Online Symptom Checkers are Poor Tools for Diagnosing Men's Health Conditions

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OBJECTIVE To analyze the accuracy of the 4 most commonly used online symptom checkers (OSCs) in diagnosing erectile dysfunction (ED), scrotal pain (SP), Peyronie's disease (PD), and low testosterone (LT).

METHODS AND OUTCOMES One-hundred and sixty artificial vignettes were created by de-identifying recent initial outpatient consults presenting to discuss ED (40), SP (40), PD (40), and LT (40). The vignettes were entered into the 4 most frequently used OSCs (WebMD, MedicineNet, EverydayHealth, and SutterHealth) as determined by web traffic analysis tools. The top 5 conditions listed in the OSC differential diagnosis were recorded and scored.

RESULTS WebMD's accuracy for ED, SP, PD, and LT vignettes was 0%, 22.5%, 0%, and 95%, respectively.

EverydayHealth was only able to diagnose SP 20% of the time, and failed to diagnose ED, PD, or LT on all occasions.

MedicineNet diagnosed ED, PD, SP, and LT in 100%, 98%, 27.5%, and 0% of vignettes, respectively.

SutterHealth correctly diagnosed ED, SP, and LT in 100%, 20%, and 80% of patients, respectively.

Cumulatively, the OSCs were most accurate in diagnosing ED and least accurate in diagnosing SP when using the Top 1 (37.5% vs 6.9%) and Top 5 (50% vs 24.5%) of the suggested conditions.

CONCLUSION No OSC could accurately diagnose all the conditions tested. The OSCs, on average, were poor at suggesting precise diagnoses for ED, PD, LT, SP. Patients and practitioners should be cautioned regarding the accuracy of OSCs. UROLOGY 170: 124–131, 2022. © 2022 Elsevier Inc.

Approximately 7% percent of Google searches are healthcare-related, which amounts to over one billion daily queries.[1] Use of online resources for urological and sexual health conditions has been well documented.[2] Patients regularly use online resources as primary sources of information for these sexual health conditions in order to maintain privacy and anonymity. Over the last decade, there has been a documented increase in online queries for men's sexual health conditions.[3-5] Simultaneously, there has been mounting concern about the quality of information patients encounter online, as well as the subsequent impact on doctor-patient relationships and healthcare decisions.[6-8]

Recent trends also highlight the increase in patient use of online resources prior to visits with medical professionals. The number of American adults that sought health information online increased from 25% in 2000 to 73% in 2018.[9] Furthermore, a study assessing the impact of social media on healthcare found that nearly 45% of participants were influenced by information on the internet and social media networks when deciding on specific treatments and providers.[10]

One such service that can impact patient decision making are the online symptom checkers (OSCs), an internet tool frequently used by patients seeking health information. OSCs are algorithm based self-assessment tools that allow patients to enter demographic information, symptoms, and relevant medical history in exchange for potential diagnoses, treatments, or education. Though they are innovative, OSCs have been found to be generally unreliable at triaging and diagnosing conditions regardless of complexity.[11] There is a paucity of research addressing OSCs and men's health conditions. As patient use of OSCs increases, the need to ensure their accuracy also grows. We hypothesize that that OSCs provide inconsistent diagnostic utility for men's health conditions making the correct diagnosis less that 70% of the time.

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METHODS

Online Symptom Checkers

We used www.semrush.com to identify web traffic to parent domains of various OSCs over the previous 6 months prior to our analysis.[12] Semrush.com, a domain traffic analyzer, is primarily used my marketing companies to measure the popularity, reach, and growth of websites. By using this tool, we were able to rank the most popular OSCs based on quantifiable statistics such as number of unique visitors and time spent on website. Web traffic to an OSC's specific webpage is not readily available so we used parent domain traffic as a surrogate for OSC popularity. This method determined the following 4 parent domains as having the most frequently used OSCs: WebMD, MedicineNet, EverydayHealth, and SutterHealth. Table 1 shows specific details regarding these OSCs. Each OSC allows users to enter multiple symptoms, age, and sex. All OSCs except for WMD ask follow-up questions based on symptoms entered. Each OSC also provides a list of potential diagnoses and attributes a numerical, categorical, or verbal confidence value to the suggested diagnoses.

