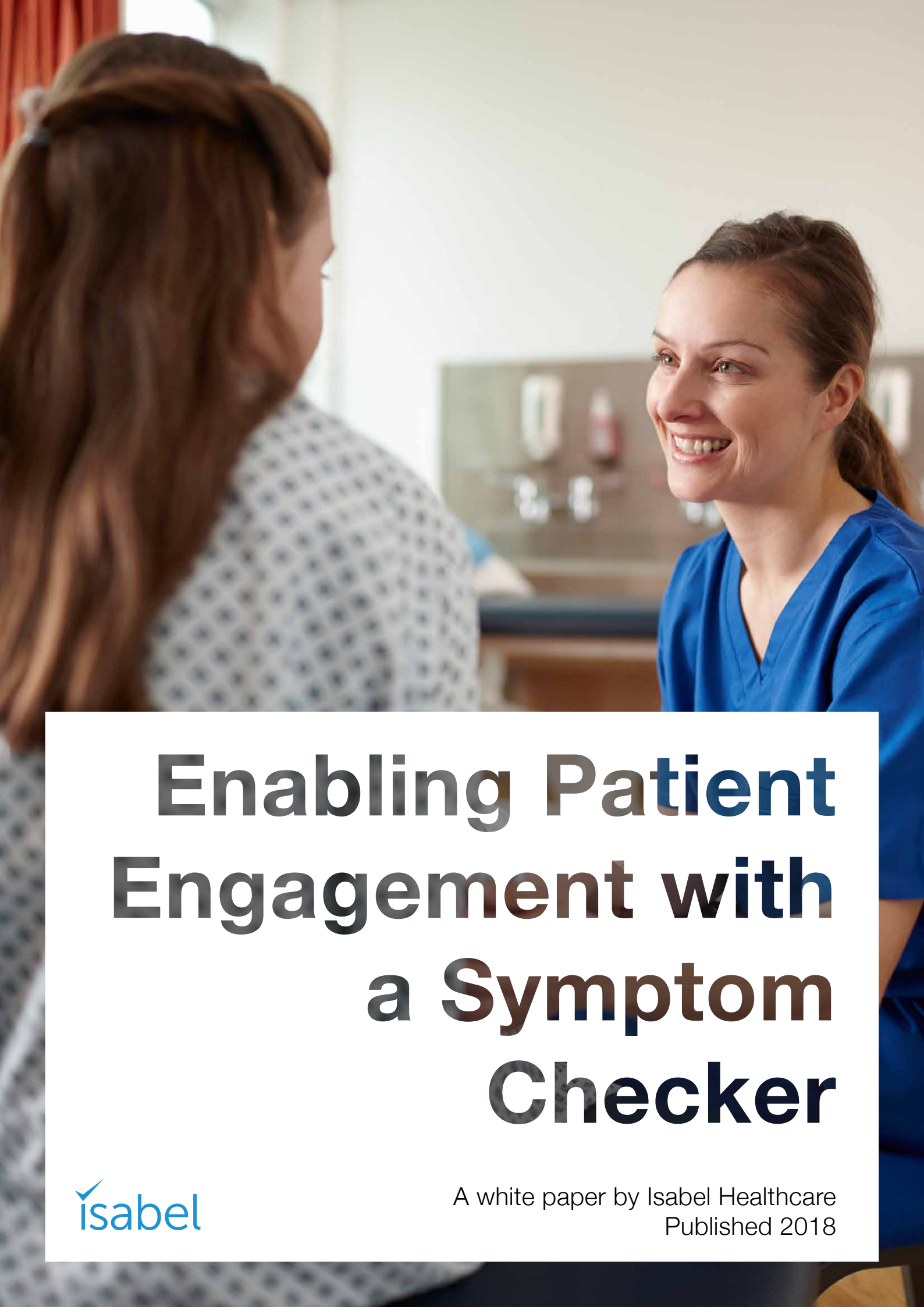

Enabling Patient Engagement with a Symptom Checker

isabel

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Introduction

One of the most important determinants of healthcare quality and efficiency is the quality of clinical decision making. The most underutilized resource within this process, however, is almost certainly the patient. The patient is the undisputed expert on his or her symptoms and how they are evolving.

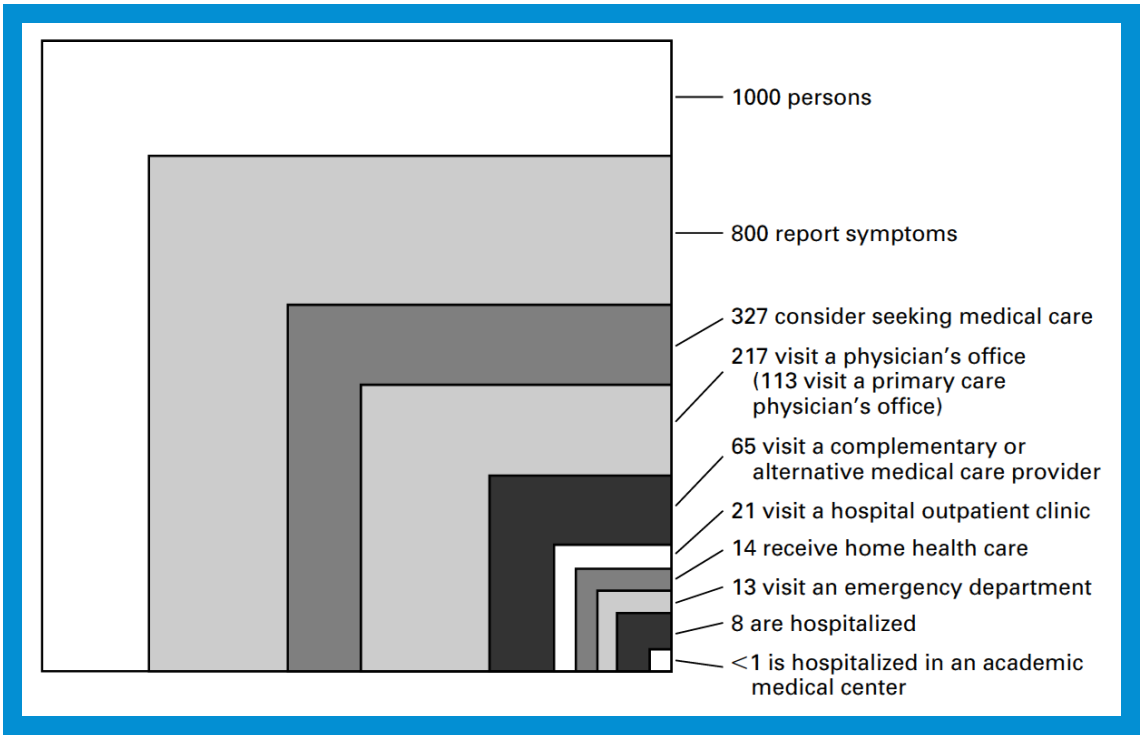
With the growing shortage of doctors around the world, ever increasing healthcare costs, and growth in alternative channels such as virtual visits, attention is turning to how healthcare institutions can both relieve the pressure on themselves and keep patients within their networks. One of the best ways this can be done is to better support patients at the very beginning of their diagnostic journey. In this white paper we will set out how symptom checkers can help with these important first stages in a patient's journey, and how they are a crucial tool to help with true patient engagement. There is now an almost bewildering range of symptom checkers, so we will also recommend our criteria for evaluating them and describe in detail the Isabel Symptom Checker.

