Information and Computer Technology for Indigenous Knowledge Healthcare

Final Report

CS 4624: Multimedia, Hypertext, and Information Access

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1. Executive Summary

The Information and Computer Technology for Indigenous Knowledge Healthcare project is an effort to create a searchable database of complementary healthcare practices accessible on desktop and mobile. As traditional doctors may not be easily reachable in all parts of the world, our database aims to be a digital library to help lay healers and citizens in a more accessible way. The website is accessible at https://health.cs.vt.edu/.

Through meetings with our client, Dr. Agozino, we came up with a list of requirements for the final website. First, it must be easy to administer even for those who don't have a technical background, to facilitate transferring the website over to another team after we finish the initial implementation. Next, the website must be mobile friendly to increase accessibility around the world. The website should allow for user uploads so that the database of knowledge can grow, with the caveat that user submissions should be moderated as to prevent anything harmful from appearing on the site. Lastly, the site should have external links to a method to donate and references for the posts on the site. Sourcing our posts will give users more confidence in the credibility of the content.

Our design of the website is a wiki-styled site using Wordpress.org. Each post will correspond to a particular remedy and be sorted into one of the categories of body work, energy work, exercise, mindfulness, food & diet, sound & music, and western. Each post will also be tagged with various symptoms it helps to allow for further categorizing of posts. Our design also includes a search bar on the home page, and static pages for a general about page, references, disclaimers, and a privacy policy.

Our website is implemented on a virtual machine hosted at Virginia Tech, allowing for flexibility in customizing what we needed for hosting. Our site has an HTTPS connection, and a MySQL database for managing the posts and pages. The frontend of our site implements Wordpress.org with the MyWiki theme that fulfills many of our client's requirements right out of the box.

For the future, we plan to implement plugins to cover the other requirements of our project, as well as continue to populate the database with our prior research. After we have completed the base requirements, we have plans for continued moderation and administration of content, which will be covered in our developer's guide.

2. Introduction

2.1 Objective

In today's world, with modern, western healthcare still unavailable to a large amount of the world's population, people are turning to complementary and alternative forms of medicine. Our goal is to create a database of research supported cures that are complementary to traditional medicine, but more accessible. Our database will primarily be aimed at Africans, with indigenous healthcare information, but also pull from India's and China's complementary healthcare practices. Since not everyone has access to a desktop computer, we aim to make our website mobile friendly. We also want our database to be extensible beyond what we add to it, and so will allow for moderated user submissions of posts. Lastly, to support further growth of the website we will include a donation link as well as a link to our client's book.

2.2 Client Background

Our client is Dr. Onwubiko Agozino, a professor in the Sociology department with a focus on Africana studies. He grew up under a priest-physician father, and as he went to university learned to heal without herbs. The result of his research was the book *Africana Drug-Free Alternative Medicine*, which became the inspiration for an online database proposal.

2.3 Project Background

Dr. Agozino and Dr. Fox held a brainstorming session that produced a logic diagram for the project design. The main information we drew from this brainstorming was the categories for our research, and the various audiences who would be most likely to use the website.

2.4 Organization of Report

After the introduction, the report continues with the requirements for our website, with subsections going into detail on individual features that our client requested. Following is a section on design, with some screenshots of the initial appearance of the website. Section 5 describes how the website was implemented. Sections 6, 7, 8, and 9 are the

Testing, User Manual, Developer Manual, and Lessons Learned. Section 10 is about future plans of the website for developers that may work on the project later on. Lastly, there are sections for acknowledgements, references, and an appendix.

3. Requirements

Following the initial meeting with Dr. Agozino, we were able to come up with a list of requirements that both met his vision for the project, and were feasible to implement in the given time frame. We knew we needed a hosting service to contain our website, as well as the capability to include external links to literature, allow users to upload their own information, moderate posts written by other users, and search for articles based on tags related to symptoms. We also needed our website to have a mobile friendly layout, and be easily updated by our client, who is not of a technical background.

3.1 Website Administration

We decided to use WordPress to implement our website because of many advantages it has over standard web development that meet our requirements. WordPress's base functionality on its own meets many of our requirements right from the start. It comes with an admin portal that is easy for a non-technical person to make use of. This way, Dr. Agozino, along with any who may be granted administrative access in the future, will be able to add articles of his choosing and curate a health news blog alongside the articles related to various remedies; as well as moderate new posts as they come in and ensure harmful ones are not accepted.

3.2 Mobile Friendly UI

Many people in the areas where this website will be most useful have much better internet access from their phone than from any other source. Because of this, we knew that designing this page to be mobile friendly was one of the most important things to ensure. WordPress takes care of this as well, since most of their front end templates scale well to smaller screens.

3.3 User Uploads

The most important requirement of this website is the ability for both experts and laypeople to upload their own information in a post format. WordPress again takes care of the base implementation for this by providing a relevant plugin, but this functionality also comes with its own share of further requirements to ensure a safe experience for any user.

3.4 Moderation

The interactivity of the website along with the nature of the information being dispensed comes with plenty of opportunities for something to go wrong, so having several layers of quality assurance is absolutely necessary. WordPress allows users to leave comments and votes on entries, so these will be useful as a secondary method of screening content. However, the primary method will be through moderation by one or more administrators who must approve a post before it is visible to the public. These moderators will also be able to remove harmful comments.

3.5 External Links

There will need to be at least two external links; a donate button for people who wish to fund future work on this project, and a link to enable users to purchase Dr. Agozino's book. In addition to this, there will be a section of the website reserved for listing academic sources that have contributed to the articles on the website. This is to ensure that users know the information is valid, and from trusted sources.

4. Design

The actual look and design of the website is something that was left mostly for us to come up with on our own, as long as it was scalable for mobile devices, and of course, easily navigable. WordPress comes with many templates, so it was trivial to settle on one that accomplishes all of our needs in an elegant way. The MyWiki theme accomplishes all that needs to be shown on each page of the site.

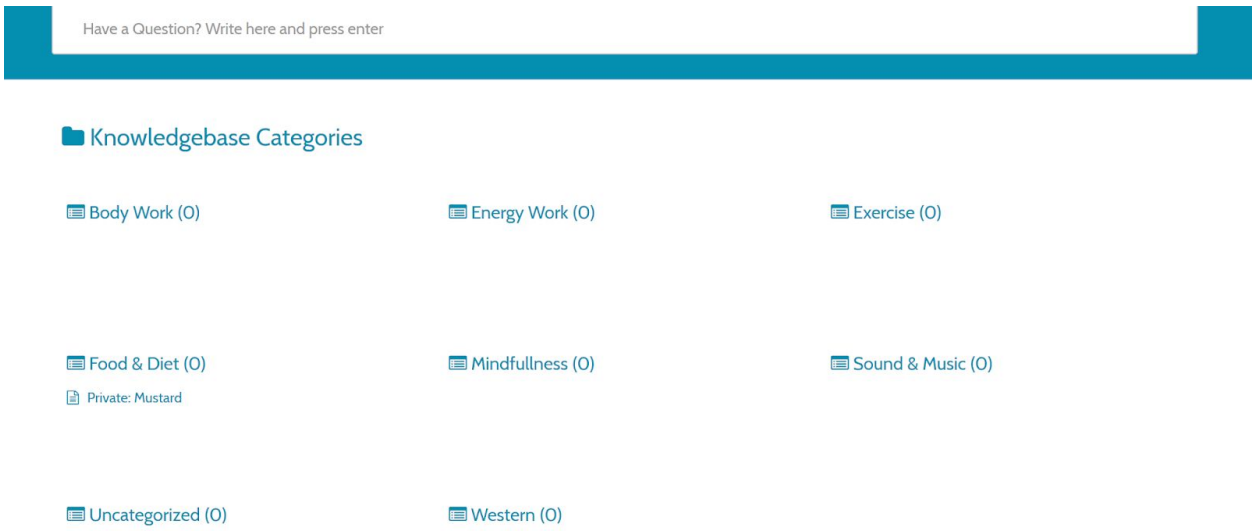

Fig. 4.1 - Front page of the website, with one test post

This homepage immediately shows clickable links to each of the many categories available, and further lists the articles available within those categories. As the site grows, certain articles can be selected to show up on the front page, and the entire list can be found by clicking on a category. There is a search bar immediately visible as well, which will allow quick searches for any topic.

Each posted article will focus on one particular type of supplementary medicine, and will have practical descriptions of how to make use of it for various symptoms, where applicable. These symptoms will also be listed as tags, so when one of them is searched for, the pages that have some solution available will be returned.

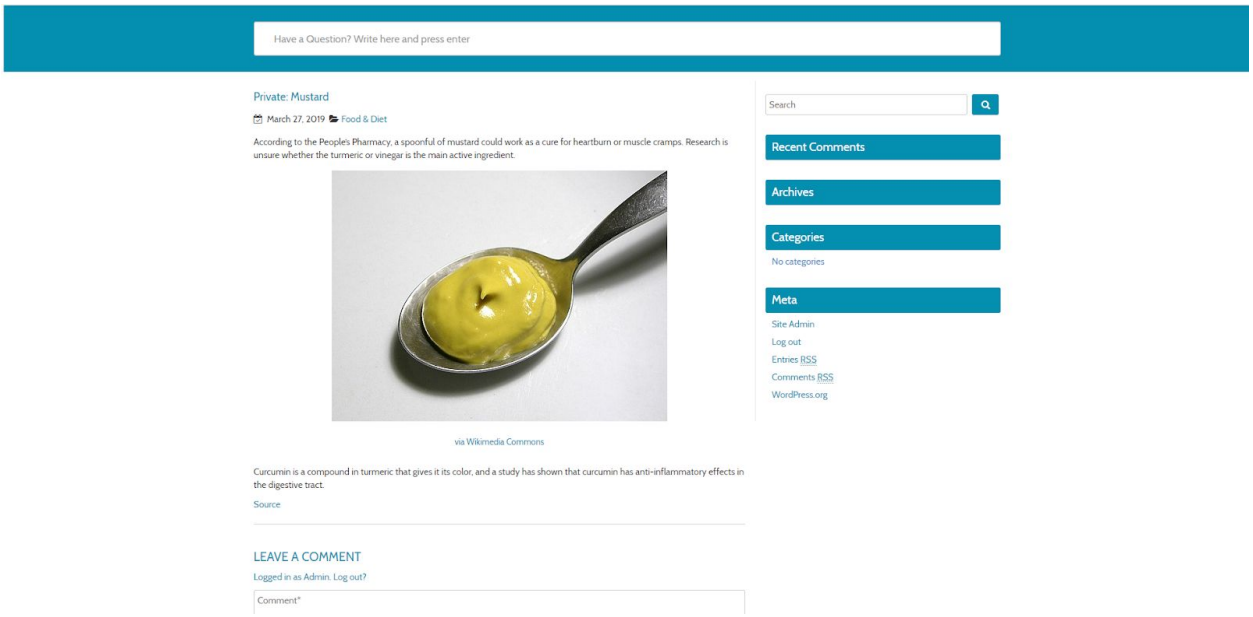

Fig. 4.2 - Example article

Each individual article page is laid out as seen in figure 2 above. Each article page, along with providing the relevant information and related images, also allows logged in users to comment, and will allow for upvoting and downvoting articles. The search bar will also remain visible on all pages, regardless of if it's a menu, or an article page. This will allow for easy navigation between different pages.

