Patient Empowerment for Chronic Diseases System

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INTRODUCTION

We will utilize Semantic Web technologies to automate access and update the patient on latest research, i.e. from completed and ongoing clinical trials, AHRQ summaries, Medline, etc. The patient will be creating his or her profile over 30 or 40 dimensions, such as height, weight, ethnicity, gender, blood chemistry, medication, allergies, disease condition, socioeconomic status, and state residency. Our tool will automatically dispatch web crawler and make web service calls that will search on the web and medical database to find the latest research. Our tool then will synthesize the information, make it customer-specific, and present the information to the patient in an easy to understand format. Our initial goal is to limit to the Medline database. Later, it will be extended to other medical databases.

To access such resources and align data from such resources, we will have to develop a semantic web infrastructure. This will require us to develop ontology and to set up rules for translation from these databases to our Semantic web database. The results will be displayed to the patient, as RSS (Really Simple Syndication) feeds.

There are two ways such a system can be setup: (1) through a website. The patient will log in, fill out a profile and set up the frequency of updates, etc. From an advertising and marketing perspective, this is the more lucrative route for a business. Collecting such information and data-mining of such data will also help improve the product. However, there is potential for misuse of the information. Patients may also not feel comfortable about sharing their personal profile at a central website. (2) Through their own desktop PC. The patient will set up their profile on their computer and an anonymous smart software agent will search the web on a regular basis for relevant information. It will also facilitate the download of relevant part of government / research / clinical databases to his or her local computer and use our semantic web tool (locally resident) to retrieve, analyze, and synthesize information specific to their condition. All this will be performed on their local PC. This will ensure a completely confidential access of the information. The agent will have to be smart enough to download a minimum of information and discard any unnecessary information downloaded.

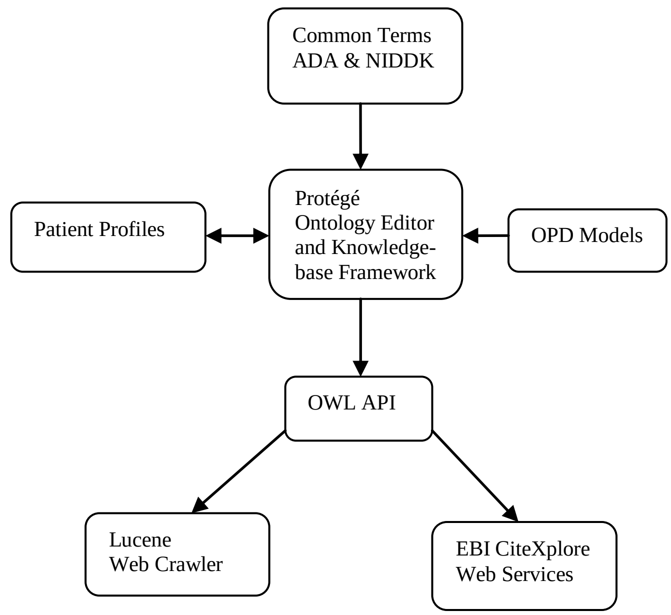
We have chosen the second route, to ensure that the patient is totally comfortable in seeking additional information. Our tool will also empower the patient just in time. The patient can then have an informed discussion with his or her doctor, supported by credible facts. The doctor can also be included in the mailing list for the generated report. We also plan to include a medical summary so the doctor and any medically knowledgeable patient can secure further benefit from this tool.

The Semantic Web, aptly labeled Web 3.0, has had important applications for Web 2.0 social networking and collaboration aspects. The Semantic Web offers a powerful, practical approach to gain mastery over the multitude of information and information services. Mr. Tim Berners-Lee (TBL), the visionary behind the World Wide Web (WWW), has said that " … if properly designed, the Semantic Web can assist in the evolution of human knowledge as a Whole." At a more practical level, the Semantic Web is a strategic technology that truly provides a solution with a significant advantage and lucrative opportunities. SEC's XBRL, TBL's Linked Data, and GeoNames are large scale success stories. However, more focused smaller scale applications have the potential to personalize the web-experience of the individual. They can also empower the individual and protect his /her rights and personal information.