What is a Symptom Checker?

'Symptom Checker' is now accepted as the generic term for tools that enable patients to see which diagnoses could be causing their symptoms. They are generally aimed at and designed for patients, and the equivalent tool for professional use is increasingly known as a 'Differential Diagnosis (DDx) Generator.' In this white paper, we look at how to choose a 'Symptom Checker' to be used by your patients, rather than the professional 'DDx Generator' designed for clinicians.

The start of the patient's journey

In 2001 the NEJM published a very interesting re-run of a study originally released in 1961 called "The Ecology of Medical Care Revisited." Against the backdrop of a sharply falling number of general practitioners in the USA in 1961, they looked at a sample of 1,000 adults and asked how many of them reported symptoms, what they did next and where they ended up. The re-analysis of this study was completed in 2001 with a wider source of data, which nevertheless came up with very similar results as shown in the graph on the next page:



Source: NEJM "The Ecology of Medical Care Revisited" 2001

Both studies found that every month a staggering 80% of the US population has health problems. Of those, almost 25% visited a physician's office (Family Practice or GP Surgery) and nearly 2% visited the Emergency Department (ED). It becomes clear from this chart, as well as the exponentially increasing use of the internet for health information by consumers, that to have any real effect on the flow of patients to your health facility, you need to influence your patient early on when they first report symptoms and think about seeking care.

Consumers are apt to use the internet to research health information, which can lead to losing both revenue and care continuity. Organizations, therefore, must help patients answer the following three basic questions through their public facing website, patient portal or apps in order to keep them within their health system network:

1. **I am sick, where should I go to get better?**
2. **How can I understand my symptoms better?**
3. **Where can I find out more about my condition?**

If the health system can't help patients at this stage in their journey, they run the risk of losing the patient to an out-of-organization tele-visit or walk-in-clinic, because the patient

has answered these questions themselves, elsewhere on the internet, and found alternative options.

Should patients be better informed?

Over the years the medical profession has ranged from ambivalent to near hostile towards the idea of patients having more information. As far back as the 19th century when modern scientific medicine was emerging, doctors were expressing their concerns about patients trying to diagnose themselves or suggesting alternative diagnoses to their doctors. Compare this to today's age of the internet, and the patient with 'the list' and pile of print-outs from Google is usually dreaded. There is a wide range of views among clinicians as to whether informed patients are helpful, or a nuisance to be tolerated. Medscape recently conducted a **survey** with some very interesting questions and received 1,089 responses from clinicians (28% physicians and 49% nurses). The results showed:

- When asked what they felt about having more empowered patients, a significant 75% thought it was helpful. Only 10% said that they found it annoying.
- Only 25% of clinicians said that patients' research made it more difficult to provide care, while 57% said this was actually beneficial to the physician-patient relationship.
- The clinicians were most negative about the extra time, with 61% noting that it meant these patients needed more than the allotted time for the consultation. However, 43% stated that patients who do research typically have better outcomes. Only 7% thought those patients had worse outcomes, while the balance was neutral.

In summary, since 75% of medical professionals surveyed thought it was helpful overall to have better informed patients, 57% said it helped the relationship and 43% said those patients had better outcomes, it would make sense for clinicians to encourage this process, at the very least among those patients who desire to be better informed and engaged in their care.

Providing patients with information

Some institutions support the idea of informing and providing patients with information, electronically or via leaflets, about specific diagnoses or treatments. The NHS in the UK, for example, makes very good reference material available via **NHS Choices**. This strategy makes the key assumption, however, that the patient knows what they are looking for; perhaps they received a diagnosis and it was correct, or they were looking for information about treatment. These efforts can assist with answering the question "Where can I find out more about my condition?" However, patients often start their journey with

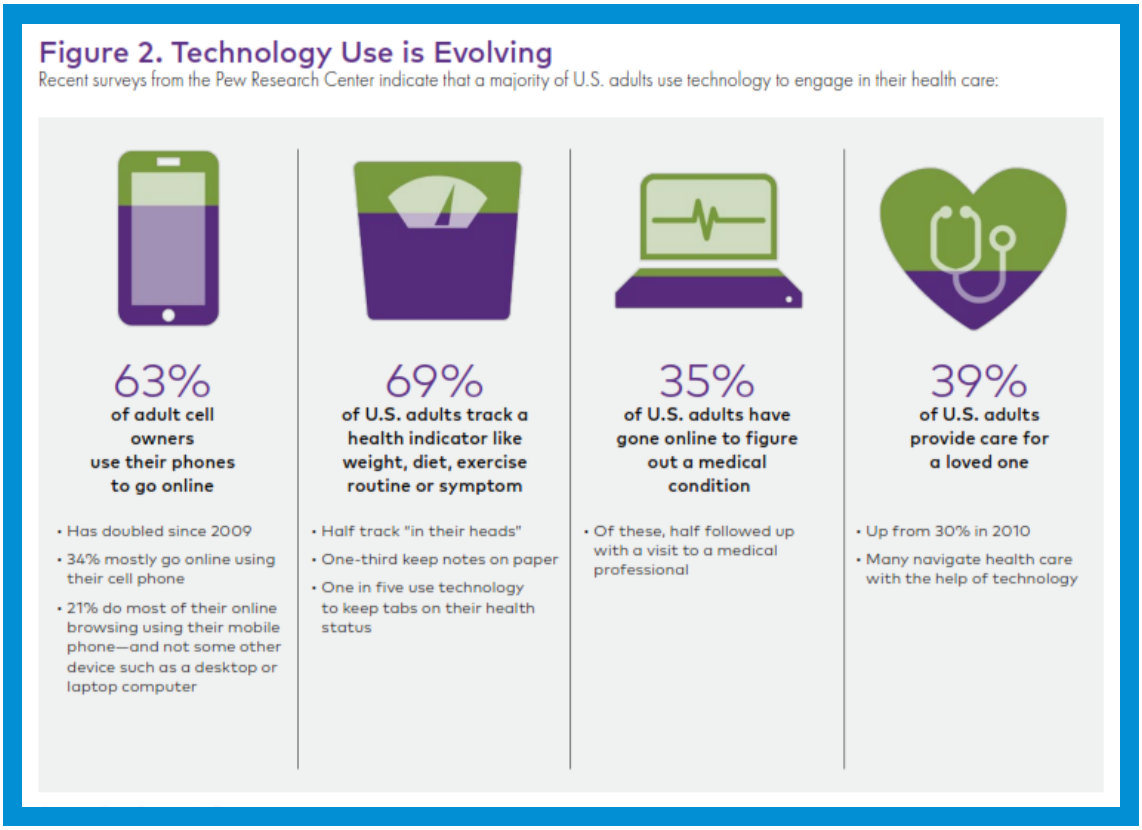
symptoms and won't know what is wrong with them, which means they won't know which diagnosis to look up.

So how do we help a patient determine how sick they are in the first place? How can we help them decide, without forcing self-diagnosis, whether they should go to the ED, an urgent care clinic, contact their primary doctor, or even just connect with a virtual visit?

Remember that according to the NEJM study, almost 1/3 of the population during any month will consider seeking medical care. A significant portion of them will have multiple symptoms and consequently won't be able to make much use of simple reference information. They need a clinically validated tool that will help them convert their symptoms into something useful, such as likely diagnoses and advice on where to seek care.