There is also a category specifically for holding references to research on the topics present in the main articles. These will be sorted by topic in a large list, as well as linked from each page that draws from the particular source. This is a feature mainly geared towards medical professionals who wish to use the website, but may also be of interest to laypeople who want more details on any one subject.

5. Implementation

The server for our website is hosted on a Virtual Machine running Centos 7. Since the VM is hosted from Virginia Tech, an IP address on campus is required to access the machine. Using a VM allowed us greater levels of customization with what we needed to support our website. The website has a secure HTTPS connection verified by Let's Encrypt, a free and open standard global certificate authority. In addition, a systemd timer has been set up on the VM to take care of automatic renewal of the certificate. The use of HTTPS is required by our front end implementation, Wordpress.org, and provides security to the end user.

The backend of our website is managed with a MySQL database, which we access using PHPMyAdmin. At the moment, the database is purely used to automatically organize all the posts, pages, and content on our WordPress site, and we do not manually add to it.

The frontend of our website is Wordpress.org with the MyWiki theme. We chose this theme because it scaled well for use on mobile devices, as well as having a pre-made home page that looked like a wiki page. We have implemented pages for our sources, an about page, a terms and conditions page, and a privacy policy page.

The posts on the website are organized in two ways. One, is under WordPress's categories, which are visible on the front page and are drawn from our client's paper on indigenous healthcare. Each post of a particular remedy then is tagged with different symptoms it can help, allowing users to sort by symptom to find a variety of remedies they can try.

6. Testing, Evaluation, and Assessment

After implementing the main features of the application, testing was the next important step to ensure the usability of this website. The main groups that need to be able to test the different features are the laypeople who will be using the site to access information, and the professionals who will be uploading their remedies and information to the site.

In order to get feedback on the structure of the website, we came up with a list of goals to have our testers perform, then after each one, discussed any issues with the website relating to said task. Other, general suggestions were taken as well. The tasks were as follows:

- Create a new account
- Submit a new post
- Leave a comment on a post
- Search for a specific post
- View any reference document

Testing for administrative functions was not part of the protocol, since those are built into WordPress, and their functionality cannot be altered. It was important to ensure all these functions work well, and are intuitive to users. Being able to open the website and navigate it without difficulty is an important part of the experience.

The first round of testing produced several suggestion for changes to the site, but most of these suggestion were purely aesthetic rather than any meaningful alterations to the workflow of the tasks themselves, and the ones that we determine to be the most worthwhile and least costly changes will be implemented in the future.

Another possible assessment to look at in the future is some sort of training module to teach new moderators and administrators how to moderate posts and comments. As the site grows, more and more posts will be submitted, and it needs to be easy to learn how to undertake these tasks. While this is not urgent yet, it is something that will need to be addressed, and tested when the time comes.

7. User Manual

This website will be used by three distinct groups of people. Healthcare professionals and those with a background in indigenous medicine are able to create an account and write posts containing information about remedies or related articles; laypeople will be able to search by symptom, remedy, or category; as well as view articles by category, read the posted information, and leave ratings or comments; and moderators will be able to approve or reject posts, and take care of site maintenance.

To access the homepage, navigate to health.cs.vt.edu/

7.1 Homepage and Navigation

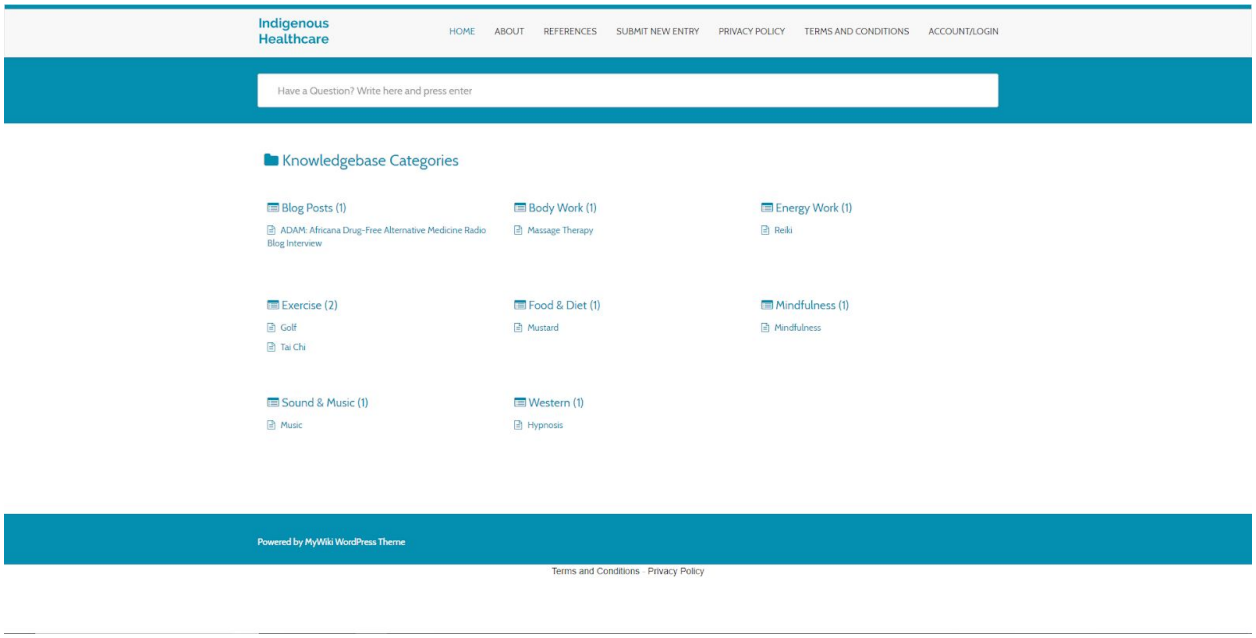

Fig 7.1 - Homepage

From the homepage, several options are immediately available. The links along the top of the page perform the following functions:

- About: Links to a page with basic information about the site.
- References: Links to a page containing a separate directory of categories, each of which contains a list of related articles and studies on the topic in question.

- Submit New Post: Links to a page allowing logged in users to write a post and submit it for approval.

- Privacy Policy: Links to a page showing the site's privacy policy

- Terms and Conditions: Links to a page containing a legal disclaimer for the website

- Account/Login: Links to a different page depending on the status of the current user, that will allow said user to either log in, or view and edit their account information.

To view a specific post, the post title may be clicked on directly from the homepage, or the category title may be clicked on to bring the user to an intermediate page that shows every post published under the category in question (see fig 7.2). Older posts that may not show up on the homepage will show up here.

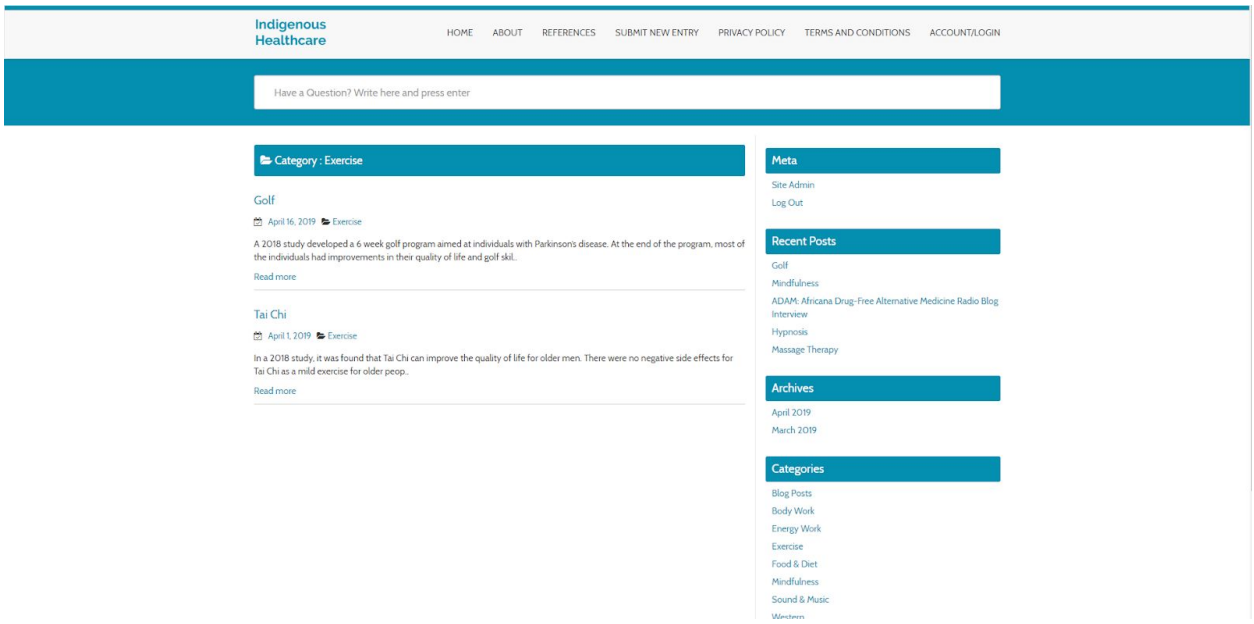

Fig. 7.2 - The exercise category

There is also a search bar available from the homepage, as well as every other page. This bar allows for searching by topic and will gather pages that feature the searched topic. This allows for a search by either symptom or remedy. Searching for a topic yields a result page in the form of figure 7.3.

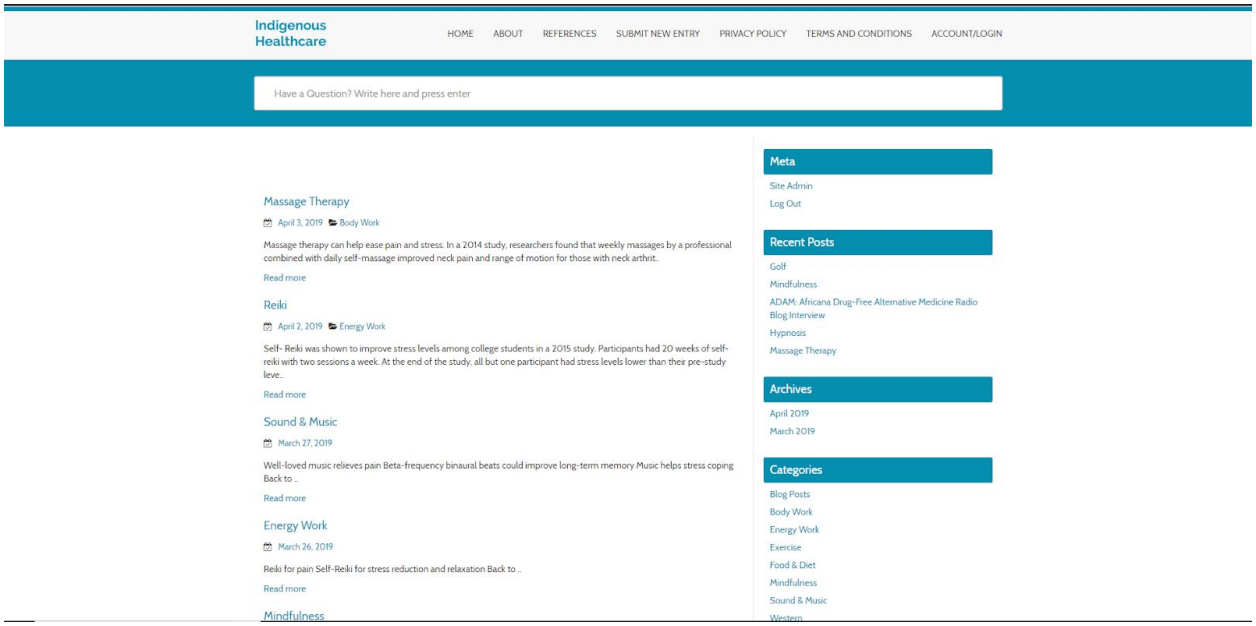

Fig. 7.3 - The results after a search for the term “Stress.”

