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Signs and symptoms in the psychiatric domain: a corpus analysis

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Abstract

In the medical domain, great effort is taken to normalize terminology at an international level. However, corpus analysis indicates that there is still much work to be done. For example, the basic conceptual distinction between SIGN (an objective change in a patient's condition) and SYMPTOM (subjective evidence of disease or condition as perceived by the patient) is something any medical expert is aware of. In texts of the subdomain of Psychiatry, however, the terms *sign* and *symptom* seem to be used indistinctly. Their use was analyzed from a multidimensional perspective in an English language medical corpus on the subdomain of Psychiatry. Collocational information was extracted and then classified according to the data obtained. Finally a comparison was made with an English language corpus on Oncology to see if the conclusions drawn can be applied to other medical subdomains or if the boundaries between the terms are even fuzzier in the Psychiatric domain.

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1. Introduction

Medical terminology is one of the most dynamic terminological domains (Prieto Velasco et al., 2013, p. 168), since it has naturally evolved and different disciplines deal with the same concepts and terms in different ways. For instance, in Psychiatry (as opposed to Neurology), the term *stupor* is used to describe a patient who is mute and immobile but fully conscious (Puri, 2008). As for concept dynamics, certain symptoms have evolved into syndromes which in turn have become diseases. Conversely, certain diseases which were thought to have a pathological basis

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are no longer regarded as such (Casey & Kelly, 2007). Therefore, great effort is taken to normalize terminology at an international level. Proof of this are the different vocabularies, taxonomies and classifications made by various organizations, such as the controlled vocabulary MeSH of the National Library of Medicine (US) or the International Statistical Classification of Diseases and Related Health Problems (ICD, WHO).

However, corpus analysis indicates that there is still much work to be done. For example, the basic conceptual distinction between SIGN and SYMPTOM is something any medical expert is aware of. A SYMPTOM is any subjective evidence of disease or condition (i.e., as perceived by the patient), whereas a SIGN is an objective change in a patient's condition indicative of some bodily or mental state, as is perceptible to the examining physician. In texts of the medical subdomain of Psychiatry, however, the terms *sign* and *symptom* seem to be used indistinctly. For example, in collocations with the verb *show*, with its basic meaning of “to cause or allow to be seen”, a preference for the term *sign* would be expected. However, corpus data indicate that this is not the case. Both terms collocate with *show* in exactly the same manner. The verb may activate, in the role of object, (1) signs or symptoms related to the disease in which they appear, or simply (2) types of different signs and symptoms.

- [PATIENT] *show sign/symptom of* [DISEASE TYPE]
- [PATIENT/DISEASE] *show sign/symptom of* [SIGN/SYMPTOM TYPE]

The aim of this study was to find an explanation for this “inappropriate” use. The question raised is if, in Psychiatry, both terms can be considered terminological variants of the same concept from a multidimensional perspective. According to Fernández-Silva et al. (2011), multidimensionality occurs when a concept can be seen from more than one perspective and can therefore be classified and designated in more than one way based on the different characteristics that it possesses. As it is not necessarily the nature of the sign or symptom which defines it, but *who* observes it, the terms *sign* and *symptom* could just describe the same concept, but highlighting a different perspective (patient vs. physician). For example, a skin rash may be noticed by either a healthcare professional as a sign, or by the patient as a symptom. Thus, the conceptual categories of SIGN and SYMPTOM are naturally multidimensional, as there are certain features that can belong to both. As such, this can be the cause of the indistinct use of the terms. In Section 2, the methodology applied to our analysis is explained. In Section 3, the results of the study are presented and discussed. Finally, in Section 4 some conclusions are drawn.

2. Material and methods

The use of *sign* and *symptom* was analyzed in an English language medical corpus on the subdomain of Psychiatry. The corpus (8 million words) combines texts targeted at experts and lay audiences. The expert corpus contains specialized books and journal papers written by experts for experts, such as the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013). The lay corpus consists of web pages and brochures written by experts for patients, or their relatives, suffering from any kind of mental disorder, such as the articles contained in MedLine Plus or the National Institute of Mental Health. The corpus query system Sketch Engine (Kilgarriff et al., 2004) was used to carry out the analysis of the corpus. The *Word Sketch* and *Sketch-Diff* functions were used to extract collocational information, those words which accompany the terms *sign* and *symptom* in a statistically significant way (mainly verbs and adjectives). The collocational information was then classified according to the dimensions expressed. Finally a comparison was made with an English language corpus on Oncology (33 million words) to see if the conclusions can be applied to other medical subdomains.