Patients will research their own health

Research from **Pew** shows that a large proportion of adults use the internet regularly. Incredibly, the average consumer spends 52 hours a year on the internet looking for health information, compared to visiting their doctor 3 times a year for a total of 30 minutes. In fact, the first port of call for many people is not their doctor, but instead a family member, a friend, an online search, or a combination of all three.



Source: Pew Research Center

Most patients are motivated to try and help themselves. In the absence of health tools they are familiar with, or have been specifically recommended to use, they will start with an online search. Since many patients are likely to do their own research, whether it's searching online, or talking to a family member or friend, it surely makes more sense to guide them to tools that are specifically designed to do this job that have also been medically validated.

Patients and self-diagnosis

It is estimated that up to 40% of Emergency Department (ED) visit presentations could have been treated at a lower acuity venue of care, which adds significant cost to the healthcare system. In an effort to curb unnecessary ED visits, one of the biggest US health insurers with 40 million members, **Anthem**, recently stated it will no longer pay for a patient's ED visit if the patient is discharged with what it deems to be a non-emergent diagnosis. The result of this initiative is effectively requiring patients to self-diagnose prior to determining where to go for care.

The crucial distinction is that the decision of whether the patient has chosen the right venue of care is not based on their initial symptoms or presentation, but on a list of diagnostic codes only determined after they have been evaluated by the physician and results are received about any tests performed.

In **a case highlighted in the press** following this announcement, a young woman living in Kentucky went to her local ED after a bad night with worsening fever and severe and increasing pain in the right side of her stomach, concerned about possible appendicitis. The clinicians carried out various tests, diagnosed her with ovarian cysts and recommended she follow up with her gynecologist. Ovarian cysts were not included in the list of diagnostic codes deemed to be an emergency problem, the insurance payment was therefore denied and the patient was presented with the full bill for $12,596.

This move by Anthem sets a precedent which may well be followed by other payers in the US and countries with similar systems. The key point is that it effectively transfers the responsibility for the initial diagnosis and triage over to the patient, further reinforcing why patients need to be provided with the appropriate tools to help inform their decisions. An effective symptom checker tool can help patients answer those three basic questions, empowering them with the information they need to make informed decisions about their care and stay engaged in their health and care. Most importantly, this needs to be done without requiring the patient to self-diagnose.

Establishing Your Criteria

With the increased focus on patient engagement over recent years, combined with advancements in technology and internet resources, the number of symptom checkers on the market has proliferated. There is a wide range of capabilities, so we strongly recommend you establish a clear set of criteria for what is required in a symptom checker.

Complexity of the system

At the outset we would admit that no single symptom checker will work with every case. At one extreme, there will be some cases where a very simple check list for a sore throat may be enough. At the other end of the spectrum, a patient may have already seen several doctors or is not getting better and needs something much more sophisticated than the former. Part of your decision will be assessing how complex your needs are and therefore how sophisticated a symptom checker is required.

From our own experience with the Isabel Symptom Checker, which has been used for over 10 million searches, patients are entering much more complex queries than most would imagine. Approximately 90% of the patient queries processed by Isabel contain 3-7 symptoms.

System architecture

The most important distinction between symptom checkers is the foundation on which the tools are built, as this determines their capabilities. There are several types of systems available, and they all have different uses and advantages.

Rules-Based Systems

Most of the symptom checkers available today are rules-based systems built on decision trees. Traditional approaches to programming rely on hard-coded rules, which set out how to solve a problem, step-by-step. There are some inherent problems with this method of construction:

1. The complexity of building and maintaining the rules and associations between the symptoms and diseases means somebody must decide on the relationships and maintain them manually.
2. The likelihood of diseases varies based on additional factors like age, gender, and potential travel history of the person. The rule sets then grow significantly more complex to cover these.

3. The systems are rigid and hard coded, meaning they can only accept symptoms that are defined in their database. As there are an almost infinite number of ways that individuals describe what is wrong with them, it is impossible to include every symptom.
4. Now accustomed to the ease and efficiency of an online search, this kind of data entry appears relatively slow and tedious for the patient of today, as the systems mechanically go down a decision tree for each symptom and ask the user numerous and often irrelevant questions, before revealing a possible answer.
5. The rigid structure makes it hard to integrate rules based systems with other electronic systems.
6. The complexity and labor-intensive nature makes it hard to scale, so most symptom checkers for patients will only cover a few hundred symptoms and a similar number of diseases, reducing their accuracy.

Deep Learning Systems

Deep learning is the technology that allows computers to learn from experience, directly from examples, in the form of data. In the particular case of a symptom checker, this means that the system is trained on how diseases present. It learns the clinical features associated with each disease, so that when the patient enters their symptoms, the system looks for matches within its database. Essentially this is pattern recognition, which is exactly what doctors do in the first stage of diagnosis. Doctors will take the clinical features they have extracted by listening to the patient's history and carrying out a physical examination, then match this to their own experience and knowledge. There are several advantages to this method of construction:

1. Once the system has been trained and tested, the database does not need continuous and burdensome manual updating, as disease presentations do not change markedly, with most having been observed hundreds or even thousands of years ago.
2. Because the system is not limited by the number of symptoms held in its database, a deep learning system can handle an almost infinite range of cases, and therefore cope with complex and atypical presentations, which could either be 'wordy' or include multiple signs, symptoms, test results, other chronic conditions and even ethnicity. An important point to clarify here is that the system needs to have been trained using free-text natural language and not codified data.
3. As the relationship between symptoms and diseases is not a pre-programmed rule, but instead done through pattern matching, the user can enter queries of multiple symptoms in everyday language and receive results within seconds, without having to follow a decision tree per symptom and answer a large number of frequently irrelevant questions.

4. These attributes allow deep learning systems to be easily integrated into a wide range of other electronic systems. This flexibility and scalability makes it easier to add diseases to the system, so the overall coverage and depth can be much greater, often covering several thousand diseases.
5. **Studies** have shown that systems built this way are the most accurate.

The major challenge with building deep learning systems is the training itself. This is the single most important element and does not depend on the quantity of data used, but the type and quality. These tools also need years of testing and tuning with thousands of cases. They do continue to learn and improve but it is not an automatic process and needs human intervention and oversight.

One possible disadvantage with the deep learning system is that they are not as transparent as rules-based systems. With a rules-based system, you can follow through exactly why a diagnosis has come up, but with a deep learning system, this will never be as transparent, as it partly depends on how the software has matched the query against the database. However, since the purpose of a symptom checker is to come up with a list of likely diagnoses rather than the final diagnosis, we view this as a minor disadvantage which is far outweighed by the advantages of accuracy and efficiency. Reference knowledge linked to each diagnosis can help rectify this situation, as the patient is able to research their likely diagnoses and better understand why it has been suggested.

Another factor to consider when selecting a symptom checker is what advice you want the tool to provide. The rules-based systems can, by nature, be more prescriptive and are designed to tell the user what to do next, whereas a deep learning system provides more information but less guidance on subsequent action. We would be concerned, however, about a computer being overly prescriptive without any oversight by a clinician who has seen the patient.

The deep learning systems are designed to come up with a list of likely diagnoses rather than a definitive diagnosis. This replicates what a doctor is trained to do. A patient using such a system then has a list of diagnoses which can be researched to discuss with the doctor. They are less prescriptive and more designed as an aid.