Clinical Vignettes

Institutional review board approval was obtained (Dartmouth CPHS 0031589) in order to create 160 artificial clinical vignettes by de-identifying recent initial outpatient urology consults. Forty vignettes were created based on confirmed diagnoses of each of the following: erectile dysfunction (ED), scrotal pain (SP), Peyronie's disease (PD), and low testosterone (LT). ED, PD, and LT cases were confirmed based on positive findings from patient history, physical examination, and blood tests where needed. All SP cases were confirmed via detailed patient history, physical examination, and scrotal ultrasound. ED and PD were selected for assessment because they are relatively straightforward diagnoses. In contrast, SP and LT were selected because of varied clinical presentations and potential etiologies. For the 40 SP vignettes, correct diagnoses included idiopathic epididymal pain (12) epididymal cyst (6), epididymitis (4), varicocele (4), hydrocele (3), sperm granuloma (2), orchialgia (2), intermittent torsion (1), inguinal hernia (1), post-hernia repair pain (1), post-vasectomy pain (1), torsed appendix epididymitis (1), referred pain from kidney stone (1), and testis appendiceal torsion (1).

The 160 vignettes were standardized to include patient age, race, duration of symptoms, past medical history, past surgical history, smoking status/history, alcohol use history, drug use history, relationship status, history of penile/pelvic trauma, and history of genitourinary conditions. Clinical vignettes for each specific condition all had the same information available for OSC entry. All vignettes included information routinely obtained during initial consultations and documented by a single men's health specialist (MSG).

Symptom Entry

Each OSC required a primary symptom or "chief complaint." The chief complaints were "erectile dysfunction," "curved/bent penis," "scrotal pain," for ED, PD, and SP cases respectively. Based on patient history, chief complaint was "loss of libido" and "fatigue" for 31 and 9 of the LT vignettes, respectively. These terms were selected as the most commonly used chief complaint terminology as described by the vignette patients seen in the office for these issues. All information from the vignettes that could be serve as symptoms or be used to answer follow-up questions was entered. When follow-up questions could not be answered using information from the vignettes, "I don't know," or "skip this question," options were selected.

Outcomes

The top 5 conditions listed in the OSC differential diagnosis were recorded and ranked based on numerical or verbal confidence value. If less than 5 conditions were offered, the available conditions were recorded and ranked. The Top 1 diagnosis was the one the OSC considered was most accurate. The primary outcome was the accuracy of Top 1 diagnosis as compared to the actual patient vignette. The secondary outcome was frequency of the correct diagnosis appearing in the cumulative Top 5 suggested differential.

Statistical Analysis

Each OSC's accuracy for diagnosing the conditions was determined using the percentage of vignettes correctly diagnosed by the Top 1 and the cumulative Top 5 diagnoses. Mean accuracy was calculated for all OSCs and conditions. All analyses were conducted using SPSS Version 27 (IBM, Chicago, IL).

RESULTS

Table 2 reports the mean age of patient vignettes along with the percentage of patients that endorsed specific symptoms. The ED patients were on average the oldest (62.1 years), while SP patients were the youngest (35.8 years). Table 3 reports the mean accuracy of each OSC for each condition when including Top 1 and Top 5 responses. As expected, OSCs accuracy is higher with Top 5 than Top 1 (35.19% vs 22.38). The vignettes yielded a total of 2502 responses across the 4 OSCs. SutterHealth offered the greatest number of responses with 747, while EH offered the fewest with 412 (Supplementary Figure 1). The LT vignettes returned the greatest number of responses (710

Table 1. Relevant statistics of selected online symptom checkers (OSCs) as of May 2021

OSC Statistics for May 2021	Domain Visits (Unique Visits) in Millions	Authority Score: Based on Overall Domain Quality (0-100)	Average Visit Duration	Average Pages per Visit
WebMD	269.9 (163.8)	85	6:30 min	1.54
MedicineNet	36.9 (28.6)	77	20:55 min	3.78
EverydayHealth	29.1 (22.8)	74	7:05 min	1.37
SutterHealth	7.1 (1.8)	63	5:03 min	4.21

Data curated from Semrush.com's website traffic analytics tool. Authority score is a compound metric calculated based on semrush.com's proprietary algorithm which measures a domain or webpage's overall quality and search engine optimization performance. The higher the score, the higher the domain's trustworthiness and authority relative to competitors in the same field.

Table 2. Demographic data for patient vignettes and percentage of patients reporting various symptoms

n = 40 for All Groups	Erectile Dysfunction	Peyronie's Disease	Scrotal Pain	Low Testosterone
Mean age (range)	62.1 (32-81)	55.6 (30-74)	35.8 (20-71)	52.3 (31-75)
Mean Duration of symptoms	7.2 y	1.4 y	3.2 y	3.6 y
Unable to initiate erection	10%	10%	-	7.5%
Unable to sustain erection	97.5%	47.5%	-	5.75%
Loss of nocturnal erection	55%	20%	-	52.5%
Decreased libido	25%	50%	-	70%
Premature ejaculation	22.5%	25%	-	17.5%
Ejaculation not feasible	7.5%	6.67%	-	0%
Delayed ejaculation	27.5%	20%	-	5%
Penile curvature	25%	95%	-	-
History of genitourinary conditions	45%	27.5%	42.5%	20%
History of penile/pelvic trauma	2.5%	6.67%	-	-

responses) and the PD vignettes returned least (311 responses). Cumulatively, the OSC differentials included 106 unique responses. Figure 1 provides a visual representation of the cumulative OSC response to the conditions tested.