3. Results and discussion

3.1. Sign and symptom in Psychiatry

In the Psychiatry corpus, *sign* (2,266 occurrences) appears significantly less than *symptom* (16,856). This fact alone seems to indicate that the field prefers the use of *symptom*, which is not strange if we take into account that this domain mostly needs the patient's subjective description of his or her state more than any other medical domain, which has more objective data to work with. In a first comparison, the Word Sketches retrieved for *symptom* and

sign (Fig. 1) show that verbs which refer to bodily experience and, therefore, perception from the inside, such as *experience*, *relieve* or *alleviate*, are the preferred collocates of *symptom*. Perception-related verbs with a basic meaning of being perceivable from the outside, however, such as *show*, *exhibit*, *display* or *recognize*, are logically more prototypical collocates of *sign* according to statistical scores.

object of	4444	2.5	object of	594	2.6
reduce	<u>177</u>	9.44	warn	<u>18</u>	9.69
experience	<u>190</u>	9.33	exhibit	<u>25</u>	8.86
relieve	<u>69</u>	8.84	show	<u>88</u>	8.7
cause	<u>186</u>	8.81	localize	<u>6</u>	8.14
alleviate	<u>61</u>	8.73	recognize	<u>18</u>	7.95
treat	<u>114</u>	8.55	display	<u>7</u>	7.35
produce	<u>87</u>	8.54	recognise	<u>4</u>	7.3
control	<u>68</u>	8.44	detect	<u>6</u>	7.17
exhibit	<u>59</u>	8.43	identify	<u>13</u>	6.68
associate	<u>158</u>	8.41	manifest	<u>4</u>	6.68
report	<u>83</u>	8.3	observe	<u>5</u>	6.19
worsen	<u>47</u>	8.29	follow	<u>9</u>	5.67
present	<u>73</u>	8.28	experience	<u>7</u>	5.29
exacerbate	<u>44</u>	8.23	produce	<u>4</u>	5.11
follow	<u>87</u>	8.21	present	<u>4</u>	5.09
improve	<u>54</u>	7.98	consider	<u>5</u>	5.09
develop	<u>87</u>	7.97	be	<u>187</u>	4.86
have	<u>363</u>	7.91	include	<u>12</u>	4.75
show	<u>75</u>	7.83	describe	<u>4</u>	4.67
display	<u>35</u>	7.77	see	<u>7</u>	4.64
trigger	<u>35</u>	7.75	associate	<u>7</u>	4.34
manage	<u>33</u>	7.65	have	<u>16</u>	3.52
describe	<u>50</u>	7.51			
explain	<u>27</u>	7.3			
ameliorate	<u>20</u>	7.17			

Fig. 1. Word Sketches of *symptom* and *sign*.

Nevertheless, at a closer look, the corpus shows that both *sign* and *symptom* collocate with them in exactly the same manner. In fact, when using the Sketch-Diff function, these are the only significant common verbs triggered by both (Fig. 2). This may indicate that, in the Psychiatry domain, *sign* and *symptom* can be considered term variants of the same concept. The dimension that changes from one term to the other is the perceiver (specialist in the case of *sign* and patient in the case of *symptom*). However, the concordances of *show*, *exhibit* and *display* (Fig. 3) do not reflect any difference regarding the perceiver dimension.

The confusion seems to be even greater, though, when we look at the context of the collocation *signs and symptoms* (274 occurrences). In the examples (Fig. 4), there does not seem to be any distinction between signs and symptoms in the lists that follow the collocation. *Extensor plantar response* (2) and *elevated or lowered blood pressure* (3) seem to be obvious signs that need the intervention of a physician. However, other items on the list might not be as clear, such as *weakness of an extremity* (2) and *pupillary dilation* (3), which could be considered signs or symptoms depending on the perceiver. The fact that signs and symptoms are put together in the same list, and no specific order is maintained, again, indicates that *sign* and *symptom* are term variants of the same concept.