Hybrid Chatbot Systems

In the last couple of years there has been a proliferation of symptom checkers using chatbots. This is the definition of a chatbot from **Wikipedia:**

> *A chatbot (also known as a talkbot, chatterbot, Bot, IM bot, interactive agent, or Artificial Conversational Entity) is a computer program which conducts a conversation via auditory or textual methods .Such programs are often designed to convincingly simulate how a human would behave as a conversational partner, thereby passing the Turing test. Chatbots are typically used in dialog systems for various practical purposes including customer service or information acquisition.*

> *Some chatbots use sophisticated natural language processing, but many, simpler systems scan for keywords within the input, then pull a reply with the most matching keywords, or the most similar wording pattern, from a database.*

This type of symptom checker uses a question and answer user interface in the form of an online chat to take a user through a decision tree, in order to elicit the key symptoms, and then come up with a limited list of diagnoses or care recommendations. Essentially these systems overlay a friendlier 'face' or interface for what most often is a rules-based system that appears to understand natural language, by carrying on a "conversation". They often describe themselves as using 'Artificial Intelligence (AI)' as the chatbot gives the illusion of 'intelligence'.

They work quite well for simple, single symptom queries, but can often be quite time consuming to use, as they ask the user 10-30 questions. If you enter something more complex, the systems will normally reply that they cannot recognize what you have said, or they will pick up on the one word they do recognize and then ask questions around that symptom, which can be quite irrelevant. An extreme example of this could be a query of "throbbing beneath the right ear." Most chat bots will reply that they don't recognize this, or that "it seems you have something wrong with your ear" and then proceed to ask questions about your ear, such as "is it blocked or sore." Clinicians will know, however that this symptom is a cardinal sign for a heart condition called 'constrictive pericarditis'.

Most of these systems have focused on the problem of extracting symptoms from a free-text query, but the quality of the differential diagnosis depends critically on the underlying system for diagnosis. This remains rules-based for the products currently on the market. In reality these systems end up inheriting all the issues of a rules-based system. Chatbot based systems could be improved qualitatively, however, by using a better underlying differential diagnosis engine.

There are some chatbot systems that also offer a virtual consultation with their own employed physicians once they have established your symptoms. In this situation, the patient is referred to the system's own consultation service, rather than being advised on where to seek care at a public institution. This could be an inherent conflict of interest, and if you were to install this kind of chatbot symptom checker into your own institution, your patients do not necessarily remain within your network.

Avatars or Body Maps

To help patients enter their symptoms, some rules-based symptom checkers use avatars or body maps. This is another decision to make when selecting a symptom checker for your institution. Superficially, this functionality may look good, but in practical terms makes little sense, as many symptoms do not apply to a particular area of the body. For example, how would the patient enter tiredness, lethargy, high blood pressure, or muscle weakness?

Triage functionality

Some symptom checkers also offer a triage functionality to help the patient decide where to go for care, and this may be an important feature you wish to consider. There are 3 basic types of tool that do this and it is important to understand how they work before deciding which to use.

Based on a single symptom

The more basic systems will take the one symptom the patient has entered and then ask questions about the severity, location and duration, amongst other questions, before coming up with care venue advice on what to do next. The questions can be quite extensive and frequently run to over 20. Often the advice will be to go to the Emergency Department (ED), and some tools can use a patient's location to highlight facilities nearby. Some will also consider a patient's insurance plan. These types of tools are limited in their scope and will not be of help to those patients with more than a single symptom. In practical terms, most consumers don't use an online tool when they have a single symptom. For example, with the single symptom of a stuffy nose, taking a decongestant will usually be the first action.

Based on a diagnosis

Some symptom checkers only provide care venue advice based on a diagnosis. In essence, this forces the patient to diagnose themselves before getting advice on where to go.

Based on the overall clinical presentation

Some of the 'chatbot' systems base their care venue advice on how the patient answers the triage questions. This means it may ask a question with response options such as, "feel very sick," "looks like a life-threatening problem," or ask, "are you sick enough to consider going to the emergency room right now?" or "do you think you have XYZ."

Isabel's triage function is based on the patient's overall clinical picture, provided by the symptoms entered and the ranked diagnoses, combined with the answers to 7 general clinical questions relating to the onset, duration and severity of all the symptoms they are experiencing. The subsequent recommendations include telemedicine, a walk-in clinic, a family doctor or the Emergency Department, but intentionally does not include self-care.

Can triage via a symptom checker improve consultation quality?

A study in the BMJ highlighted how the average consultation time in primary care across the world is a little over 5 minutes. There is growing pressure on primary care as the population gets older. Time taken to access a general practice or family doctor is a common complaint in many developed countries. In countries such as India, the consultation time is measured in seconds rather than minutes, leaving time only for the clinician to do basic triage and issue a prescription.

Although efforts are being made to increase primary care, by using nurse practitioners for example, it is unlikely these will have any real effect on consultation time, due to increased demands, current levels of physician burnout, and early retirement.

One potential solution is to get the patient to do more of the initial work currently carried out by the physician. Using a symptom checker and triage tool, the patient can be encouraged to think about and articulate their symptoms, as well as research diagnoses they may be worried about, before they enter the consultation room.

After using the Isabel tool, for example, a form can be sent to the clinician before the consultation, which contains the symptoms as described by the patient, answers to the general clinical questions around the onset, duration and severity of symptoms, and a list of ranked likely diagnoses. This would help reduce the time spent by the clinician on basic history taking and make the consultation more productive. In addition, **research** has shown that the diagnostic accuracy of doctors is increased by being provided with a differential diagnosis before they start thinking. Having the patients do this groundwork is a practical way of achieving this.

Validation and peer reviews

The validation of a symptom checker should be an important consideration when looking at the different systems available.

Sadly, there have been very few peer reviewed studies published looking at symptom checkers specifically, rather than professional tools. With the wide range of tools now available, we believe it would be very helpful to both patients and the healthcare industry if an independent organization, such as Consumer Reports, carried out a full study.

The most notable study published so far has been "**Evaluation of symptom checkers for self-diagnosis and triage: audit study**" in the BMJ. Although this is the best study so far, it still has serious limitations, as the tools were tested with clinical test cases, rather than patient reported symptom cases, and many symptoms of the cases were negative symptoms, which patients are very unlikely to report. Furthermore, this study did not look at the ease and speed of use, factors which are very important to both doctors and the patients. With very few impartial studies currently available, other criteria should be established to help you with your decision.

Current Symptom Checkers Available

As part of an evaluation process for these tools, we strongly recommend that you try as many of them as possible with a range of cases.

Rules-based systems

As mentioned previously, rules-based systems are limited by their database of symptoms. The examples here range from around 29-500 symptoms within their database, although this is always changing as the systems develop. We recommend you research the actual capabilities of each one thoroughly.

- **WebMD - https://symptoms.webmd.com**
- **Everyday Health - https://www.everydayhealth.com/symptom-checker**
- **Healthline - https://www.healthline.com/symptom-checker**
- **Symcat - http://www.symcat.com**
- **Health Navigator - https://www.healthnavigator.com**
- **Symptoma - https://www.symptoma.com**
- **ADAM - http://www.adam.com**
- **Healthwise - https://www.healthwise.org**
- **Staywell - https://www.staywell.com**

Hybrid chatbot systems

These are the main chatbot systems, which are all very similar. The number of questions they ask the patient varies from 10-30, with some more relevant than others. As before, we recommend you test each one and research their capabilities.