Results for Conditions Tested

With a Top 1 and Top 5 mean accuracy of 37.5% and 50%, respectively, the OSCs were most accurate in diagnosing ED (Table 3) and least accurate when diagnosing cause of SP (Top 1: 6.9%; Top 5: 22.5%). Mean OSC accuracy for PD was 24.5% for both Top 1 and Top 5. It is important to note, however, that only MedicineNet accurately diagnosed PD (Top 1: 98%; Top 5: 98%), while the other OSCs maintained a 0% accuracy for both Top 1 and Top 5. Similarly, mean OSC Top 1 accuracy for diagnosing LT (20.6%) was skewed by WebMD (Top 1: 82.5%). The remaining OSCs had a 0% Top 1 accuracy when diagnosing LT vignettes.

WebMD Results

WebMD failed to diagnose all ED and PD vignettes (Table 3). Mean Top 1 and Top 5 for WebMD was 23.32% and 29.38%, respectively. WebMD was most successful in diagnosing LT vignettes when including Top 1 (82.5%) and Top 5 (95%). Cumulatively, WebMD offered 679 diagnoses (average 4.2 diagnoses per vignette): suggesting the most for ED (200 diagnoses) and LT (200), and the least for PD (93).

MedicineNet Results

On average, MedicineNet was the most successful OSC with a Top 1 and Top 5 mean accuracy of 48.3% and 56.3%, respectively (Table 3). With a mean Top 1 and Top 5 accuracy of 98%, MedicineNet was the only OSC to correctly diagnose PD vignettes. MedicineNet failed to diagnose LT in all cases. Cumulatively, MedicineNet offered 571 diagnoses (average 3.6 diagnoses per vignette): suggesting the most for SP (200 diagnoses) and LT (200), and the least for PD (78).

EverydayHealth Results

EverydayHealth was the least accurate OSC with a Top 1 and Top 5 mean accuracy of 1.3% and 5%, respectively. EverydayHealth failed to diagnose ED, PD, and LT in all cases and only rarely diagnosed SP vignettes (5%) some of the time. Cumulatively, EverydayHealth also offered the fewest diagnoses (412): suggesting the most for SP (140) and the least for PD (54).

SutterHealth Results

The Top 1 diagnosis from SutterHealth failed to diagnose PD and LT in all vignettes (Table 3). However, SutterHealth diagnosed LT correctly in 80% of vignettes when including the Top 5 suggested diagnoses. Mean Top 1 and Top 5 for SutterHealth was 18.1% and 50%, respectively. Cumulatively, SutterHealth offered 747 diagnoses (average 4.7 diagnoses per vignette), suggesting the most for LT (200 diagnoses) and the fewest for SP (180).

DISCUSSION

Using 160 standardized patient vignettes, we assessed the accuracy of 4 popular OSCs. Average OSC Top 1 accuracy was 22.4%, with MedicineNet's diagnosis of PD vignettes to be the most accurate (98%). Average OSC Top 5 accuracy was 35.2%, with MedicineNet and Sutter Health's diagnosis of ED vignettes in the Top 5 being the

Table 3. Percent of vignettes correctly diagnosed using Top 1 or 5 conditions from online symptom checker (OSC) differentials

Online Symptom Checker	Top 1					Top 5				
	ED	PD	SP	LT	Top 1 Mean	ED	PD	SP	LT	Top 5 Mean
WebMD	0%	0%	5.0%	82.5%	**23.3%**	0%	0%	22.5%	95%	**29.9%**
MedicineNet	87.5%	98%	7.5%	0%	**48.3%**	100%	98%	27.5%	0%	**56.3%**
EverydayHealth	0%	0%	5.0%	0%	**1.3%**	0%	0%	20%	0%	**5.0%**
SutterHealth	62.5%	0%	10%	0%	**18.1%**	100%	0%	20%	80%	**50%**
Mean	**37.5%**	**24.5%**	**6.9%**	**20.6%**	**22.4%**	**50%**	**24.5%**	**22.5%**	**43.8%**	**35.2%**

ED, Erectile Dysfunction; LT, Low Testosterone; PD, Peyronie's Disease; SP, Scrotal Pain; Top 1, Only first diagnosis from differential included to measure OSC accuracy; Top 5, First 5 diagnoses from differential included to measure OSC accuracy.

most accurate (100%). WebMD, the most popular OSC by a wide margin, had a mean Top 1 and Top 5 accuracy of 23.32% and 29.38%, respectively. OSC accuracy varied greatly and no OSC successfully diagnosed all conditions tested.