object_of	594	4444	2.6	2.5	modifier	1190	10364	1.2	1.3
reduce	0	177	--	9.4	psychotic	0	532	--	10.4
relieve	0	69	--	8.8	somatic	0	141	--	8.7
cause	0	186	--	8.8	psychiatric	0	174	--	8.4
alleviate	0	61	--	8.7	PTSD	0	111	--	8.4
treat	0	114	--	8.6	severe	0	121	--	8.1
control	0	68	--	8.4	dissociative	0	82	--	7.9
report	0	83	--	8.3	anxiety	0	167	--	7.9
worsen	0	47	--	8.3	unexplained	0	69	--	7.7
exacerbate	0	44	--	8.2	negative	4	301	5.0	9.5
improve	0	54	--	8.0	depressive	7	429	5.6	10.0
develop	0	87	--	8.0	withdrawal	10	314	5.9	9.5
trigger	0	35	--	7.7	positive	6	156	5.8	8.6
manage	0	33	--	7.6	other	55	345	6.6	8.6
have	16	363	3.5	7.9	physical	33	308	7.4	9.3
associate	7	158	4.3	8.4	common	21	155	6.4	8.2
experience	7	190	5.3	9.3	first	28	50	7.9	7.0
produce	4	87	5.1	8.5	prodromal	25	73	9.1	7.8
present	4	73	5.1	8.3	neurological	40	60	8.7	7.3
follow	9	87	5.7	8.2	early	81	51	8.9	6.8
display	7	35	7.3	7.8	neurologic	9	12	7.7	5.2
exhibit	25	59	8.9	8.4	Brudziński	8	0	7.8	--
show	88	75	8.7	7.8	focal	15	0	8.4	--
recognize	18	24	8.0	7.0	soft	17	0	8.7	--
localize	6	0	8.1	--	vital	26	0	9.2	--
warn	18	0	9.7	--	warning	49	0	10.0	--

Fig. 2. Sketch-Diff for *sign* (green) and *symptom* (red) in Psychiatry.

feral child caught in 1798, **showed** several **signs** of autism; the medical student Jean Marc attachment”: consists of child **showing signs** of avoidance and resistance. In the form less motor-inhibitory control, but **show** no **sign** of difference in cognitive flexibility, that 31 percent of college students **show signs** of alcohol abuse and 6 percent are depend

not relapse continued to **show** subsyndromal **symptoms** of depression or mania (Gitlin & Hammen diagnosed with a phobia one also has to **show symptoms** of impairment and avoidance. In the exampl the orbitofrontal cortex has also **shown symptoms** of intense fear and even visual hallucinatio colleagues found that people who **showed symptoms** of mania, but who did not meet criteria

answers, and may **exhibit** neurovegetative **signs** of depression. Pharmacological treatment for several days, they **exhibited** several **signs** of drowsiness, such as yawning and frequent conditions or complications; **exhibits** no **signs** of emotional, behavioral, or cognitive

aripiprazole the woman began to **exhibit symptoms** of acute dystonia, typical of a patient disorder who often **exhibit** the characteristic **symptoms** of ADHD. The doses of methylphenidate l alektorophobia typically starts **exhibiting symptoms** of anxiety and uneasiness at the mere sig

Hallucinogen Abuse. David does not **display** any **signs** of physical withdrawal symptoms. David corroborated that Mario has not **displayed** any **signs** of Substance Abuse during their marriage is not at risk of withdrawal; **displays** no **signs** of any bioÂmedical conditions or complicati

individuals might **display** the psychiatric **symptoms** of a broad spectrum of anxiety and phobic
 ref> Children who **display** the behavioural **symptoms** of ADHD but who do not have any significan
 children likely to continue **displaying symptoms** of ADHD into adolescence. Barkley (2005
 and will therefore almost always **display symptoms** of FXS, while females with a full mutation

Fig. 3. Collocations of sign/symptom with show/exhibit/display.