7.2 Account Management

From the homepage, Click on Account/Login to begin. If you are not currently logged in, you will be taken to the login screen (see fig. 7.4)

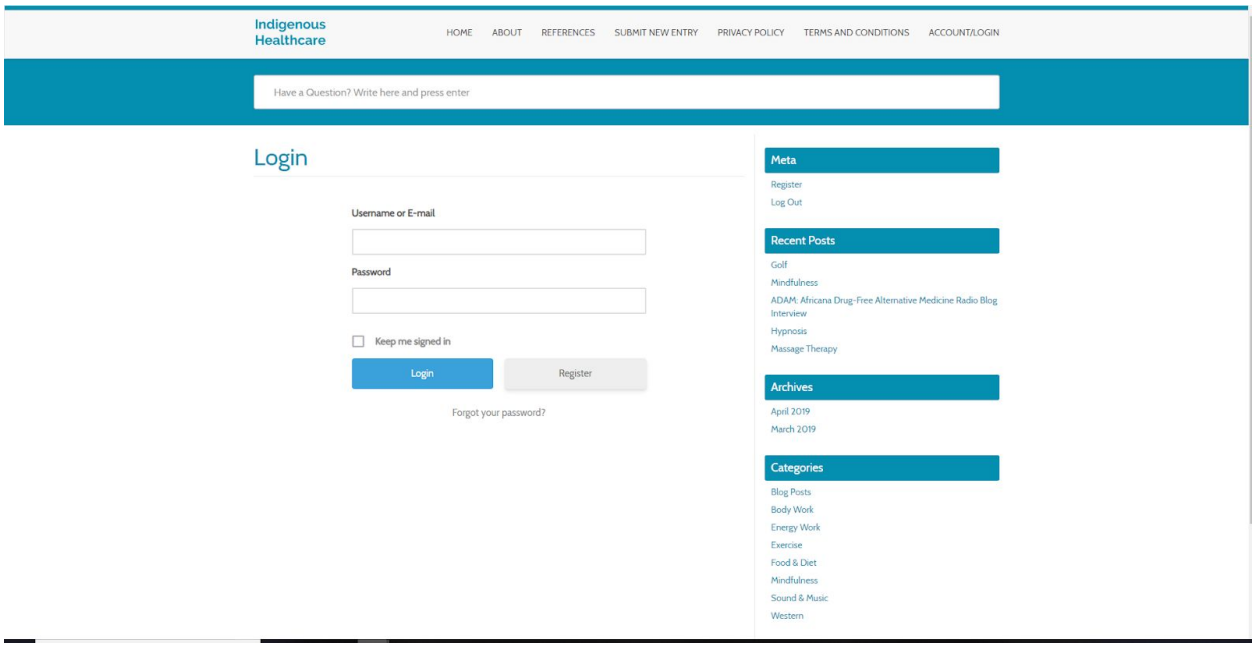

Fig. 7.4 - Login Screen

If the current user has an account, they may login here, otherwise they may register by clicking the Register link, either below the login fields, or on the left sidebar, under the Meta section. Upon clicking Register to create an account, the page shown in figure 7.5 will be shown:

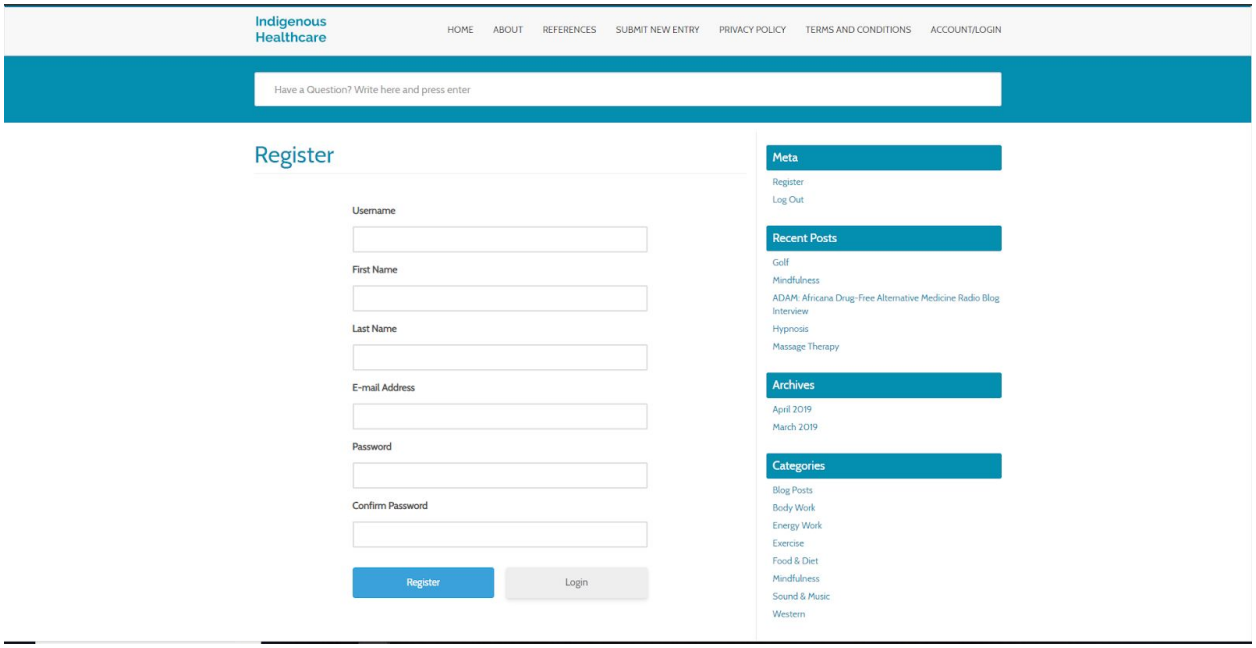

Fig. 7.5 - Registration Screen

To create an account, simply fill out all the fields, then click Register. Clicking the Login button on the bottom of the screen will bring the user back to the login page (figure 7.4). Registering automatically logs in the new user

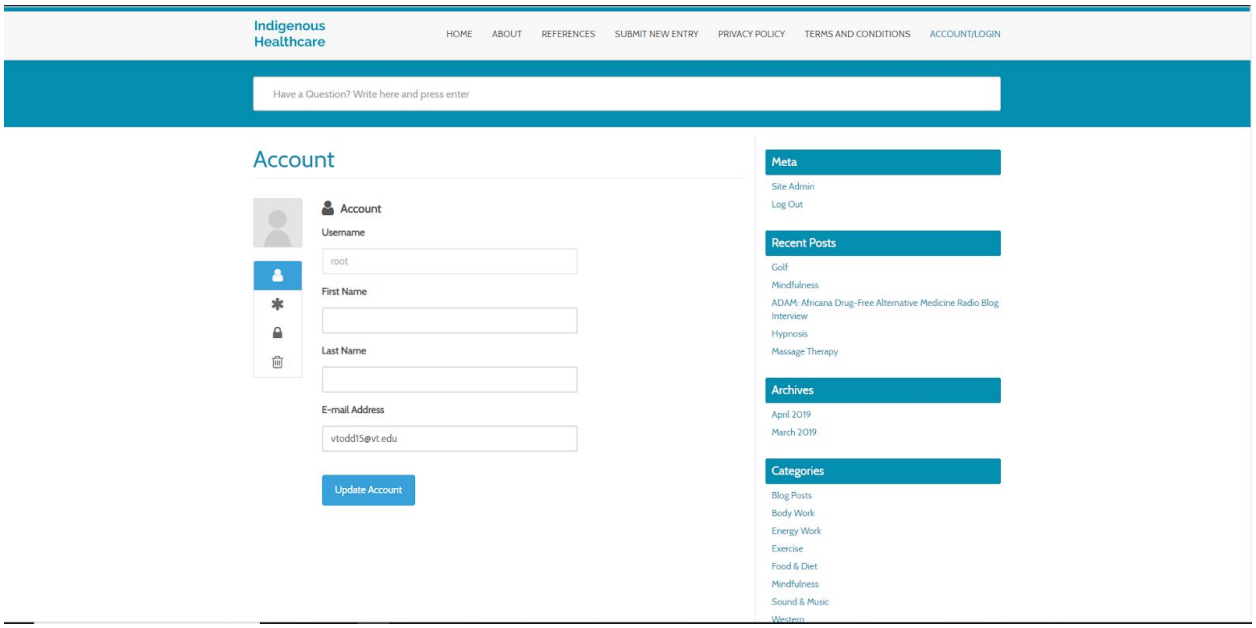

Fig. 7.6 - Account Screen

Upon registering, logging in, or clicking “Account/Login” while logged in, users are brought to the page shown above (figure 7.6) where they can update their personal information, or using the links on the sidebar, change their password or delete their account. Click on the * button to see the form to change password, or the trashcan icon to see the form to delete your account.

To logout, simply click the Log Out link on the meta menu in the right sidebar. This will also redirect users back to the homepage.

7.3 Writing A New Post

Clicking on Submit New Post brings the user to one of two pages. If this user is not logged in, they will be redirected to a page directing them to log in. If they are logged in, they will be brought to a page where they can create a post (figure 7.7).

