of similar words within a body of text via latent dirichlet allocation **(Figure 1)**. This was followed by clinician annotation of anhedonic topics **(Figure 2)** to enable the selection of patients whose posts carried anhedonic topics
- Patients were classified as "noted anhedonia" if their posts' anhedonia topic strength was within the top 20% of anhedonia topic strength across all posts **(Figure 2)**
- A subset of patients have linked electronic health records (EHR) and medical and pharmacy claims through privacy-preserving tokenization **(Figure 3)**
- Baseline patient characteristics and HCRU were evaluated and compared between patients with and without noted anhedonia, and further stratified by MDD diagnosis codes
- Analysis was performed using descriptive statistics and conducted in R. Median and IQR are presented for continuous variables. Count and percentages are presented for categorical variables

Results

Figure 1: Illustrative topic modeling

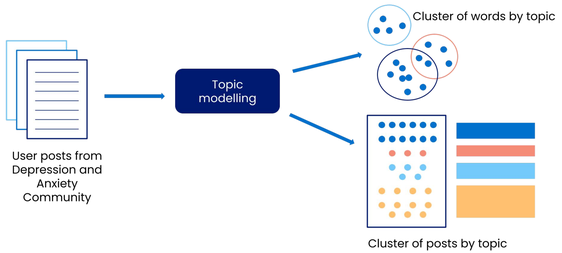

Figure 2: Anhedonic topics

Anhedonia Topic	Prevalence of topic across all user posts
Future-facing and hope for change (oneself or peer)	84.67%
Community or volunteer activities that are enjoyable and support mental health (oneself or peer)	59.12%
Past experiences with or onset of mental health condition (oneself)	35.80%
Loss of enjoyment, low energy, and low mood (oneself)	22.53%
Doing hobbies or activities that are enjoyable and support mental health (oneself or peer)	4.82%
Inability of others to understand one's feelings and symptoms (oneself)	3.01%
Delivering emotional support and encouragement to seek care (peer)	2.70%
Inability to feel happiness and practice of faking it (Onseself or peer)	2.39%
Day to day struggle with depression symptoms (oneself)	1.45%

Patient ID	Total No. of Posts	Prevalence of topic across all posts within the member
000001	1582	25.02%
000002	403	18.71%
000003	1234	17.69%
000004	605	12.49%
000005	473	10.86%
000006	754	10.36%
000007	1118	9.80%
000008	140	9.79%
000009	350	8.76%
000010	724	8.44%
.	.	.
.	.	.
.	.	.
011939	3	0.02%
011940	2	0.02%
011941	3	0.02%
011942	5	0.02%
011943	1	0.00%

Figure 3: Anhedonia Cohort Identification

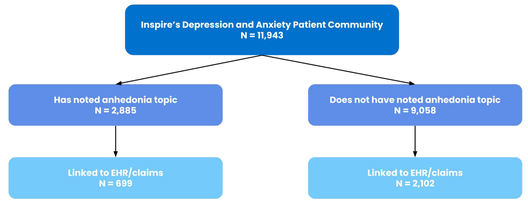

Table 1: Patient Characteristics of Subset with EHR/Claims Linkage

Characteristic	Non-anhedonia Patients n= 2,102	Anhedonia Patients N = 699
Gender		
Female	1,391 (66%)	461 (66%)
Male	448 (21%)	160 (23%)
Unknown	263 (13%)	78 (11%)
Current age, Median (IQR)	53 (36, 69)	55 (37, 69)
Region		
Northeast	436 (21%)	140 (20%)
South	715 (34%)	263 (38%)
Midwest	461 (22%)	156 (22%)
West	397 (19%)	117 (17%)
Unknown	93 (4%)	23 (3%)
No. of claims per patient, Median (IQR)	46 (16, 110)	49 (18, 105)
Time between first and last claim (months), Median (IQR)	83 (56, 95)	82 (55, 94)
Has a MDD ICD-10 code[1] (dx) in claims or EHR	1,020 (49%)	352 (50%)
No. of MDD related procedures[2] per patient		
Median (IQR)	2 (2, 4)	2 (1, 4)
Range	[1, 12]	[1, 9]
No. of psychiatric hospitalizations per patient[3]		
Median (IQR)	2 (1, 3)	1 (1, 3)
Range	[1, 39]	[1, 14]
No. of psychotherapy visits per patient[4]		
Median (IQR)	4 (2, 14)	4 (1, 14)
Range	[1, 180]	[1, 160]

Notes:
1. Mental / behavioral health ICD-10 codes included ICD-10 codes F32.*, F33.*, F34.1
2. MDD related procedures were defined as presence of a CPT/HCPCS code for electroconvulsive therapy, transcranial magnetic stimulation, vagus nerve stimulation, and esketamine
3. 1,955 non-anhedonia and 650 anhedonia patients do not have any claims for psychiatric hospitalizations
4. 1,773 non-anhedonia and 570 anhedonia patients do not have any claims for psychotherapy visits

Table 2: Patients with MDD Medications in Claims/EHR

	Non-anhedonia Patients N = 2,102		Anhedonia Patients N = 699	
	No MDD dx N = 1,082	Has MDD dx N = 1,020	No MDD dx N = 347	Has MDD dx N = 352
No MDD drugs in record	950 (87%)	563 (55%)	299 (86%)	186 (53%)
Has MDD drugs in record	132 (13%)	457 (45%)	48 (14%)	166 (47%)
Drug name[1]				
citalopram	14 (11%)	70 (15%)	6 (13%)	26 (16%)
desvenlafaxine	4 (3%)	34 (7%)	2 (4%)	17 (10%)
duloxetine[2]	18 (14%)	100 (22%)	6 (13%)	43 (26%)
escitalopram	40 (30%)	133 (29%)	18 (38%)	52 (31%)
fluoxetine	26 (20%)	142 (31%)	11 (23%)	45 (27%)
levomilnacipran	0 (0%)	5 (1%)	0 (0%)	2 (1%)
milnacipran	0 (0%)	2 (0.4%)	0 (0%)	3 (2%)
paroxetine	11 (8%)	72 (16%)	6 (13%)	21 (13%)
sertraline[2]	34 (26%)	142 (31%)	5 (10%)	50 (30%)
venlafaxine[2]	5 (4%)	61 (13%)	2 (4%)	24 (14%)
vilazodone	0 (0%)	10 (2%)	1 (2%)	3 (2%)
vortioxetine[2]	4 (3%)	52 (11%)	3 (6%)	15 (9%)
Drug class[1]				
Selective serotonin reuptake inhibitors	111 (84%)	371 (81%)	43 (90%)	129 (78%)
Serotonin modulators[2]	4 (3%)	52 (11%)	3 (6%)	15 (9%)
Serotonin-norepinephrine reuptake inhibitors[2]	26 (20%)	165 (36%)	10 (21%)	73 (44%)

Notes:
1. Patients can be prescribed more than one medication. Percentages for drug name and drug class are based on number of patients in the sub-cohort who have a MDD medication in their record
2. Test of equal proportions p-value < 0.05

Conclusion

Patient voice from digital online health platforms is an emerging source of data to help identify patients with anhedonia as the diagnosis code is significantly underutilized in clinical practices. Here, we show distribution of demographics and medications taken by patients with anhedonia and without through the use of natural language processing of the depression-anxiety community forum. Describing early and frequent symptoms of anhedonia may help facilitate clinical diagnosis, awareness promotion and treatment/therapy planning.

Limitations: Medical and pharmacy claims may not provide a patient's complete medical journey as there may be gaps in insurance coverage. Findings from this study may not be generalizable to the broader MDD population.