1. Common **signs and symptoms** include, but are not limited to, social withdrawal; emotional lability; aggression; greater sensitivity (human)|sensitivity to violence; somatic symptoms; sleep difficulties; Intrusive thoughts|intrusive imagery; Cynicism (contemporary)|cynicism; sexual difficulties; difficulty managing boundaries with clients; and core beliefs and resulting difficulty in relationships reflecting problems with security, trust (social sciences)|trust, esteem, intimacy, and control
2. The focal neurological **signs and symptoms** include extensor plantar response, pseudobulbar palsy, gait abnormalities, exaggeration of deep tendon reflexes, or weakness of an extremity.
3. These behavioral and psychological changes are accompanied by two or more of the following **signs and symptoms**: tachycardia or bradycardia; pupillary dilation; elevated or lowered blood pressure; perspiration or chills; nausea or vomiting; evidence of weight loss; psychomotor agitation or retardation; muscular weakness, respiratory depression, chest pain, or cardiac arrhythmias; and confusion, seizures, dyskinesias, dystonias, or coma (Criterion C).

Fig. 4. Corpus examples of the collocation *signs and symptoms*.

The above examples do not seem to differentiate between these terms variants, although there is a clear tendency for *symptom* to “borrow” *sign*’s collocational behavior. However, we agree with Bowker and Hawkins (2006, p.101) when they say that “while some degree of non-systematic variation is inevitable, it appears that medical experts generally make an effort to formulate their expressions carefully based on a combination of conceptually, linguistically and socially motivated factors.” In our corpus, the order *signs and symptoms* (274 occurrences) is preferred over *symptoms and signs* (60 occurrences). In a quick search on Google, *signs and symptoms* occurs over 8 million times, whereas *symptoms and signs* only 1 million times. There does not seem to be a conceptual motivation for this preference, the explanation should thus be looked for in linguistic and social motivations.

When analyzing the modifiers of *sign* and *symptom*, there are several cases in which modifiers are used with sign and symptom alike (Fig. 2): *physical*, *common*, *first*, *prodromal* and *neurological*. Other modifiers have a slight preference for one or the other: *early* and *neurologic* for *sign*, and *withdrawal*, *positive* and *other* for *symptom*. *Prodromal* collocates with *sign* and *symptom* in exactly the same way, referring to early non-specific symptoms and signs of disorders. *Early* on the other hand shows a preference for *sign* over *symptom*. This may be explained by the fact that *early sign* is normally related to specific evidence of a disorder in our corpus. *Neurological* shows no preference and the fact that there are many examples of the collocation *neurological signs and symptoms* shows the degree of interchangeability of the terms *sign* and *symptom*. *First* is a similar case, although in collocations with *symptom*, sometimes, an additional modifier is found, such as *unspecific*, *positive*, or *clinical*. There are many more instances of *physical symptom* (308) than of *physical sign* (33). After analyzing the collocation in context (Fig. 5), *physical symptoms* is used mostly in relation to types of symptom (e.g. *blushing*, *sweating*), whereas *physical signs* is used when expressing causal relations pointing to mental disorders (e.g. *schizophrenia*) or the behaviour that could have caused it (e.g. *cannabis use*).

anxiety often manifests specific **physical symptoms** , including blushing, sweating, and difficulty
 alcohol abuse can cause a number of **physical symptoms** , including cirrhosis of the liver, pancreatitis
 individuals often exhibit a variety of **physical symptoms** , including fatigue (medical)|fatigue, fidgeti
 sharing methods for coping with **physical symptoms** , increasing ability to perceive and express
 or a congenital syndrome with **physical symptoms** , such as tuberous sclerosis.<ref>{{cite
 }}</ref> Some people also have **physical symptoms** , such as sweating, pacing, and weight loss
 items *psychologically created **physical symptoms** , such as Butterflies in the stomach|upset
 eeping; ♦ feeling out of control; ♦ **physical symptoms** , such as bloating, breast tenderness, head

the individual must exhibit some **physical signs** of cannabis use. DSM-IV-TR requires the easy to diagnose because of the **physical signs** of intravenous use, drug-seeking behavior Although there are no pathognomonic **physical signs** of schizophrenia, some individuals have course without development of **physical signs** or structural abnormalities, and (3) absence

Fig. 5. Collocations of *physical symptoms* and *physical signs*.