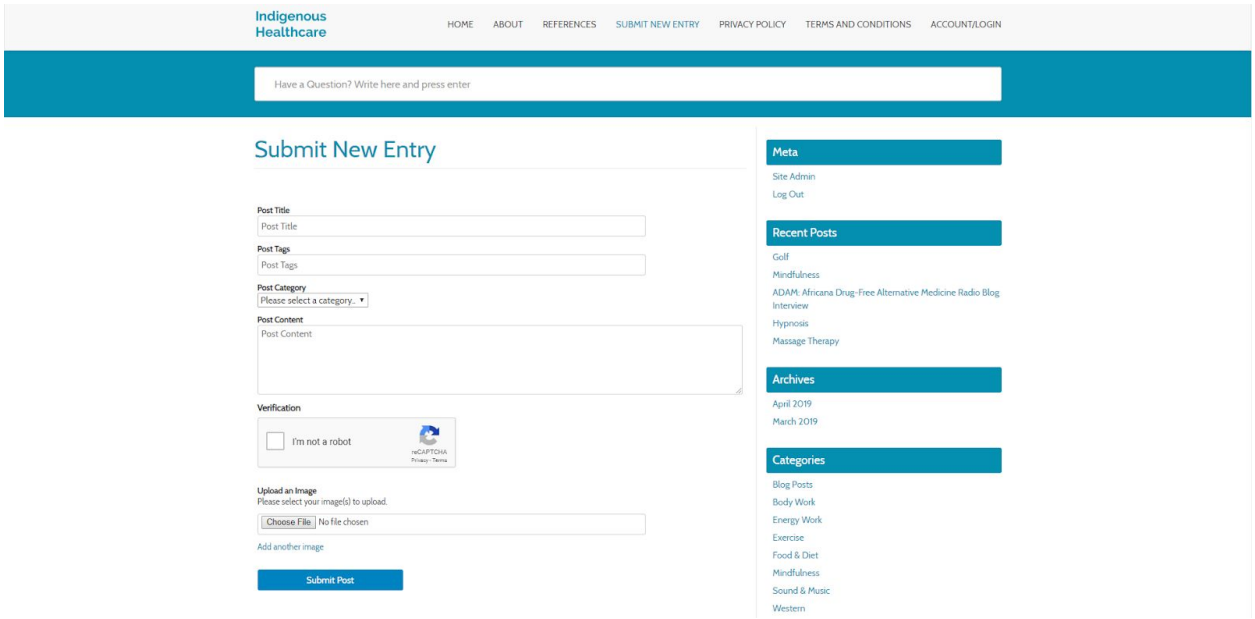

Fig. 7.7 - Submit a new entry

Fill out all the provided fields, then click “Submit Post” to submit the post. Uploading an image is not required. Any urls placed into the post content will be converted to clickable links. Upon clicking Submit Post, the post will be sent for approval. Once it has been approved by an administrator or moderator, the post will show up on the homepage (figure 7.1), and will be viewable. See figure 7.8 for a sample page.

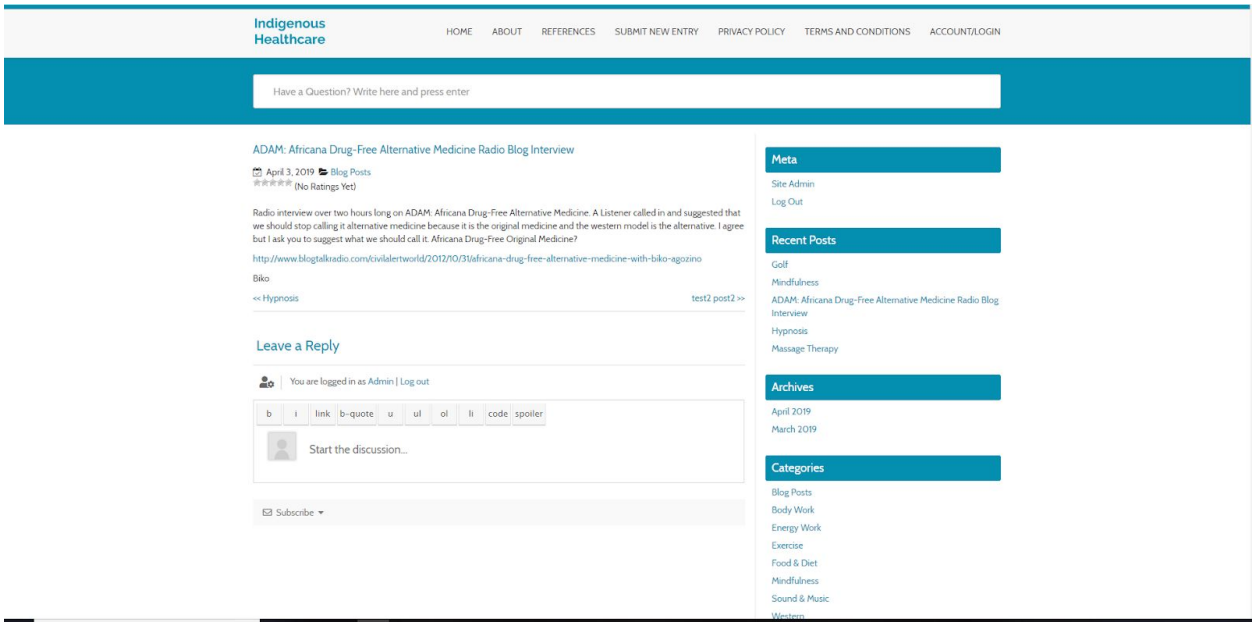

Fig. 7.8 - An approved blog post

7.4 Rating and Commenting

Rating Posts

At the top of each written post (figure 7.8) there is a small section allowing for users to rate the page from 1 to 5 stars. Anybody can do this, logged in or not. The star ratings are averaged together to give an overall rating of the page. See figure 7.9 for a closer view.

Fig. 7.9 - The rating system

Commenting on Posts

At the bottom of each written post (figure 7.8), there is a comment box available to any user, logged in or not. See figure 7.10 for a detailed view of this area. If the user is logged in, their account information is used to determine author, otherwise they must fill their name and email to post as a guest. Comments made by unrecognized email addresses must be approved before they will appear; then subsequent comments will automatically show up.

Underneath the comment box is an option to subscribe, simply adding your email address will cause notifications to be sent for new comments on the post.

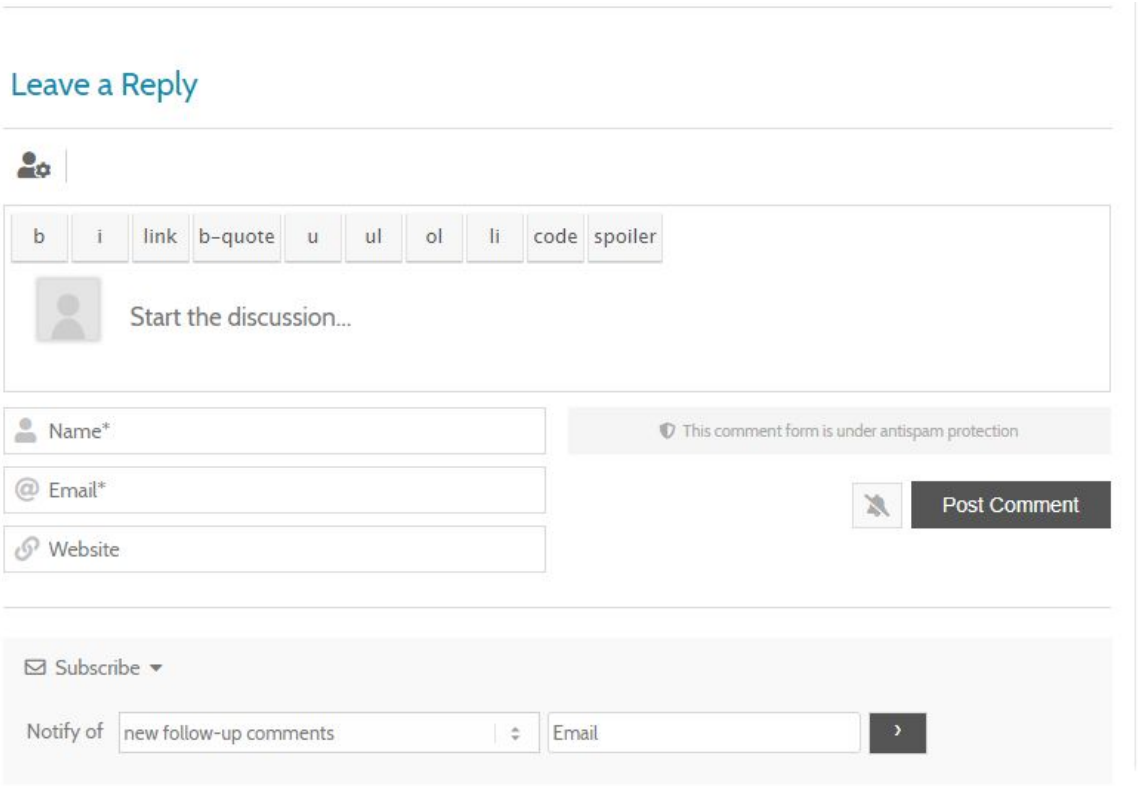

Fig. 7.10 - The comment box, seen as a guest

Once a comment has been made, it will show up underneath the box where they can be posted. See figure 7.11 for an example of this. Using the formatting tools in the comment box, text can be made bold, italicized, can include clickable links, or spoiler tags to cover up certain information should the need arise.

Every posted comment may be replied to by clicking Reply underneath. Just to the left, is an upvote/downvote system, where users may either approve or disapprove of the comment. To the right of the Reply button is an option to edit the comment. The final two options only appear to an administrator; Stick will allow the admin to set the comment as sticky so it remains at the top of the discussion, while Close will prevent further replies to said comment.