- **Babylon Health - https://www.babylonhealth.com**

- **Buoy Health - https://www.buoyhealth.com**
- **Ada - https://ada.com**
- **Your MD - https://www.your.md**
- **Mediktor - https://www.mediktor.com**

Deep learning based systems

As far as we are aware, Isabel is the only enhanced deep learning symptom checker.

Isabel uses a database that has been trained on over 6,000 diseases. This means that for each disease the system has learned and knows all the typical and atypical presentations. The core knowledge has been extracted from evidence-based resources over many years. This is the most important element of a deep learning system, and it's crucial that the right type and quality of training information is used, rather than just quantity. The database is hand built, as human clinical judgment is used when adding content, as opposed to simply spidering or grabbing content from the internet. Isabel then uses statistical natural language processing software to make the match between what the user has entered and the database. In addition, Isabel uses several other tools and algorithms to make sure the results are relevant for the age, gender, region and pregnancy status of the patient.

- **Isabel Symptom Checker - https://symptomchecker.isabelhealthcare.com**

To pilot or not to pilot?

There will be a temptation to pilot the symptom checker you finally select. All too often, pilots are doomed to failure from the start for one very simple reason; it is difficult to commit resources, marketing efforts, and awareness efforts to communicate to patients about the availability of the tool, and the benefits it provides them and the institution. This is a commitment that must be made by the institution for the success of integrating any symptom checker into their patient engagement strategy. Patient behavior only changes if a determined and conscious effort is made to help it change. It is vital that use of the symptom checker is not viewed as the end in itself, but merely a means to an end.

Engaging, recruiting and retaining patients, to help them get to the appropriate venue of care and take a greater role in their own healthcare, is a major cultural change. This is difficult to pilot without serious institutional commitment.

In our view, once your institution has decided to fully commit to patient engagement, then you need to start with the intention to go on. This means implementing a process for full patient engagement and making the necessary tools, of which a symptom checker and

triage are examples, available as part of this process. This will entail making the use of these tools an engrained part of your existing processes. For example, instead of just making a symptom checker available somewhere on your website and hoping patients will use it, you need to get your doctors recommending patients use it before their consultation, and market the service to your patients on an ongoing basis. Making it available in several spots like the home page, patient portal or apps can help, as well as fully integrating it as part of the patient intake process. You can even forward the results to a provider as part of the process for getting an appointment. Crucially, access must be as easy as it is for a patient to go to the Internet and do a general search.

Testing a Symptom Checker: *Questions to ask*

Once you have decided you need a symptom checker, we recommend asking the following questions of each tool you assess, to help inform your choice:

1. How long has the system been generally available and in use?
2. What system architecture does the tool use (rules-based, deep learning, chatbot, or other)?
3. Does the system understand and accept at least 3 clinical features entered together (signs, symptoms, lab results) to generate a list of diagnoses? Try several cases, of which you know the final diagnosis, to test this out.
4. Can the user enter the clinical features they want in free-text or do they pick from a pre-defined list?
5. How many clinical features can be entered at once and is there a limit?
6. What is the average time it takes to enter a 4-feature query and get the results back?
7. How many diagnoses are covered by the system?
8. How often is the clinical database updated?
9. Are results adjusted for age, gender, pregnancy and regional or travel prevalence?
10. Are the diagnosis results ranked, and if so, how?
11. Can the diagnosis results be sorted by specialty? This helps to map the diagnosis to the correct doctor in an institution.

Testing a Symptom Checker: *Questions to ask*

12 Can the diagnosis results be sorted by common or rare?

13 Are 'Emergency' critical diagnoses, that cannot be missed, highlighted?

14 Does the system include contextual links from diagnosis results to comprehensive evidenced-based knowledge resources?

15 Can the symptom checker be integrated into other electronic systems. These could be a patient portal, apps, or the hospital website.

16 What methods of integration are available for the system?

17 Is the system available in an API version, so the health system can 'white label' and tailor the features to their unique workflow and 'look and feel?'

18 Has the clinical database been independently validated? If so, in how many peer-reviewed and published studies? Request copies or access to all of the studies.

19 Can the system work in multiple languages?

20 Can your organization's usage be tracked to support analytics projects?

21 Does the triage functionality require the patient to self-diagnose?

22 Can the triage tool be customized to direct patients to a specific organization's venue of care?

23 Can the patient-entered data, triage data and the diagnosis list be sent to the clinician prior to a visit?

The Isabel Symptom Checker

Isabel is an enhanced deep learning symptom checker which also uniquely combines rules-based tools and statistical natural language processing.

Isabel was first made available as a professional system for pediatrics in 2001. It was then expanded to cover all age groups in 2006 and is now called the Isabel Differential Diagnosis (DDx) Generator. The patient version discussed in this white paper, called the Isabel Symptom Checker, was released in 2012 and is derived from our existing professional system. This means that the core system was used and tested by clinicians for 11 years before it was made available to patients.

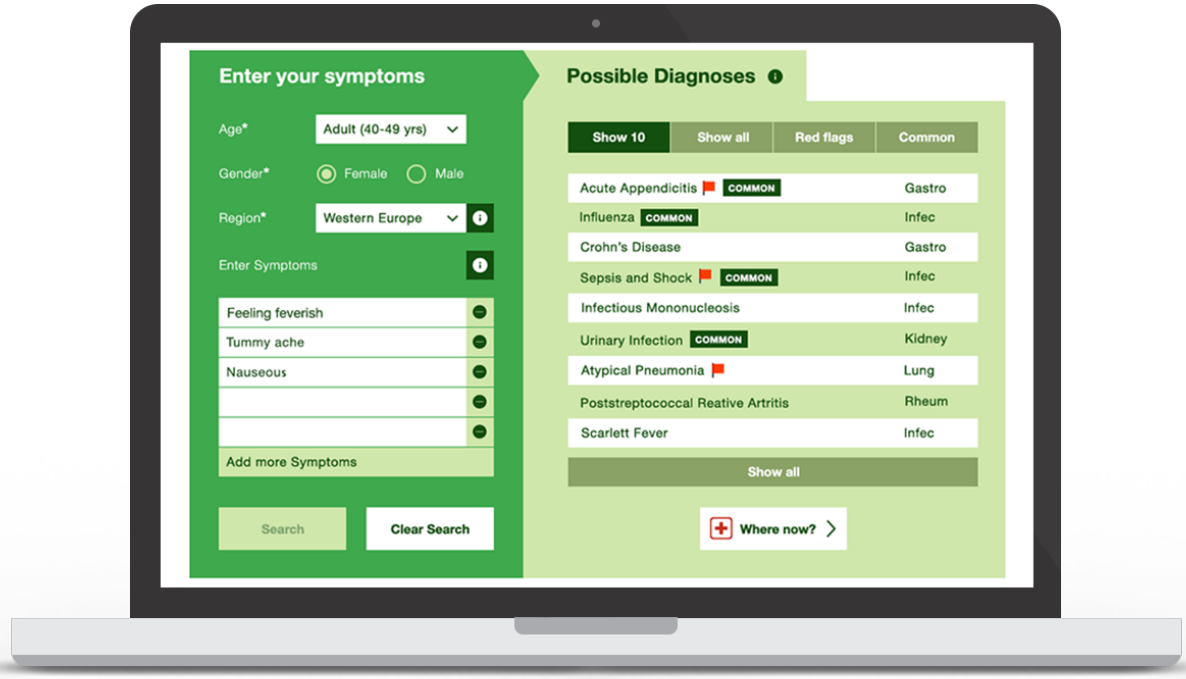
The Symptom Checker covers all age groups and displays 3,700 diseases compared to 6,000 in the professional system, and has been modified to better suit lay users. The main differences compared to the professional system are:

1. Fewer diseases are displayed. For example, instead of showing all the different types of viral hepatitis sub-diagnoses, the general diagnosis 'viral hepatitis' will be displayed. A medical professional will make the diagnosis of the specific type of hepatitis the patient has if that is found to be the cause of their symptoms.
2. The common diseases are highlighted with a 'common' label to try and avoid patients inappropriately focusing on rarer diseases.