The question arises whether there are specific contexts in which either *sign* or *symptom* is obviously the preferred term. According to Fig. 2, *Brudziński*, *focal*, *soft*, *vital* and *warning* collocate with *sign* only. The *Brudziński*'s sign is defined as the reflex flexion of the patient's lower extremities when the physician forces the flexion of the patient's neck (Saber & Syed, 1999, p. 24). In this case, there does not seem to be any confusion, and *sign* is the preferred collocate, since only a physician can check such a sign. *Soft* only collocates with *sign* in our corpus. Soft signs are related to neurological disorders and are non-specific indicators of impairment. They are not associated with focal brain dysfunction or any specific disease process, as opposed to hard signs. In this case, there is no confusion in the Psychiatry domain, although the fact that hard signs do not appear in our corpus, does reveal the specificity of the domain. There is also no confusion in the case of the collocation *vital signs*, which refers to the basic bodily functions as measured by medical professionals. *Focal* seems to collocate with *sign* only, but when analyzing the concordances many cases of *focal signs and symptoms* show up. *Warning sign*, on the other hand, is found in contexts where patients themselves or their relatives must take into account certain changes in behavior or other symptoms that may indicate a relapse (Fig. 6). Here the fuzzy boundaries between categories show again. However, in this case, they are motivated by the fact that in general language *warning sign* is a fixed expression and, in this case, used as such in a more specialized context.

1. After the symptoms of schizophrenia are controlled, therapy can help people learn social skills, cope with stress, identify early warning **signs** of relapse, and prolong periods of remission.
2. A time line of events, a selective relevant psychiatric history, and a focus on the present can help the individual to recognize the impact of the crisis and identify the early warning **signs** of feeling overwhelmed (Feinstein & Carey, 1995).
3. If you recognize two or more warning **signs** of compulsive exercise in your child, call your doctor to discuss your concerns.

Fig. 6. Corpus examples of the collocation *warning signs*.

The modifiers that only, or mostly, collocate with *symptom* are, on the one hand, related to disorders (*psychotic*, *PTSD*, *dissociative*, *anxiety*, *depressive*, *withdrawal*) and, on the other hand, related to their typology (*somatic* vs. *psychiatric symptom*, *negative* vs. *positive symptom* and *severe symptom* (its counterpart *mild* does not occur in our corpus)). The few cases in which *positive* (6) and *negative* (4) are found in combination with *sign*, the subtypes that co-occur are the same as the ones found with negative and positive symptom. The difference lies in the broader context, where reference is made to clinical tests and diagnosis through words such as *psychiatrist*, *interview*, *test*, *verification*, etc. (Fig. 7).

1. A positive **sign** with the tilt table test must be taken in context of patient history, with consideration of pertinent clinical findings before coming to a conclusion.
2. In excluding neurological disease, the neurologist has traditionally relied partly on the presence of positive **signs** of conversion disorder.
3. The individual is usually unable to report strategies used to diminish the hallucinations and has difficulty faking schizophrenic thought processes and negative **signs** such as blunted affect (Resnick, 1997). Interviews with others often reveal the nature of the individual's illness; thus the **verification of facts** is essential.

Fig. 7. Corpus examples of *positive* and *negative sign/s*.

3.2. Comparison of results with Oncology

When comparing the Psychiatry corpus analysis with a corpus on Oncology, several things have drawn our attention. In the first place, in the Oncology corpus *sign* (3,282) occurs significantly less than *symptom* (10,766) as happens in the Psychiatry corpus. However, the total number of occurrences of both *sign* and *symptom* is comparatively much higher in the Psychiatry corpus, as it is much smaller than the Oncology one (8 million tokens vs. 33 million tokens). This is probably due to the focus on diagnosis and treatment in the Psychiatry domain, whereas the Oncology domain includes other facets, such as body part and tumor description, surgery, etc.

There seems to be much less confusion in the use of *sign* or *symptom* in the Oncology domain, as verbs of perception from the outside show a clear preference for *sign* over *symptom*, even though they are still activated by both: *show* (161 occurrences with *sign* vs. 40 with *symptom*), *exhibit* (26 vs. 18) and *manifest* (13 vs. 9) (Fig. 8).

The collocation *signs and symptoms* occurs much less in the Oncology corpus (253 vs. 274 in Psychiatry), which might reflect their higher degree of multidimensionality in the Psychiatric domain. In addition, the concordances indicate a different use. In Oncology, the collocation is never followed by a list of signs and/or symptoms as in Psychiatry. The structure found most often is *signs and symptoms of* [DISEASE].