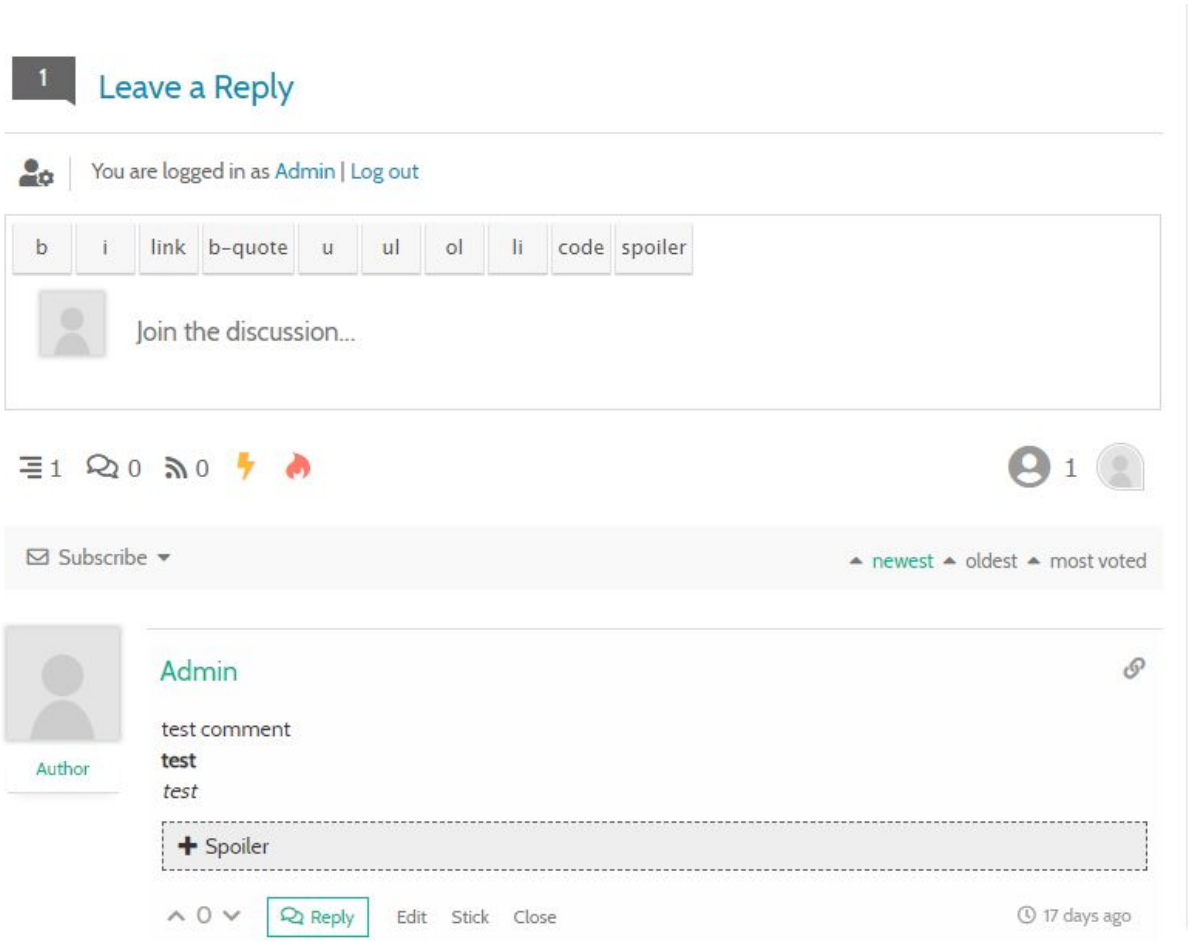

Fig. 7.11 - A posted comment with formatting and controls

7.5 References and Sources

Clicking the References tab will bring the user to a page that hosts a list of the major categories (figure 7.12). Upon choosing one of these categories, a list of links to scholarly articles and research on the topic in question will be shown (figure 7.13). Selecting one of these will open the article in question. At the bottom of the list is a link to go back to the list showing the categories.

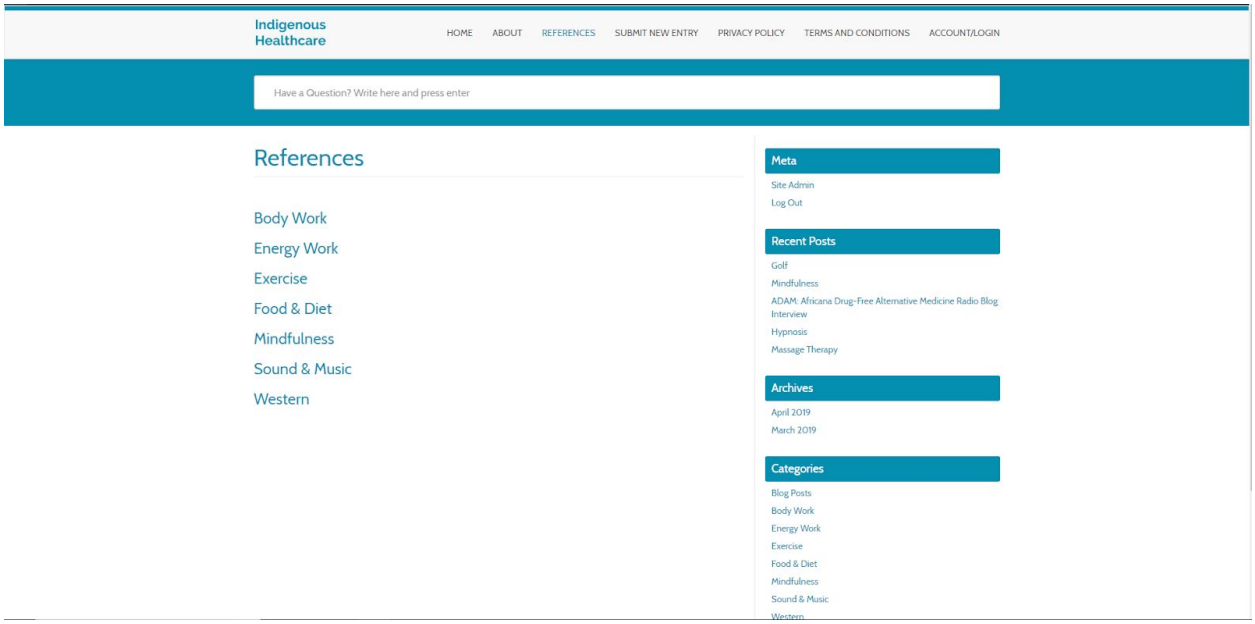

Fig. 7.12 - View displaying the various categories of research

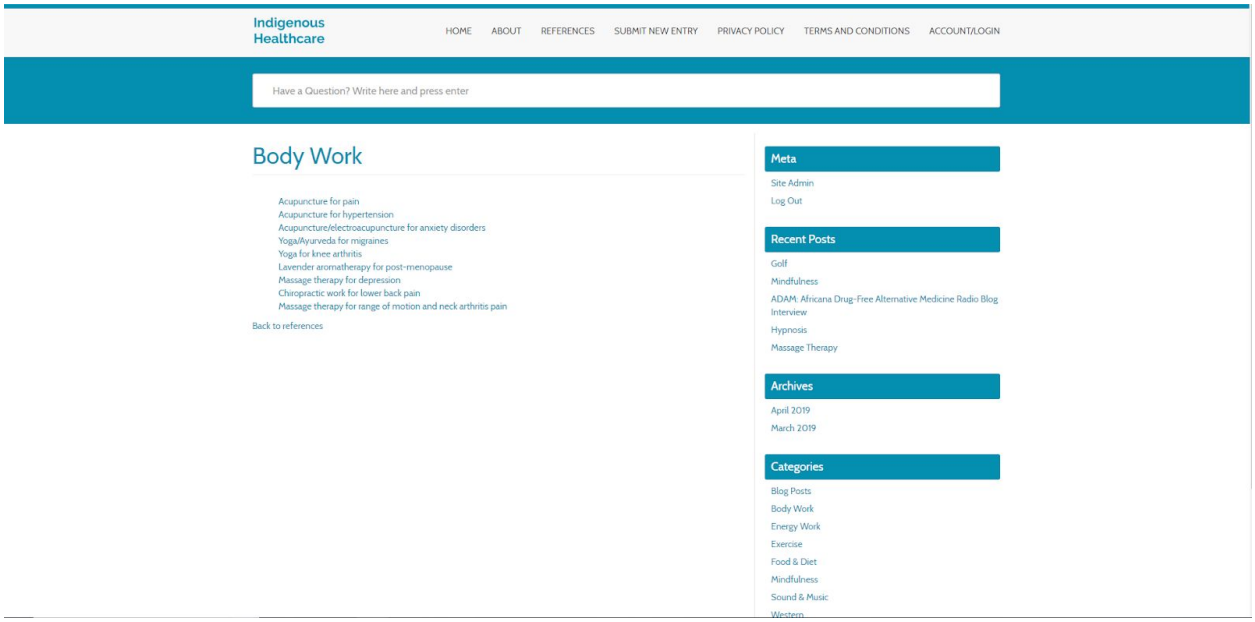

Fig. 7.13 - View displaying the articles provided under one of these categories

7.6 Administrator Controls

To access administrator controls, first login to the site using an account with admin permissions. After this, on the right sidebar under the Meta tab, there is a link that says Site Admin. This will take the user to the administrator dashboard (figure 7.14).

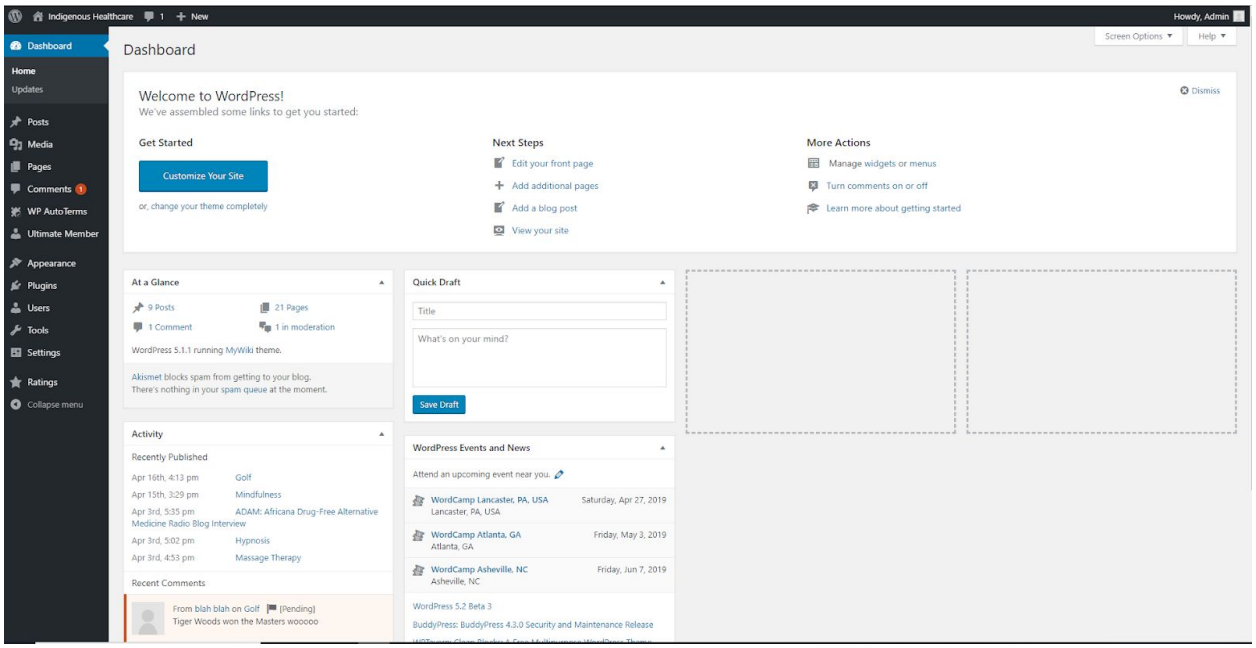

Figure 7.14 - Administrator Dashboard

There are many available developer options from this page; those will be explained in detail in section 8, Developer Manual. For an administrator, the most important functionality is approving, moderating, and if necessary, deleting posts Instructions for these tasks can be found in section 8.6, Approving Posts and Comments.

8. Developer Manual

8.1 Server Information

The website is hosted on a server managed by Techstaff at Virginia Tech. The virtual machine has 2 cores, 8GB of RAM, 500 GB of disk space, and is running Centos 7. Apache, PHP, MySQL, phpMyAdmin, and WordPress installed. As it is hosted from Virginia Tech, an IP address from VT's campus is required to log onto the virtual machine. This can be accomplished by using Pulse Secure VPN when off campus. The server was created with a lifespan of 1 year as of 3/6/19; and so future developers should take note to renew the server before it expires.

The source code can be accessed by an SSH client at health.cs.vt.edu, and edited by accessing the system as Root. From here, navigate to the directory "/var/www/html/wp-content." Included here is all of the code powering the website, including all installed plugins. Any lower level modifications that cannot be resolved within the WordPress plugin manager can be made here, by editing the files directly. The WordPress database can be accessed at health.cs.vt.edu/phpmyadmin.