We will use open source tools, so the cost will be minimal. However, there is initial R&D and incremental R&D involved in building the semantic web application and refining it. So, there will be quarterly updates that the patient will have to download and pay for. We will create our own test patient profiles and verify that the appropriate information is downloaded. We will quantify the meta information and use the metrics to improve the tool with regard to its results, performance, and code size. We will work to continually improve the Semantic Web ontology and the rule set. We assume that the databases are reliable (for now), since they are generated by government agencies. In addition to the desktop version, we plan to develop a mobile phone version. Since the profile is created by the patient, there is potential for incorrect information which can cause our tool to provide inappropriate information. Patient may wish to get the profile authenticated by his/her doctor. We can provide a tool for communication with the doctor and validation from the doctor.

ONTOLOGY

There are different components needed to assemble our Patient Empowerment for Chronic Diseases System. First, we utilized Common Terms from the American Diabetes Association (ADA) and the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) to create our ontology via Protégé Ontology Editor. American Diabetes Association formed a list of diabetes-related terms and their definitions, which was adapted from The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). NIDDK performs and assists fundamental and clinical research on many of the most life-threatening diseases affecting public health. Next, we uncover novel key terms presented in recent research articles by constructing object-process diagrams utilizing Object-Process CASE Tool (OPCAT) software [2, 3].



The Components of our Patient Empowerment for Chronic Diseases System

OPD MODELS

Three key clinical trials have shown compellingly that customized lifestyle interventions can considerably postpone, or perhaps deter, the inception of type-2 diabetes in persons with pre-diabetes. Figure 1 shows the first clinical trial, the Da Qing study, which examined over 110,000 men and women for impaired glucose tolerance (IGT) in 33 health centers in China. The researchers classified 577 persons (average age 45 and average BMI 25.8 kg/m^2) with IGT and randomized them according to clinic to obtain either standard care (i.e. the control condition) or one of the three interventions: diet only, exercise only, or a joined diet and exercise intervention. These interventions were chosen to tackle insulin resistance through weight loss and physical movement. Each of the interventions was customized to adjust individuals' lifestyle and circumstance. After 6 years of monitoring, the

Da Qing study revealed a 31% decline in the risk of forming diabetes for the diet intervention, a 46% decline for the exercise intervention, and a 41% decline for the joined diet and exercise intervention. This was the first investigation that distinctly confirmed that utilizing a customized lifestyle intervention was equally achievable and beneficial for the deterrence of type-2 diabetes [1]. Figure 2 is included to show the corresponding representation in OPL (object process language).