We found mean OSC accuracy for diagnosing an acute condition such as SP to be 6.9% and 22.5% for Top 1 and Top 5, respectively. A similarly structured study that assessed the accuracy of OSCs for ear, nose, and throat pain found WebMD's Top 1 response to be accurate 16% of the time. WebMD's accuracy increased substantially to 70% when all suggested diagnoses were included.[13] Likewise, we found WebMD's accuracy for diagnosing SP to increase from 5% to 22.5% when using the first 5 suggested diagnosis as compared to just the first. Another study, assessing the accuracy of 11 different OSCs for orofacial pain, reported that the correct diagnosis was found within the top 4 responses only 5.9% of the time.[14] In comparison, we found mean Top 5 OSC accuracy for SP vignettes to be 22.5%, which is considerably higher than mean OSC accuracy for diagnosing orofacial pain.[14]

Several studies have also attempted to gauge the accuracy of OSCs for diagnosing for chronic conditions. Berry et al's 2019 study assessing OSC accuracy for HIV and

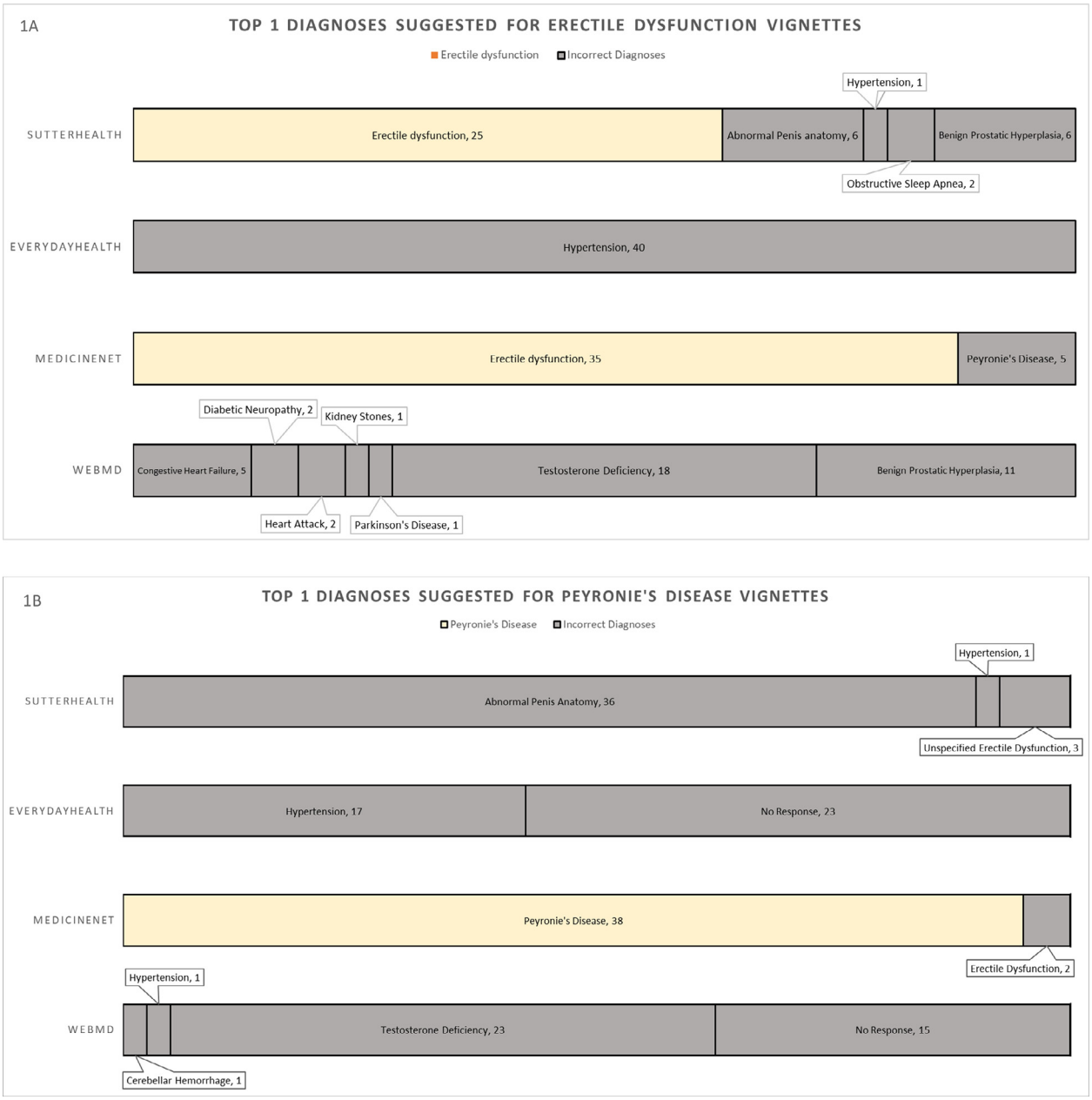
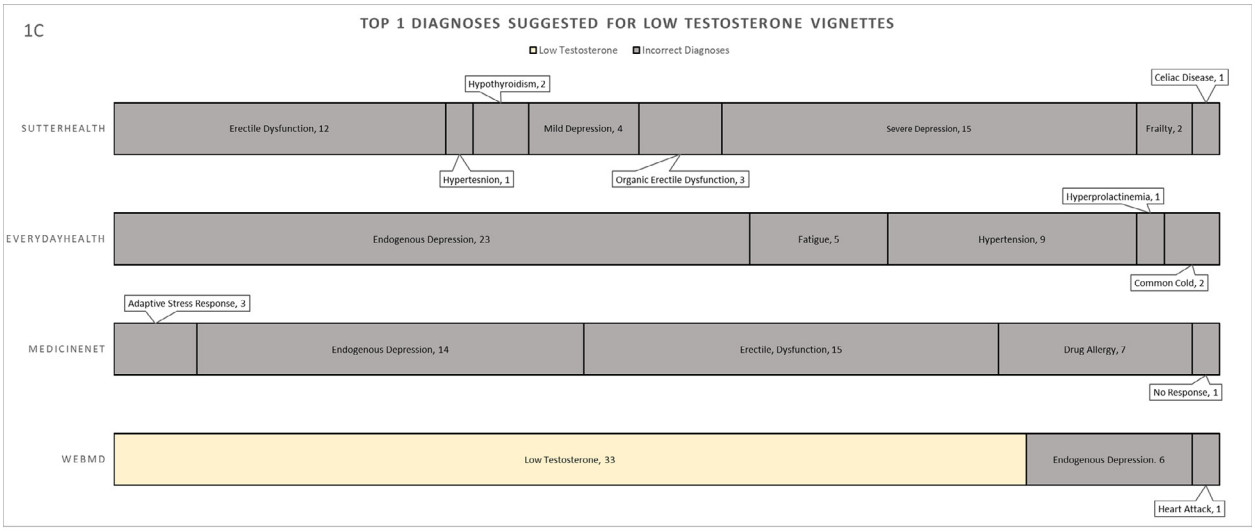