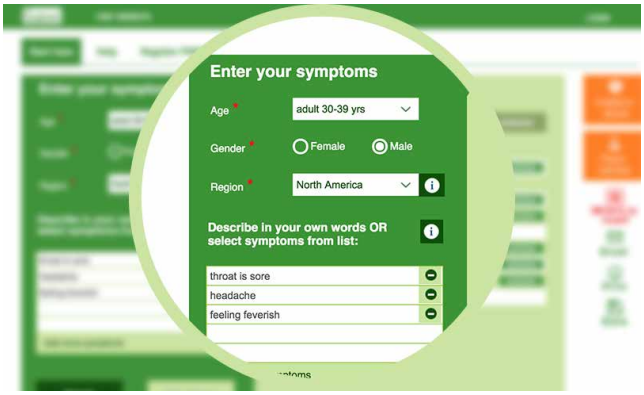
3. The language inputs have been modified so that the system better understands non-medical terms. For example, ‘tummy ache’ is recognized as being equivalent to ‘abdominal pain.’
4. The knowledge resources are respected, patient-friendly resources.
5. A triage tool has been added to help the patient decide where to present based on their symptoms and responses to triage questions.
6. ‘Contact a Doctor’ functions connect to the specialties, ensuring patients are connected to the correct doctor for the listed diagnosis. This means that a patient clicking on ‘Find a Doctor’ while reading about rheumatoid arthritis, for example, could be shown your institution’s list of rheumatologists.
7. Links have been added so the tool will connect to the institution’s physician finder, scheduling and messaging systems, and venues of care.

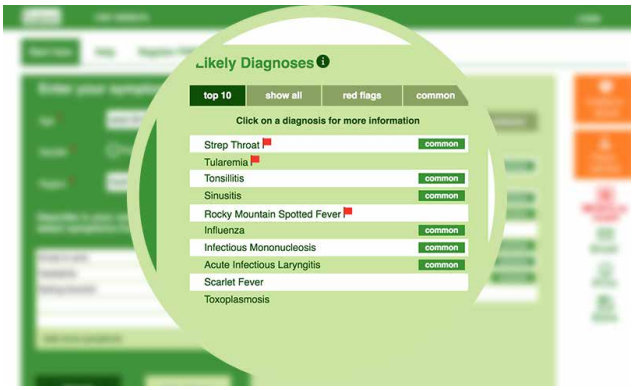
What makes Isabel different?

Firstly, the Isabel Symptom Checker is based on the medically validated Isabel Differential Diagnosis (DDx) Generator, our professional tool. Basing the system on a professional tool gives piece of mind to both the medical professionals and the patients, and makes our symptom checker more credible than other, simpler systems designed only for patients.



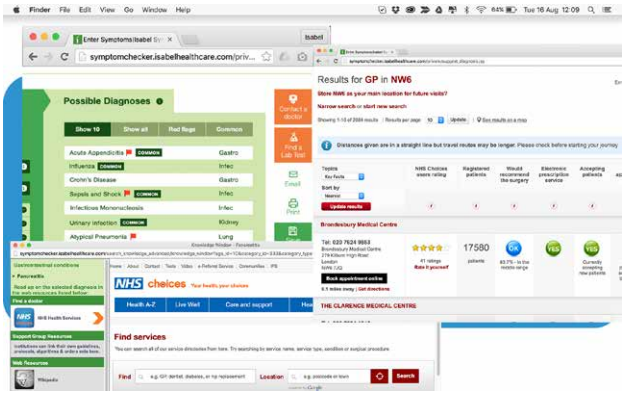
Unlike other symptom checkers, Isabel enables patients to enter multiple symptoms, combined with their age, gender and region, in everyday language and make sense of them. This allows for an infinite number of symptoms to be entered, compared to other tools which cover just a limited list of common symptoms.

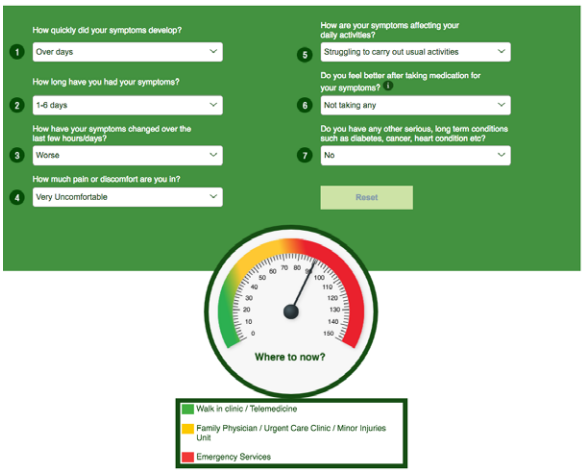




The combination of symptoms is analyzed by the Isabel artificial intelligence engine, which is the most intelligent and accurate of its kind, and the only enhanced deep learning system to be applied to a symptom checker. This process takes seconds, cross-referencing 3,700 disease possibilities with the symptoms entered, to bring up a list of likely diagnoses.

Results can be sorted by different views, highlighting common and red flag diagnoses. Each listed condition also links through to patient-friendly disease information, allowing patients to research the diagnoses and discuss their findings with a doctor.





A ‘Where now?’ triage feature is also provided to help patients decide where to seek care within their health system. After answering 7 key questions about their symptoms, a unique set of algorithms consolidates the information entered with the initial list of likely diagnoses and recommends the most clinically appropriate setting to seek care within a health system. This whole process takes less than a minute.

Facts about Isabel Symptom Checker

- It is the only tool that is based on a medically validated database
- Our 'Where Now' feature is the only triage tool that does not force the patient to self-diagnose
- It covers 3,700 conditions
- It is the only tool available that allows natural language input
- It can be deployed in multiple patient engagement workflows

Validation of Isabel

The Isabel system as a whole has undergone a continual validation process, with the first studies appearing in peer reviewed journals over 15 years ago. The studies have looked at 'accuracy', 'utility' and 'impact' and are available **on our website**.

Due to there being very little validation material for patient-oriented symptom checkers, and the fact the Isabel Symptom Checker is based on our professional tool, we are one of the very few tools to have any validation on our system for patients. We are also trying to get more validation specifically for symptom checkers. More recently there have been **4 independent reviews** published on both professional differential diagnosis generators and symptom checkers, and we are constantly pushing for more symptom checker specific publications.

How is Isabel Symptom Checker used by patients?