8.2 WordPress Dependencies

Prior to installing WordPress, we were required to install a number of other programs in order to support the WordPress installation. These programs don't need to be managed by the developer, so they will only be explained in brief here. The Apache Server is an open source HTTP server that should be restarted when changes are made to the MySQL Database but can otherwise be left alone. phpMyAdmin and MySQL go hand in hand, and were used to create a database for the posts and pages on the WordPress site. They do not need to be updated manually, but can be restarted if there are errors with the database.

Due to the unique circumstances of requiring a Virginia Tech IP address to access the server, WordPress requires the use of direct file I/O requests from within PHP (listed as 'FS_METHOD' 'direct' in the wp-config file) for updating files on the server. Since this is a more vulnerable access method, it should only be used when updating WordPress or the installed plugins.

8.3 Let's Encrypt & Certbot

Let's Encrypt is a free, automated, and open certificate authority allowing us to offer a secure HTTPS connection for our end users. On the back end, Certbot was set

up to install the initial certificate, and a systemd timer was created in order to automatically renew the certificate, since Let's Encrypt's certificates have a short life of 90 days. Further management of the certificate should not be needed, but a link to Certbot's documentation has been included in the appendix just in case.

8.4 Logging In and the Dashboard

The admin can log in either through WordPress's default login page (https://health.cs.vt.edu/wp-login.php) or through clicking the Account/Login tab at the top of the home page.

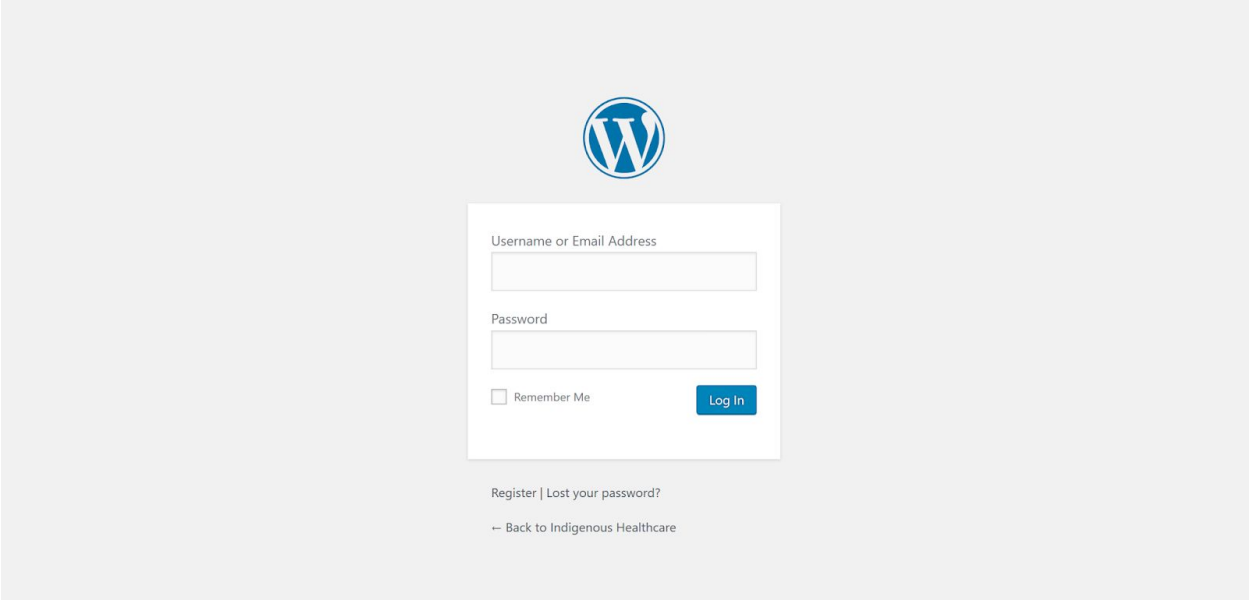

Fig 8.1 - The default WordPress login page

Once the admin is logged in, the admin dashboard can be accessed at https://health.cs.vt.edu/wp-admin/ .

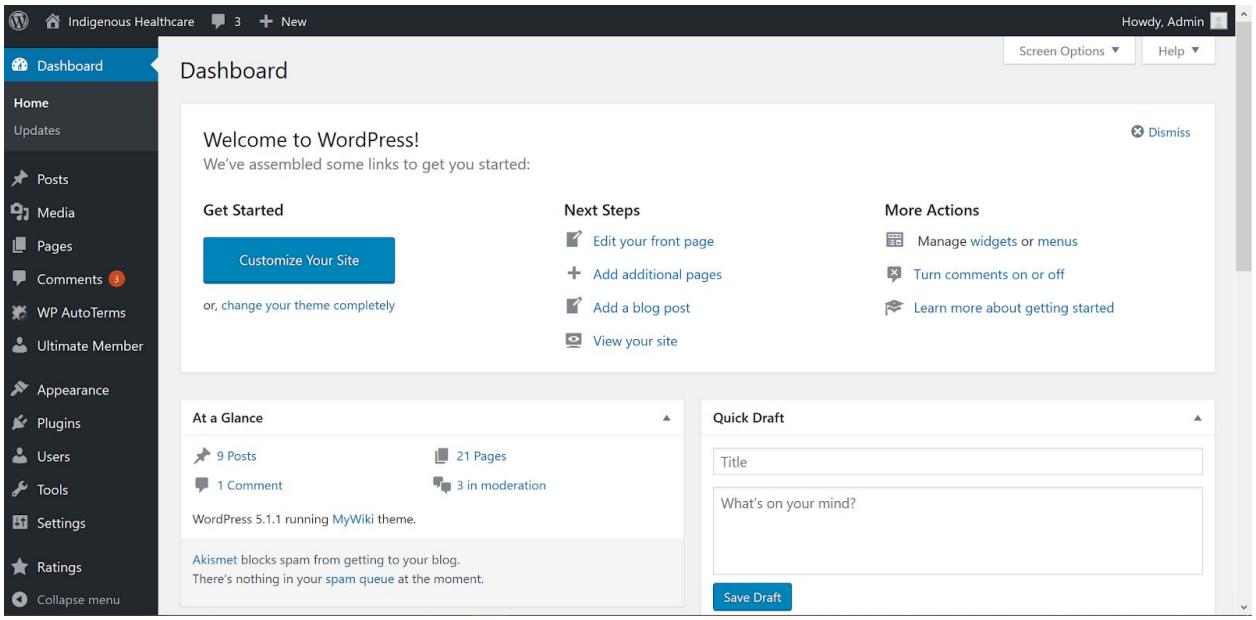

Fig 8.2 - Admin dashboard

Here, the main parts to focus on are the Posts and Pages options on the left sidebar, which will be discussed in the next section. WP AutoTerms, Ultimate Member, and Ratings are installed plugins which have their own section below. Appearance is simply for changing the look of the website, and Tools is for exporting/importing settings to the site. Comments and Users will also be discussed in their own sections

8.5 Posts and Pages

Fig 8.3 - Posts dashboard

New posts can be added from the Posts dashboard, which shows all the current posts with their tags, categories, ratings, and comments (both pending and allowed). Categories are intended for the general type of remedy in the post, while tags relate to symptoms that the remedy has been tested on. Blog Posts is a special category where posts relating to complementary health in general can be made (as opposed to specific remedies), and so tags for these posts are used in a typical way to describe the post.

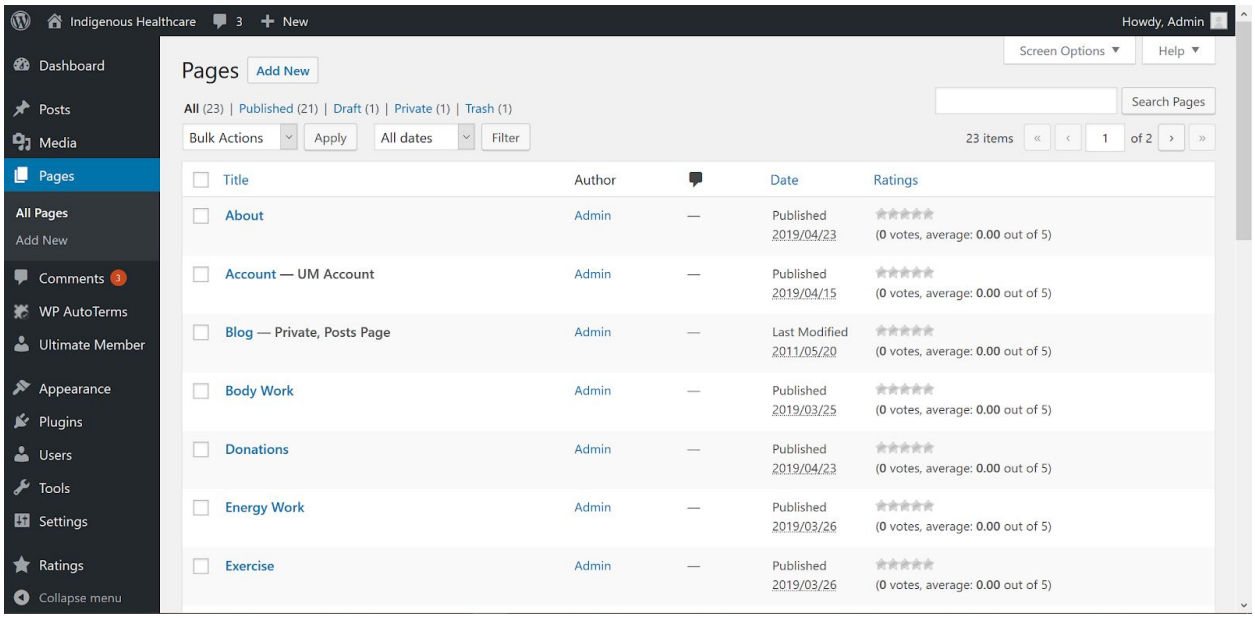

Fig 8.4 - Pages dashboard

While posts are used for individual remedies, pages are used to hold references for the posts and other administrative tasks (such as an about page, and a terms and conditions page). The pages titled with one of the main post categories (Energy Work and Exercise) are lists of references, as seen in Fig 8.5. The other pages are self explanatory. New pages can be added as well, although since they can't be categorized or tagged it is a less organized way of adding new content, and should really only be used to static pages visible across the blog or plugin related content.