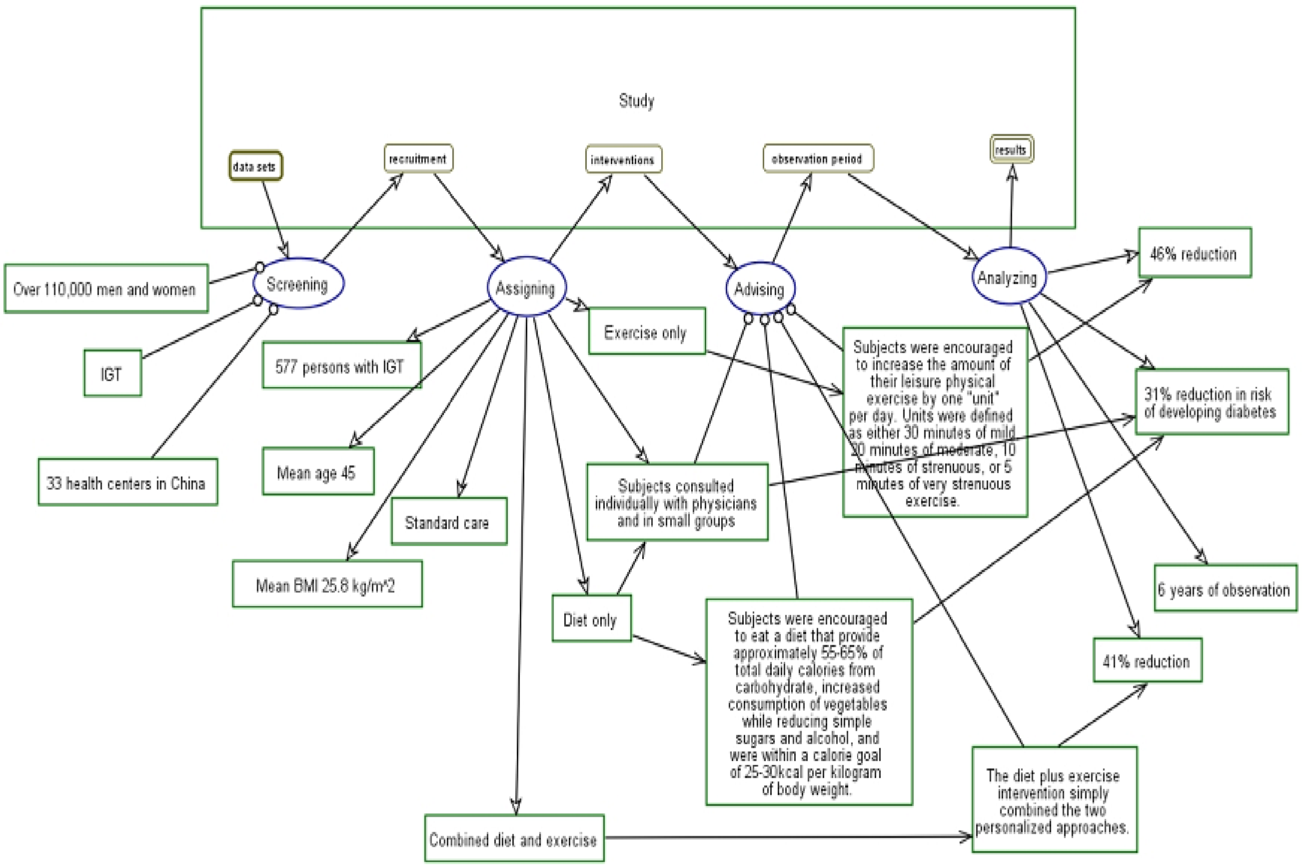


Fig. 1 OPD model for the Da Qing Study

Study can be data sets, recruitment, observation period, results, or interventions.
data sets is initial.
results is final.
Subjects were encouraged to eat a diet that provide approximately 55-65% of total daily calories from carbohydrate, increased consumption of vegetables while reducing simple sugars and alcohol, and were within a calorie goal of 25-30kcal per kilogram of body weight. relates to 31% reduction in risk of developing diabetes.
The diet plus exercise intervention simply combined the two personalized approaches. relates to 41% reduction.
Subjects were encouraged to increase the amount of their leisure physical exercise by one "unit" per day. Units were defined as either 30 minutes of mild, 20 minutes of moderate, 10 minutes of strenuous, or 5 minutes of very strenuous exercise. relates to 46% reduction.
Diet only relates to Subjects consulted individually with physicians and in small groups.
Diet only relates to Subjects were encouraged to eat a diet that provide approximately 55-65% of total daily calories from carbohydrate, increased consumption of vegetables while reducing simple sugars and alcohol, and were within a calorie goal of 25-30kcal per kilogram of body weight..
Exercise only relates to Subjects were encouraged to increase the amount of their leisure physical exercise by one "unit" per day. Units were defined as either 30 minutes of mild, 20 minutes of moderate, 10 minutes of strenuous, or 5 minutes of very strenuous exercise..
Subjects consulted individually with physicians and in small groups relates to 31% reduction in risk of developing diabetes.
Combined diet and exercise relates to The diet plus exercise intervention simply combined the two personalized approaches..
Screening requires Over 110,000 men and women, IGT, and 33 health centers in China.
Screening changes Study from data sets to recruitment.
Assigning changes Study from recruitment to interventions.
Assigning yields Combined diet and exercise, Subjects consulted individually with physicians and in small groups, Exercise only, Diet only, Mean BMI 25.8 kg/m^2, Mean age 45, 577 persons with IGT, and Standard care.
Advising requires The diet plus exercise intervention simply combined the two personalized approaches., Subjects were encouraged to eat a diet that provide approximately 55-65% of total daily calories from carbohydrate, increased consumption of vegetables while reducing simple sugars and alcohol, and were within a calorie goal of 25-30kcal per kilogram of body weight., Subjects were encouraged to increase the amount of their leisure physical exercise by one "unit" per day. Units were defined as either 30 minutes of mild, 20 minutes of moderate, 10 minutes of strenuous, or 5 minutes of very strenuous exercise., and Subjects consulted individually with physicians and in small groups.
Advising changes Study from interventions to observation period.
Analyzing changes Study from observation period to results.
Analyzing yields 6 years of observation, 46% reduction, 31% reduction in risk of developing diabetes, and 41% reduction.