Approximately 90% of the queries entered into Isabel by patients are for 3-7 symptoms. Contrary to what is generally assumed about these tools, very few patients are only entering a single symptom such as headache or sore throat. In fact, many of the queries are quite wordy. Here are some examples:

> *"anxiety made worse by emotional stress, anxious, depressed, stressed, mentally, unable to cope, struggle with life"*
>
> *"pain in abdomen, urinate urgent desire, pain when peeing, tiredness persistent, nauseous, clammy"*
>
> *"sudden bout of blurred vision, seems to help having hot drink or biscuit, left with bad headache, symptoms more frequent"*
>
> *"left upper abdominal pain, hurts to talk or cough, high blood pressure, rapid heart rate, nausea, swelling under left breast, pain goes thru back, all around"*

From patient feedback, our view is that most users get a sense of relief from using Isabel. Many appear to use it either after having seen several doctors or when they've had something bothering them for a while. Here are some examples of patient feedback:

> *"I have been dealing with these symptoms for months. I get different opinions from 4 different doctors, each one different from the other. This finally gives me a new direction to follow."*
>
> *"This is a good tool, forces you to be honest and confirmed what I didn't want to do, but know I have to! Thank you"*
>
> *"I like Isabel's symptom checker! Less razzle dazzle than others and much more empowering and grounded... Helpful"*
>
> *"I am impressed with this page. I like that you put your symptoms in instead of only giving the person one [body] area to choose from. This allows you to give your own symptoms which can be in several parts of the body, not just stomach, back, arm etc. It is better all the way around. Thank you for your help. I have various symptoms that involve several areas of my body and it gave me an answer that I kind of figured was the problem. Thanks again"*

One thing to note is that we have not seen any feedback where the patient has stated they are no longer going to see their doctor after using Isabel. Isabel has always positioned itself to support rather than replace the doctor.

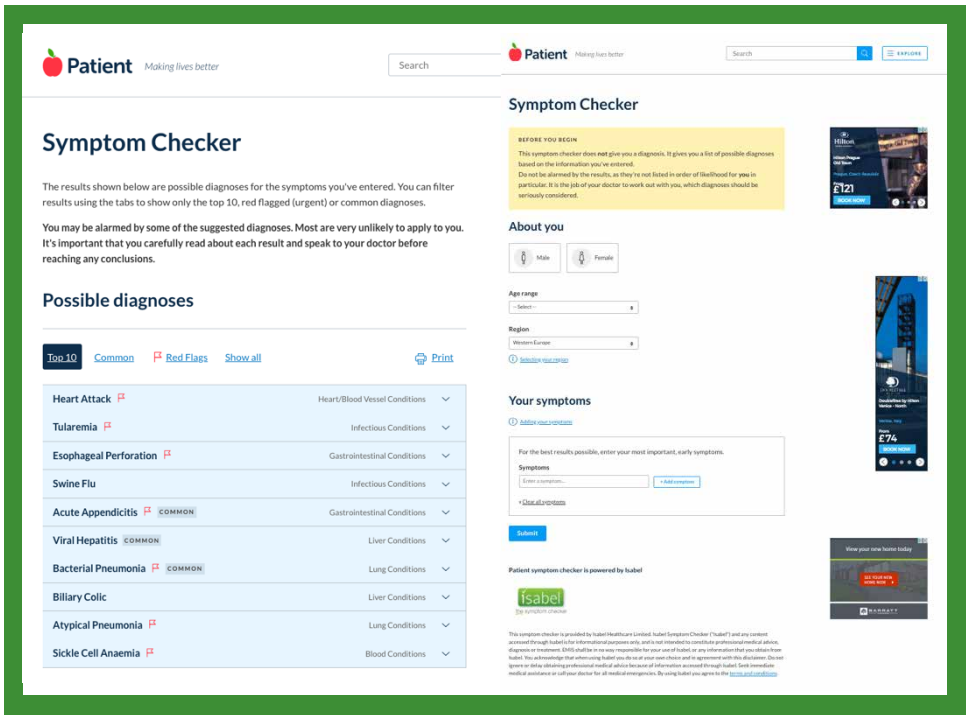
The Isabel Symptom Checker API and Integrations

The deep learning structure of Isabel, combined with APIs that cover all of the tool's functionality, mean that it can easily be incorporated into a wide variety of workflows and contact points within a health system. For example, it can be built into an institution's own public facing website, app, patient portal or personal health record, improving efficiency and the patient experience. The Isabel Symptom Checker is already used by many institutions and companies to improve their patient engagement.

Patient.info

Patient.info is a UK based health information site which receives approximately 20 million visitors a month. Isabel powers its symptom checker, which is used by many of its visitors to help them understand their symptoms.

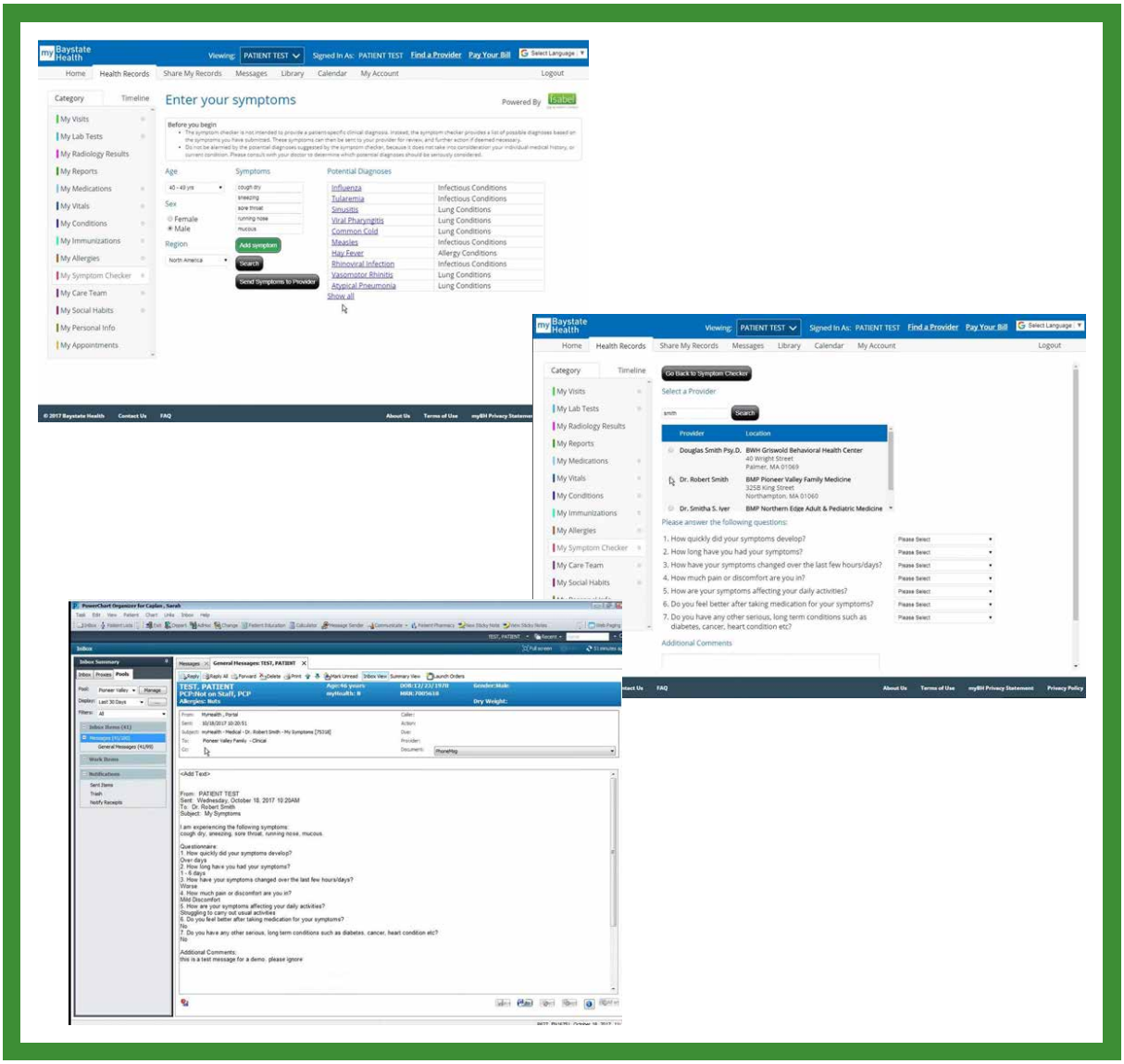
Patient.info also publishes a lot of highly respected clinical content which enables the site to link the diagnosis in Isabel directly to its own resources.