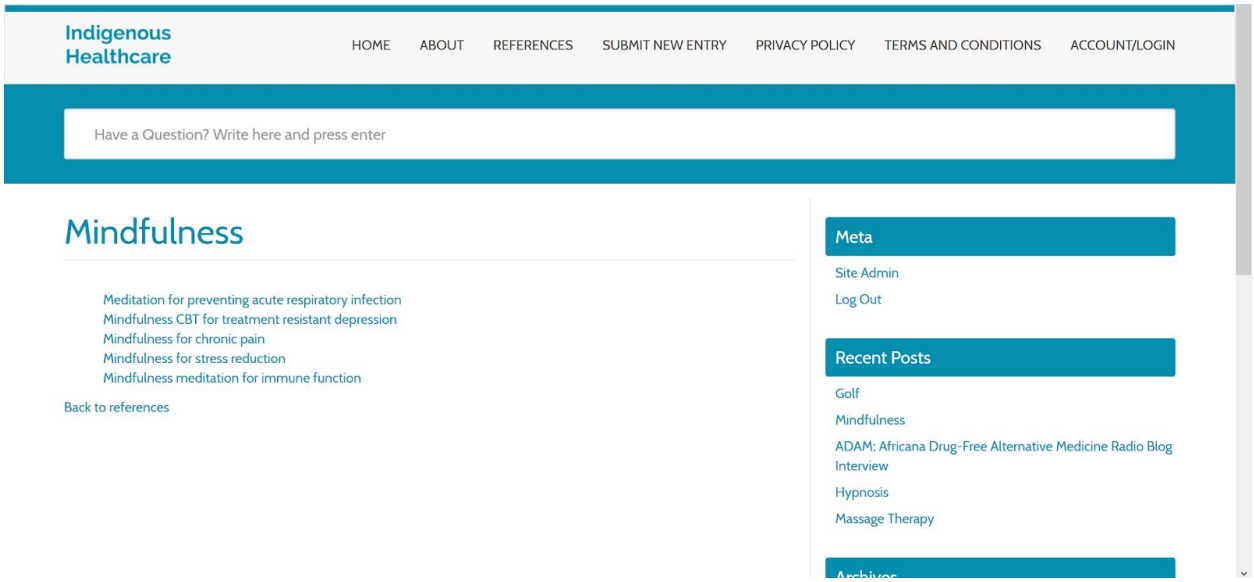

Fig 8.5 - Mindfulness Reference Page

8.6 Approving Posts and Comments

When a post is submitted by a user, it appears in the dashboard as a pending post.

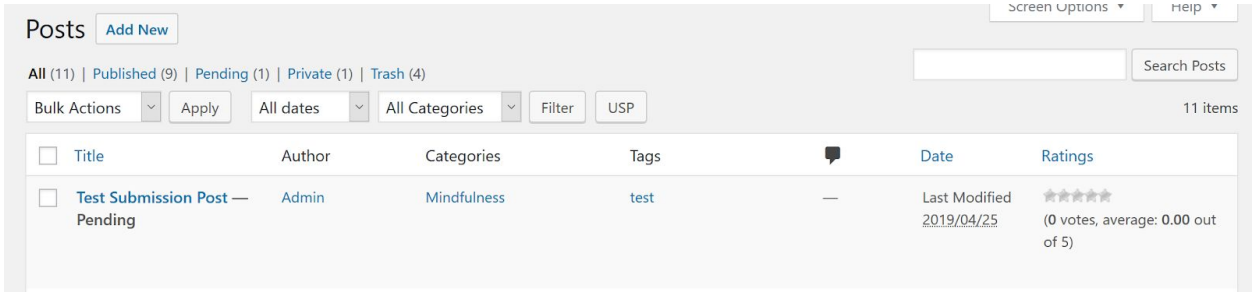

Fig 8.6 - Pending submitted post

Pending posts can be viewed and edited before they are published. Note that a submitted post also keeps track of who submitted it.

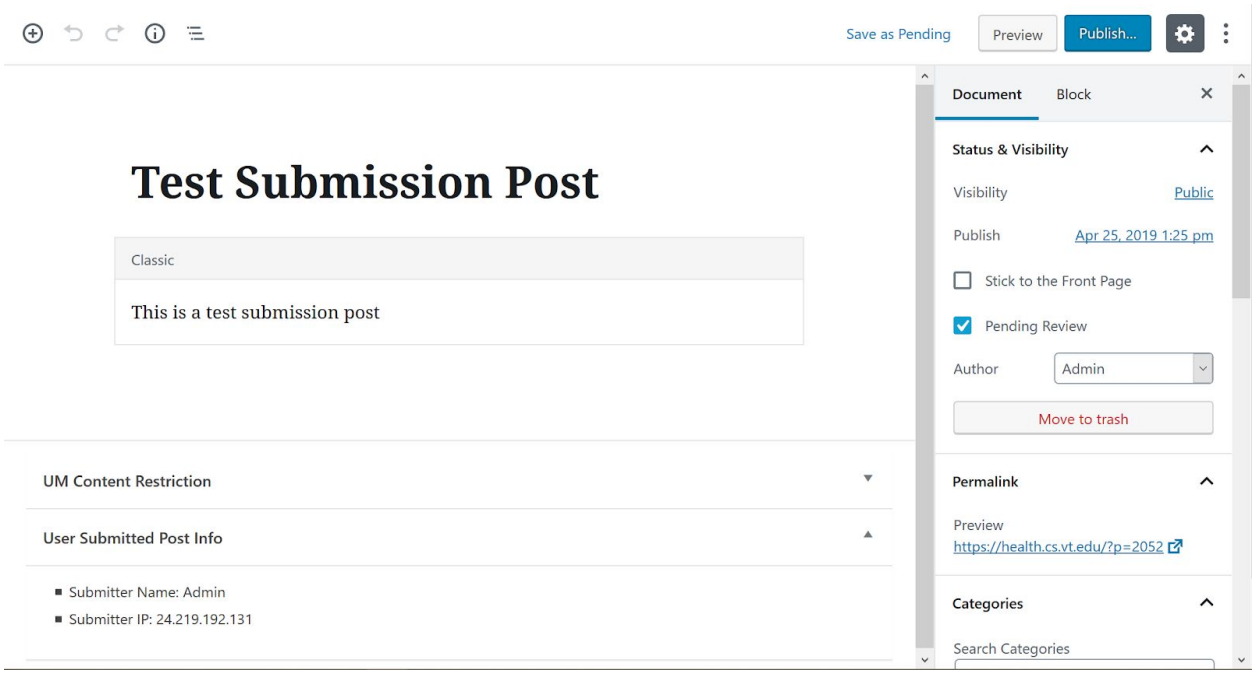

Fig 8.7 - Editing a submitted post

Comments can be viewed, edited, and approved in a similar way. One of our plugins,
Akismet Anti-Spam, filters out comments that are highly likely to be bots, allowing for less moderation on behalf of the admins.

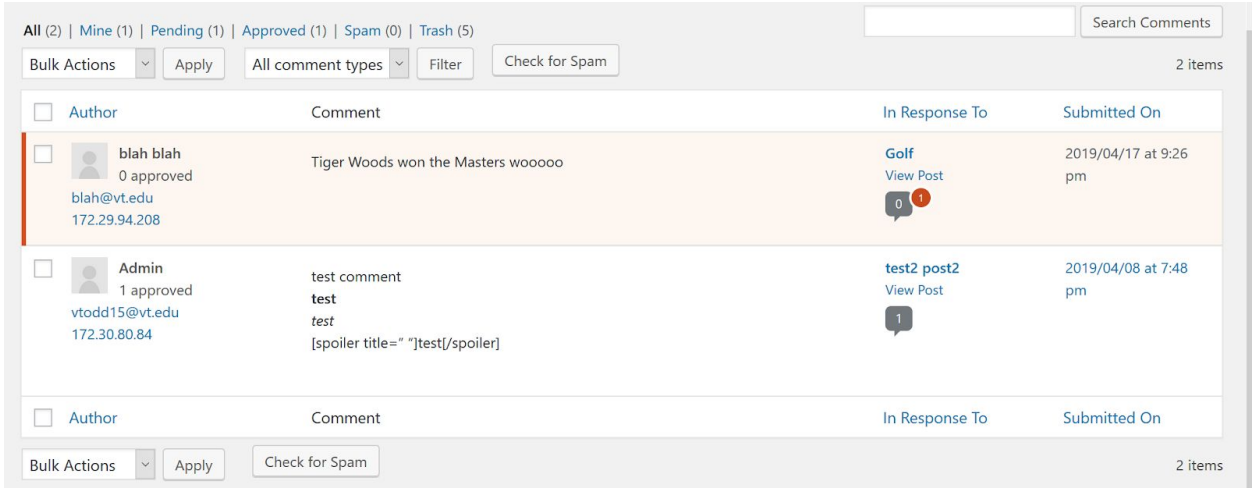

Fig 8.8 - Comments dashboard, showing one approved and one yet to be approved comment

8.7 Plugins

WordPress's basic functions are extensible through plugins. Following is a brief overview of the plugins we utilized, along with how to add more plugins

8.7.1 Site Appearance

Two of our plugins correspond to site appearance: WP-PostRatings and Custom Meta Widget. PostRatings allows us to display a rating out of 5 stars at the top of each post, which users and guests can use to rate the post. Ratings can be viewed from the Ratings dashboard

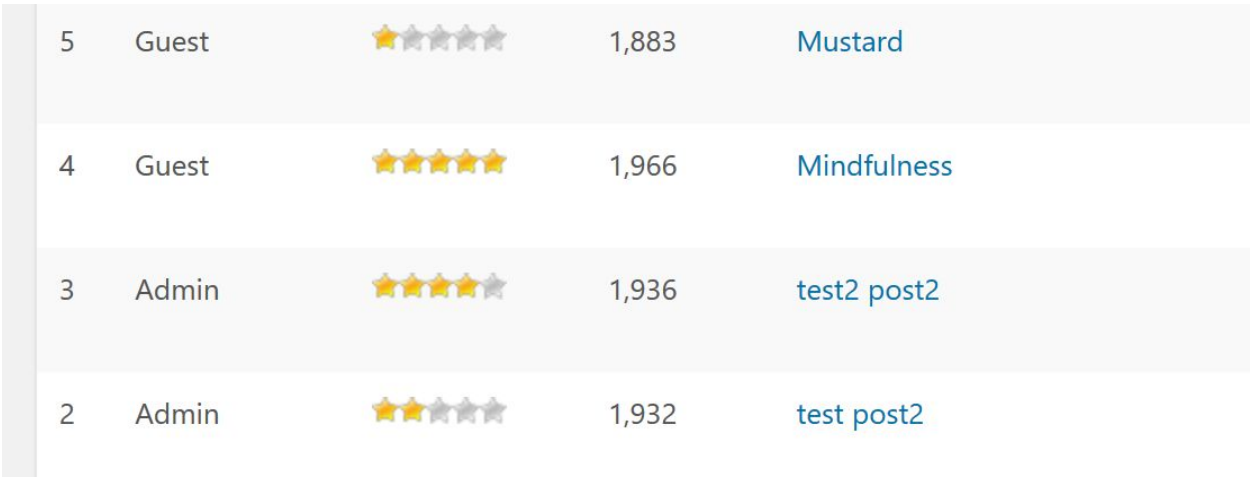

Fig 8.9 - Section of the Ratings Dashboard

The custom meta widget is simply used to remove some of the links that the default meta widget comes with, like RSS feeds and a link to WordPress. We also have a custom link to log out, which takes the user back to the homepage unlike the default WordPress log out that takes users back to the WordPress default login page.

8.7.2 User Experience

In terms of user experience, we have a few plugins related to that. Ultimate Member provides many customization options for giving users roles, designing user profiles, and creating member directories. We are primarily using it for its custom user registration and login page features, since the default WordPress login screen is plain. Future developers may wish to use more of Ultimate Member's features, and so the documentation is included in the references of this paper.