Figure 1. A: Top 1 suggested diagnoses for erectile dysfunction vignettes for each online symptom checker. B: Top 1 suggested diagnoses for Peyronie's Disease vignettes for each online symptom checker. C: Top 1 suggested diagnoses for low testosterone vignettes for each online symptom checker. D: Top 1 suggested diagnoses for scrotal pain vignettes for each online symptom checker. (Color version available online.)



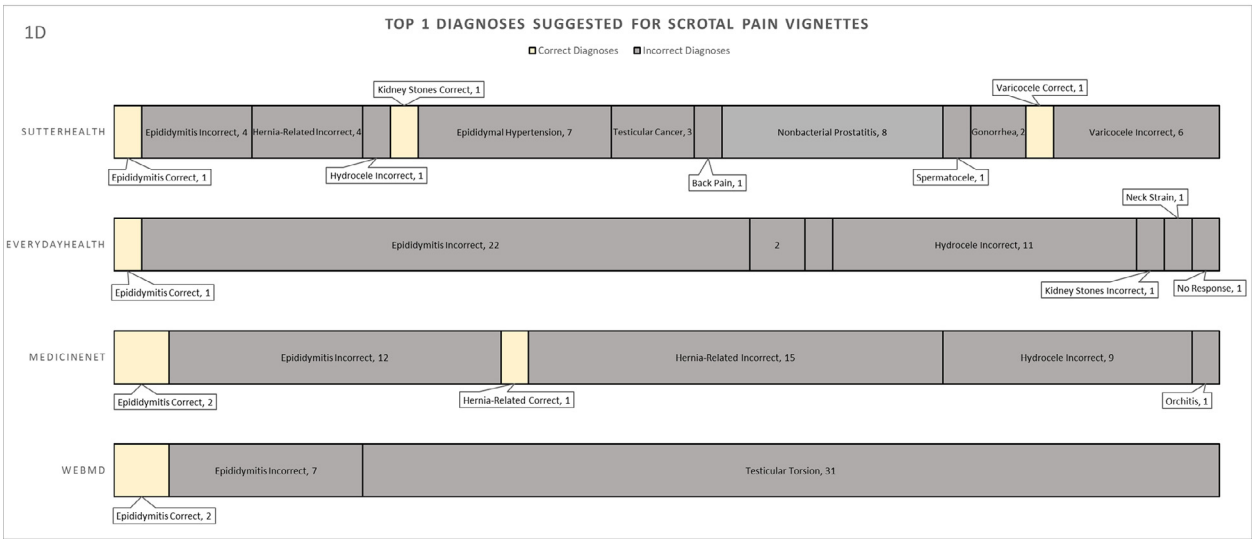


Figure 1. Continued

hepatitis C found OSCs to be relatively poor when including Top 1 (mean accuracy 20%), Top 3 (35%) and Top 10 (40%).[15] Similarly, we found mean OSC accuracy for chronic conditions like ED and LT to be poor when including Top 1 (ED: 37.5%, LT: 20.7%) and Top 5 (ED: 50%, LT: 43.8%). Berry et al proposed that OSCs failed to diagnose HIV and hepatitis C patients accurately and consistently because of the complexity and variability of symptom presentation.[15] We believe that many OSCs fail to diagnose ED and LT for the same reasons. The psychological and mechanical symptoms associated with ED can be multifactorial.[16] In our experience, OSCs do not treat these symptoms as a presentation of ED. Rather, they treat ED as a manifestation of psychological and metabolic conditions such as depression and diabetes. While ED can be sequelae of vascular and metabolic disease, it is also an independent male sexual health condition that commonly affects men over 40.[16] If the OSCs fail to incorporate this nuance into their diagnostic algorithms, they will continue to misdiagnose ED patients.

We also found that certain OSCs do not include ED in their list of suggestable diagnoses. Even for cases of LT, a condition with clinical overlap with ED, WebMD and MedicineNet never suggested ED as a potential diagnosis. This observation, along with the low overall Top 1 and Top 5 accuracies, further supports our hypothesis OSCs are poor diagnostic tools due to their limited andrological utility.

Similar to the ED vignettes, overall OSC accuracy for PD vignettes was also very low. Limitations in symptom recognition led to 3 of the 4 OSCs diagnosing 0% of PD vignettes correctly. Both WebMD, which accepted "head of penis curves downwards," as a symptom, and SutterHealth, which automatically suggested the symptom "unusual penis shape" for "curved/bent penis," never included PD in their differentials. Conversely,

EverydayHealth failed to diagnose PD because it wouldn't accept any variation of "curved/bent penis" as a possible symptom. Not only do these shortcomings lead to inaccurate differentials, but they can also precipitate cyberchondria, an anxiety associated with repeated use of OSCs.[17,18] Along with improvements to their diagnostic algorithms, we recommend that OSCs prioritize expanding their library of symptoms.

It is important to note that each OSC provides a disclaimer stating that the service should not replace professional medical advice, nor should its results be considered formal diagnoses. As studies have shown, however, information that patients encounter online can influence their decision-making process.[10] Not only do the OSCs misdiagnose men's health conditions, but they also frequently suggest non-urologic etiologies. After excluding "no response" from the suggested diagnoses, WebMD diagnosed ED and PD patients with a non-genitourinary condition 62% and 71% of the time, respectively. Similarly, EverydayHealth diagnosed 74% of ED patients and 100% of PD patients with non-genitourinary conditions. MedicineNet, which correctly diagnosed ED and PD patients, did however; suggest non-genitourinary conditions for LT patients 91% of the time. Suggestions of non-genitourinary diagnoses can not only misinform patients but may also lead to delaying appropriate care as patients spend more time and money prior to visiting men's health specialists.

Despite their shortcomings, patient attitudes towards OSCs are overwhelmingly positive. More than 80% of patients perceive OSCs as useful diagnostic tools and over 90% report they would use OSCs again.[19] Moreover, the popularity and availability of OSCs is subject to change daily. MedicineNet, the OSC with the highest mean Top 1 and Top 5 accuracy, was recently removed from its parent website. When factoring in this development, we find that overall OSC Top 1 and Top 5 accuracy drops from 22.4% to 13.9% and 35.2% to 28.3%, respectively. Additionally, the loss of MedicineNet results in a 0% mean accuracy for PD vignettes. The landscape of OSCs will continue to change and men's health specialists should, therefore, be well versed in the utility, or lack thereof, of these tools.