In the Oncology corpus, *withdrawal* collocates with both *sign* and *symptom*, whereas in Psychiatry it shows a clearer preference for *symptom*. *Physical* does not show a preference for *sign* or *symptom* in Oncology and no contextual distinction can be made between the use of one or the other. *Clinical* does not appear in the Psychiatry corpus, as the domain is not considered to have a clinical facet, but it appears quite often (768 occurrences) and collocates with *sign* and *symptom* alike in the Oncology corpus. There is a preference for *sign* (391 vs. 377), especially when we consider that there are many more occurrences of *symptom* than of *sign* in the corpus. This makes sense if we take into account that *clinical* refers to when a physician assesses the state of a patient.

As in the Psychiatry corpus, *warning* and *vital* only collocate with *sign*. In the case of *warning* in Oncology, most occurrences are similar to the ones in Psychiatry, using the general language expression in a specialized context: “Once able to identify warning signs, women responded with strategies of avoidance...”, “What warning signs should patients look for?” There are cases, however, where a specific sign is referred to: “The most common warning sign of bladder cancer is blood in the urine.” *Early* shows a preference for *sign* in Oncology in the same way as in the Psychiatry corpus. The modifiers that collocate with *symptom* only are: *depressive, psychiatric, psychotic, asthma, flu-like, psychological, negative, severe, gastrointestinal, urinary, respiratory* and *subjective*. Apart from the disease and type dimensions which were also found in Psychiatry, the *body_part* dimension is added in Oncology. The adjective *subjective* is found in Oncology to reinforce the patient perspective.

4. Conclusion

The results of our study indicate that in Psychiatry, *sign* and *symptom* can be considered terminological variants of the same concept from a multidimensional perspective. The dimension that changes from one term to the other is the perceiver. There seems to be much less confusion in the use of *sign* or *symptom* in the Oncology domain. Especially in the collocations with *symptom*, but also with *sign*, the dimensions seen in the corpora can be classified according to DISORDER (*depressive, anxiety, asthma*), TIME (*early, prodromal*), ATTRIBUTE (*mild, severe*) or TYPE (*negative, positive*). According to Bowker & Hawkins (2006, p. 82), “discovering the motivations behind term choices is important for both theoretical and practical reasons. On a theoretical level, it may help us to determine the extent to which lexicalization is the reflection, in language, of the mental processes involved in concept formation and association.” This will improve terminological resources in their intent to facilitate communication among experts and term choices for, for example, translators.

object_of	3295	1106	2.5	2.6	modifier	6442	2192	1.3	1.3
warn	0	9	--	7.9	vital	0	58	--	9.3
check	0	9	--	7.3	warning	0	26	--	8.5
show	40	161	4.4	6.5	radiological	0	22	--	7.8
manifest	9	13	6.0	7.5	Babinski	0	10	--	7.2
exhibit	18	26	5.7	6.5	early	44	81	6.0	7.2
present	153	59	7.9	6.7	extrapyramidal	30	14	7.2	7.6
resolve	33	6	7.7	6.1	clinical	377	391	8.1	8.3
have	393	118	6.4	4.6	neurologic	64	24	8.1	7.8
develop	102	25	6.9	5.0	neurological	101	39	8.6	8.3
produce	61	9	6.3	3.7	physical	57	25	7.3	6.8
associate	119	16	6.3	3.5	withdrawal	73	13	8.1	6.5
report	99	6	7.1	3.2	common	142	22	7.8	5.4
cause	177	7	7.6	3.0	respiratory	135	8	8.6	5.2
ease	8	0	6.2	--	psychological	36	0	7.2	--
disable	9	0	6.4	--	few	58	0	7.2	--
ameliorate	10	0	6.4	--	flu-like	33	0	7.4	--
record	23	0	6.4	--	asthma	54	0	7.4	--
control	44	0	7.0	--	severe	95	0	7.5	--
void	15	0	7.1	--	negative	103	0	7.6	--
relate	113	0	7.2	--	urinary	77	0	7.8	--
improve	95	0	7.4	--	gastrointestinal	81	0	8.2	--
palliate	23	0	7.8	--	psychotic	62	0	8.2	--
experience	57	0	8.0	--	psychiatric	83	0	8.3	--
alleviate	52	0	8.9	--	subjective	71	0	8.3	--
relieve	162	0	10.3	--	depressive	192	0	9.8	--

Fig. 8. Sketch-Diff for *sign* (red) and *symptom* (green) in Oncology.

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