Source: Patient.info

Baystate Health

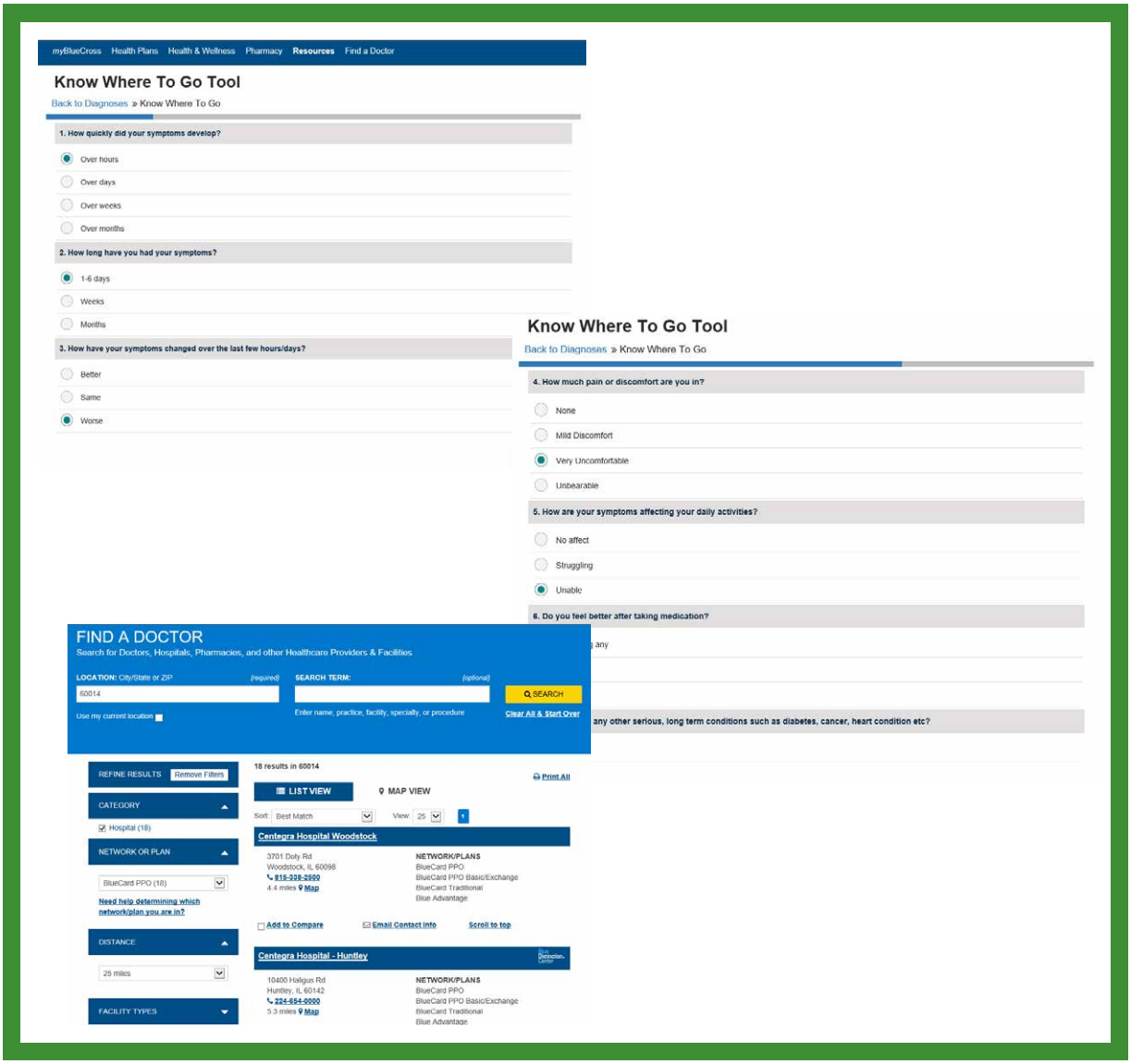
BayState Health is a community Hospital in Massachusetts, which makes the Isabel Symptom Checker available directly within the patient portal. To access Isabel, the patient chooses 'My Symptom Checker' in the option on the left-hand column. If the patient wants to see a doctor, they select one from the available list and answer the additional triage questions which are taken from the "Where Now?" Isabel feature. The symptoms entered, along with answers to the triage questions, are then sent to the doctor as a secure message, which lands in the physician's message cue. The doctors reportedly find this very advantageous, as it cuts down the number of calls or messages they experienced previously, and the fact it is so intrinsically integrated into the system is what makes it so efficient and useful.



Source: BayState Health

BlueCross BlueShield of Alabama

BlueCross BlueShield of Alabama is helping their members get to the appropriate venue of care to potentially reduce unnecessary Emergency room visits. Providing access to the symptom checker and triage tool from their homepage as a starting point, it helps connect members within the network to physicians and venues of care.



Source: BCBS Alambama

Conclusion

We hope this white paper has helped in your patient engagement journey.

We believe that healthcare should make much greater use of patients and help them play a much more active role in their healthcare, not only for their benefit but also for those who care for them as well. The patient engagement train left a while back and is picking up speed as more sophisticated tools become available to patients, and the healthcare industry can either get on board or get left behind.

With the proliferation of digital tools, and not only symptom checkers, it is now increasingly important to really think about what you want your patients to do and how you plan to help them. A decade ago there was probably just WebMD for patients, but now there are a myriad of symptom checkers to choose from. However, we would argue that if you need something more sophisticated that will cope with today's more complex patients, then the choice is much more limited.

Although many clinicians will air concerns about patients misusing tools, alarming themselves unnecessarily and creating a new generation of 'cyberchondriacs,' the evidence doesn't seem to support this notion.

Lastly, if your institution decides to adopt a symptom checker, we would urge you not to do it as a tick box exercise, but instead ensure it is an integral part of the way your institution functions, with working processes and methods adapted to fully embrace it. If this is not the case, it will remain a fringe event used by just a small portion of patients.

We wish you the best of luck in this very important endeavor.