LIMITATIONS

A key limitation to this study is that one author conducted all of the vignette entry and data collection. To improve on this design, more than one data collector could be added and agreement between the collectors can be used to further validate the accuracy results. Furthermore, definitive diagnosis of LT requires measurement of total and free serum testosterone. No OSC required asked for laboratory values and therefore, the accuracy of LT diagnosis may be under reported. Another limitation is that data entry and analysis was done by someone in the medical field. Therefore, their interpretation of OSC inputs and outputs are most likely not representative of the general population. To control for this interaction, we used vignettes based on patient responses to a detailed survey to mimic the average patient's input as best as possible. However, it was impossible to answer every follow-up question that OSCs like SutterHealth and EverydayHealth posed using information from the standardized questionnaire. As such, the OSCs accuracy may be underreported in some instances.

CONCLUSION

Men's use of online resources for sexual health conditions has been well-established. The effect of an OSC's missed or incorrect diagnosis on patient outcomes and health choices remains unknown, but the utilization of these tools is widespread. We found that, on average, OSCs fail to accurately diagnose a variety of men's sexual health conditions. While specific OSCs show high Top 1 and Top 5 accuracy for specific conditions, no OSC is effective in diagnosing all of the conditions tested. We recommend that OSCs update their algorithms so that they are more accurate in diagnosing nuanced male sexual health conditions.

References

1. Murphy M. Dr Google will see you now: search giant wants to cash in on your medical queries. *Telegr*. Available at: https://www.beckershospitalreview.com/healthcare-information-technology/google-receives-more-than-1-billion-health-questions-every-day.html. Published March 10, 2019. Accessed June 30, 2021.
2. Baunacke M, Groeben C, Borgmann H, Salem J, Kliesch S, Huber J. Andrology on the internet: most wanted, controversial and often primary source of information for patients. *Andrologia*. 2018;50:1–5. https://doi.org/10.1111/and.12877.
3. Russo GI, di Mauro M, Cocci A, et al. Consulting "Dr Google" for sexual dysfunction: a contemporary worldwide trend analysis. *Int J Impot Res*. 2020;32:455–461. https://doi.org/10.1038/s41443-019-0203-2.
4. Hunt N, McHale S. Psychosocial aspects of andrologic disease. *Endocrinol Metab Clin North Am*. 2007;36:521–531. https://doi.org/10.1016/j.ecl.2007.03.001.
5. Gualtieri LN. The doctor as the second opinion and the internet as the first. In: *Proceedings of the 27th International Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '09*. ACM Press; 2009:2489. https://doi.org/10.1145/1520340.1520352.
6. Laugesen J, Hassanein K, Yuan Y. The impact of internet health information on patient compliance: a research model and an empirical study. *J Med Internet Res*. 2015;17:e143. https://doi.org/10.2196/jmir.4333.
7. Tan SS-L, Goonawardene N. Internet health information seeking and the patient-physician relationship: a systematic review. *J Med Internet Res*. 2017;19:e9. https://doi.org/10.2196/jmir.5729.
8. Zhang Y, Sun Y, Xie B. Quality of health information for consumers on the web: a systematic review of indicators, criteria, tools, and evaluation results. *J Assoc Inf Sci Technol*. 2015;66:2071–2084. https://doi.org/10.1002/asi.23311.
9. Polansky A, Leslie J, Heimann G. The great American search for healthcare information. *Weber Shandwick*. 2018. Published online Available at: https://www.webershandwick.com/wp-content/uploads/2018/11/Healthcare-Info-Search-Report.pdf. Accessed 30 June 2021.
10. PricewaterhouseCoopers. Social media "likes" healthcare. Health San Francisco. Published 2012. Available at: http://www.pwc.com/us/en/health-industries/publications/health-care-social-media.jhtml. Accessed June 30, 2021.