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User Submitted Posts does exactly what the title says. There shouldn't be much maintenance involved with this plugin aside from approving or rejecting the posts that come in. The last plugin related to user experience is wpDiscuz. This allows for greater customization of the comments section without requiring us to use an external source like Facebook comments or Disqus. On the user's end, it allows for sorting comments based on date, and multi-level comment threads

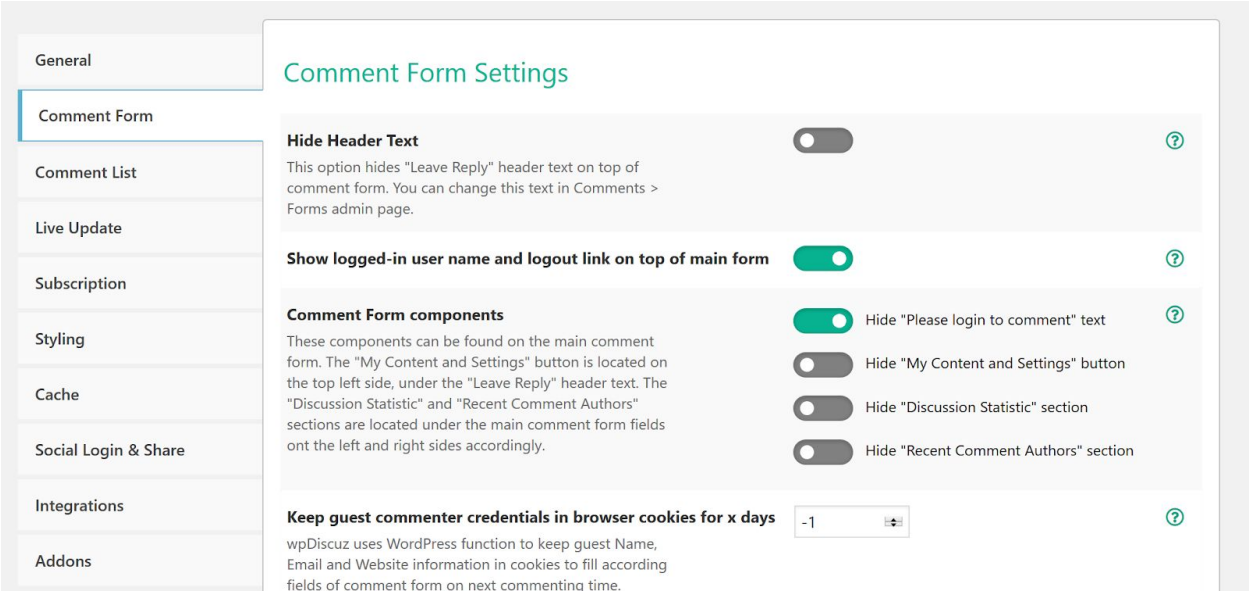

Fig 8.10 - Screenshot of part of the wpDiscuz settings page

8.7.3 Administrative functionality

Next, a few plugins to deal with functions on the admin side. WP AutoTerms is a plugin to automatically generate and manage legal pages like a terms of service or a privacy policy. Future developers can edit these pages through the WP AutoTerms dashboard, and they will be updated on their respective pages with a new date automatically.

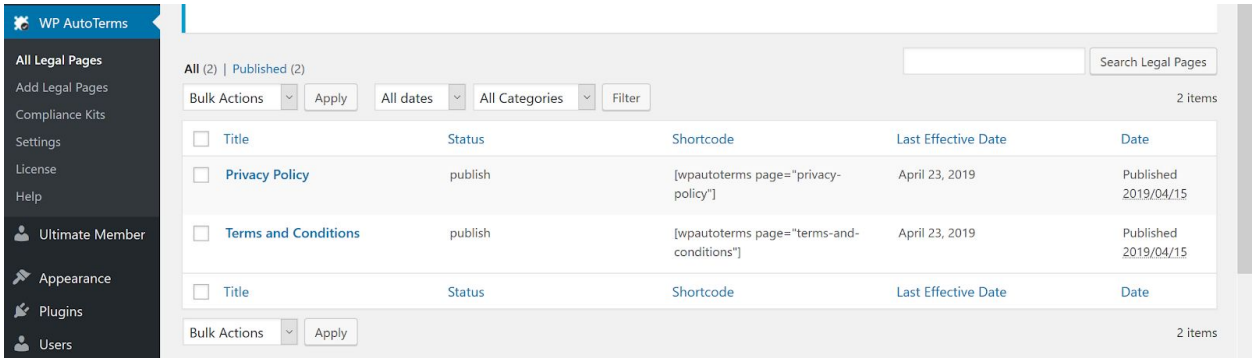

Fig 8.11 - The WP AutoTerms dashboard

The Akismet Anti-Spam plugin was installed to filter out obvious spam comments before they are sent to the moderators. Currently the website is using a basic plan, which is free, but if it gets popular enough future developers should look into upgrading to one of the higher tiers.

8.7.7 Other Plugins

Lastly, there are a few other plugins on the blog that are not being used at this time, but may be helpful to future developers. Customizer Import/Export, Widget Importer and Exporter, and WordPress Importer were all plugins used at the very beginning to test out the theme by importing dummy data. If a future developer decides to move the blog's hosting elsewhere, the importer/exporter plugins can be used to move the data over to the new location. The SSH SFTP Updater Support plugin was downloaded to attempt to allow WordPress to update itself without using the direct method of file sharing, but unfortunately it didn't work. Still, if the hosting was changed then this plugin could be used for a SSH connection.

8.7.8 Adding Plugins

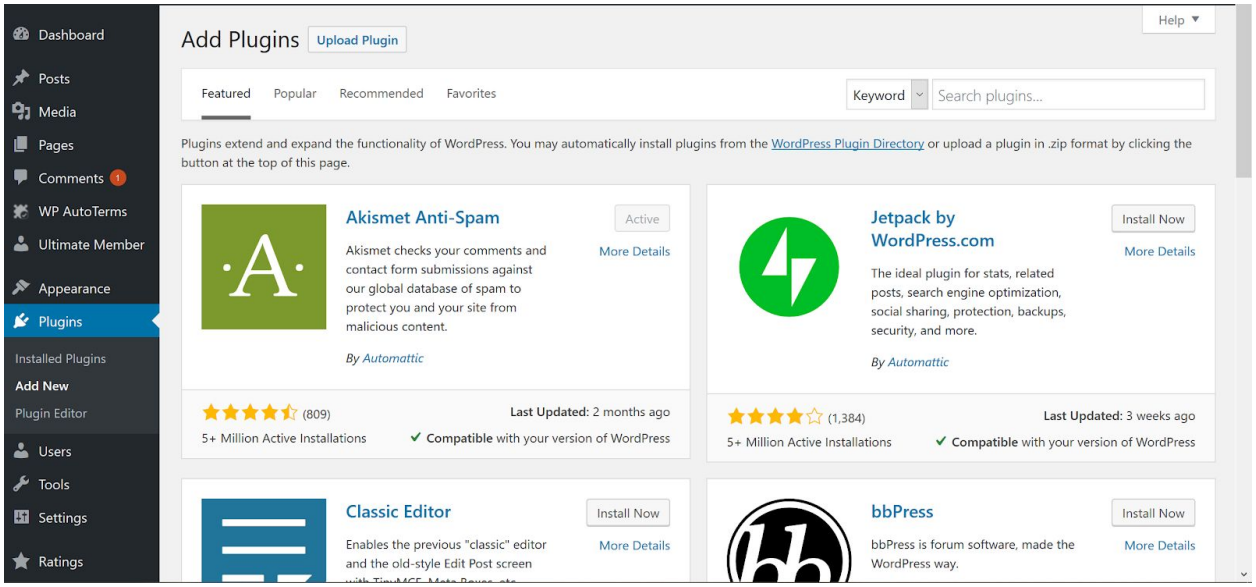

Fig 8.12 - Plugins database

Adding new plugins to WordPress is simple. Under the plugins menu, WordPress has listed all the plugins that are part of the plugin directory. Plugins that a developer wants to add that aren't part of the directory can do so by uploading a zip file to WordPress through this page, under the "Upload Plugin" button. Care should be taken that new plugins don't conflict with old plugins.

9. Lessons Learned

9.1 Setting up the Site

On setting up the server, originally our team wasn't sure what we would use to host the website. Research into previous website projects showed that people either coded their own site from scratch, or used WordPress. Since our team was small, we opted for using WordPress to have basic functionality quickly. However, the version of WordPress we decided on required for us to provide our own hosting, and so following in the footsteps of previous projects, we requested help from VT4Help in order to set up a server. The reply from 4Help was that they didn't have the resources to give web space to class projects. With the rejection from 4Help, we had to search for an alternate hosting source that would be sustainable, and so our professor, Dr. Fox, set up a virtual machine for us to use to host the site. The downside of this was that we had to set up all the programs and material we needed ourselves, including HTTPS encryption. Luckily, we did get the server up over Spring Break which allowed us to move into developing the site.

9.2 Vetting sources

Neither of our team members are majoring in medicine, so filtering out dangerous remedies was a concern from early on. We attempted to tackle this problem by doing our initial research from trusted sites like PubMed, and planning to use that research to fact check any submitted posts we receive. We also collected contact information for a variety of people around Virginia Tech who would be willing to help us in vetting posts.

9.3 Legal Concerns

Understandably, classmates were concerned about the legal consequences of our project. If someone used a remedy listed in our database and had complications because of it, would we be liable? We discussed this matter with the Student Legal Council at VT and were told that we should focus on branding our site as for informational purposes only, and not actual medical advice. We also added a Terms and Conditions and Privacy Policy page to our site to be compliant with legal requirements.

10. Future Plans

Now that the base model for the website is up and completed, the main component of ongoing future work will involve continuing to monitor new entries as they come in, and moderating comments to ensure nothing gets out of hand. In addition to this, there is potential for the website to be made available in other languages, as well as transformed into a mobile app that is optimized for the phone, rather than just compatible. The framework of the website may be extended in the future too, to include more categories, or otherwise change the structure as needed.

As mentioned in the testing section, growth of this website is expected, therefore there will need to be many more people willing to moderate in order to keep the community running smoothly. A possible future change is to separate the moderation controls from the developer controls, so that only those who are authorized to actually change the site itself are able to access the controls to do it. It would also provide a less immediately overwhelming UI for future moderators.

11. Acknowledgements

We would like to acknowledge our client, Dr. Onwubiko Agozino, and our professor, Dr. Fox.

12. References

[1] WordPress. Developer Documentation. Retrieved from https://codex.wordpress.org/Developer_Documentation/.

[2] Onwubiko Agozino. 2006. *Africana Drug-Free Alternative Medicine.* Iva Valley Media, Cheyney, PA.

13. Appendix

Certbot Documentation: https://certbot.eff.org/docs/

Ultimate Member Documentation: https://docs.ultimatemember.com/

PubMed Medical Literature Database: https://www.ncbi.nlm.nih.gov/pubmed