11. Semigran HL, Linder JA, Gidengil C, Mehrotra A. Evaluation of symptom checkers for self diagnosis and triage: audit study. *BMJ*. 2015;351:h3480. https://doi.org/10.1136/bmj.h3480.
12. Semrush - online marketing can be easy. Available at: https://www.semrush.com/projects/. Accessed March 21, 2021.
13. Farmer SEJ, Bernardotto M, Singh V. How good is internet self-diagnosis of ENT symptoms using Boots WebMD symptom checker? *Clin Otolaryngol*. 2011;36:517–518. https://doi.org/10.1111/j.1749-4486.2011.02375.x.
14. Yoshida Y, Thomas Clark G. Accuracy of online symptom checkers for diagnosis of orofacial pain and oral medicine disease. *J Prosthodont Res*. 2021;65:186–190. https://doi.org/10.2186/jpr.JPOR_2019_499.
15. Berry AC, Cash BD, Wang B, et al. Online symptom checker diagnostic and triage accuracy for HIV and hepatitis C. *Epidemiol Infect*. 2019;147:e104. https://doi.org/10.1017/S0950268819000268.
16. Yafi FA, Jenkins L, Albersen M, et al. Erectile dysfunction. *Nat Rev Dis Prim*. 2016;2:16003. https://doi.org/10.1038/nrdp.2016.3.
17. Starcevic V, Berle D, Arnáez S. Recent insights into cyberchondria. *Curr Psychiatry Rep*. 2020;22:56. https://doi.org/10.1007/s11920-020-01179-8.
18. Müller A, Baumann E, Dierks M-L. [Cyberchondria - a new behavioral syndrome?]. *Psychother Psychosom Med Psychol*. 2021;71:243–255. https://doi.org/10.1055/a-1348-8059.
19. Meyer AND, Giardina TD, Spitzmueller C, Shahid U, Scott TMT, Singh H. Patient perspectives on the usefulness of an artificial intelligence-assisted symptom checker: cross-sectional survey study. *J Med Internet Res*. 2020;22:e14679. https://doi.org/10.2196/14679.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2022.08.032.

APPENDIX A

List of genitourinary conditions suggested by online symptom checkers:

- **Abnormal Penis Anatomy**
- **Benign Prostatic Hyperplasia**
  - Enlarged prostate
- Stones
  - Bladder
  - Kidney
- **Epididymitis**
- **Epididymal Hypertension**
- **Erectile Dysfunction**
  - Organic Erectile Dysfunction
  - Unspecified Erectile Dysfunction
- **Hydrocele**
- **Hypospadias**
- **Lymphedema of the genitals**
- **Male Hypogonadism**
  - Low testosterone
- **Prostatitis**
  - Bacterial
  - Nonbacterial
- **Obstructive Uropathy**
- **Orchitis**
- **Paraphimosis**
- **Persistent Premature Ejaculation**
- **Peyronie's Disease**
- **Prostate Cancer**
- **Spermatocele**
- **Urinary Incontinence**
  - Stress Urinary Incontinence
- **Testicular Cancer**
- **Testicular Epidermoid Cyst**
- **Testicular Torsion**
- **UTI**
- **Urethritis**
- **Varicocele**

APPENDIX B

List of non-genitourinary conditions suggested by online symptom checkers organized into subgroups:

- Psychologic
  - Adaptive Stress Response
  - Endogenous Depression
  - Fatigue
  - Mild Depression
  - Reactive Depression
  - Seasonal Depression
  - Somatic Symptom Disorder
  - Bipolar Disorder
  - Anorexia Nervosa
  - Dementia
  - Mild Cognitive Impairment
  - Severe Depression
  - Insomnia
- **Neurologic**
  - Alzheimer's Disease
  - Cerebellar Hemorrhage
  - Cerebellar Thrombosis
  - Diabetic Neuropathy
  - Hyperprolactinemia
  - Lumbar Spinal Stenosis
  - Parkinson's Disease
- **Gastrointestinal**
  - Acute Appendicitis
  - Constipation
  - Food Poisoning
  - Gallstones
  - Hernia
  - Incarcerated Inguinal Hernia
  - Inguinal Hernia
- **Cardiovascular**
  - Atrial Fibrillation
  - Blood Clot in the Legs
  - Congestive Heart Failure
  - Coronary Artery Disease
  - Diastolic Heart Failure
  - Heart Attack
  - Hypertension
  - Peripheral Vascular Disease

- Unstable Angina Pectoris
- Atrial Septal Defect
- Heart Failure

- **Endocrine/Hematologic/Systemic**
  - Hypothyroidism
  - Metabolic Syndrome
  - Obesity
  - Type 2 Diabetes
  - Hyperthyroidism
  - Osteomalacia
  - Chronic Disease Anemia
  - Iron Deficiency Anemia
  - Non-GU Cancer
  - Celiac Disease
  - Vitamin Deficiency
- **Sexually Transmitted Disease**
  - Chlamydia
  - Genital Herpes
  - Gonorrhea
- **Respiratory**
  - Chronic Pulmonary Hypertension
  - Obstructive Sleep Apnea
  - Chronic Obstructive Pulmonary Disorder
- **Miscellaneous**
  - Gout
  - Klinefelter's Syndrome
  - Late Onset of Puberty
  - Lichen Sclerosis
  - Mechanical Back Pain
  - Mumps
  - Neck Strain
  - Retroperitoneal Fibrosis
  - Liver Cirrhosis
  - Rheumatoid Arthritis
  - Chronic Fatigue Syndrome
  - Drug Allergy
  - Intoxication
  - Alcohol Intoxication
  - Acute Sinusitis
  - Common Cold
  - Frailty