Fig. 2 OPL model for the Da Qing study

The second key clinical trial of lifestyle as a deterrence method for type-2 diabetes was the Finish Diabetes Prevention (FDP) study. Figure 3 shows that the FDP selected and randomized 522 adults age 40-65 with IGT to obtain either a control or a lifestyle intervention. At the conclusion of 4 years, people in the intervention group exhibited a 58% decline in the risk of forming diabetes rivaled to controls [1].

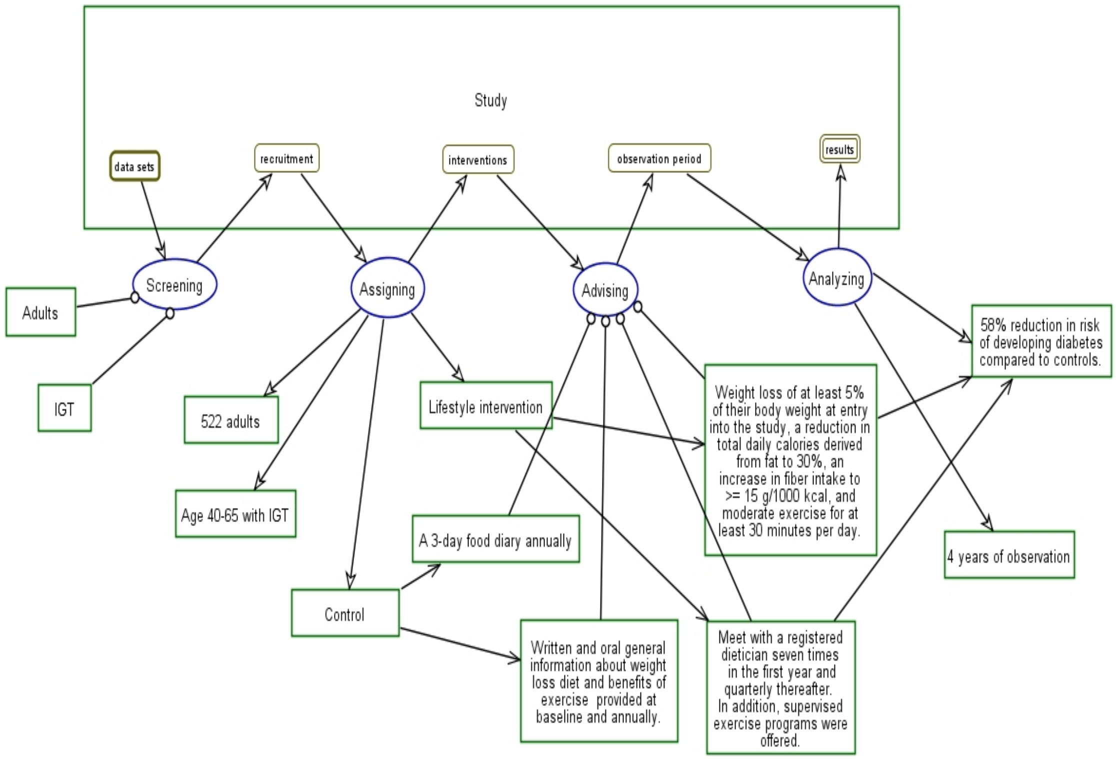


Fig. 3 OPD model for the Finish Diabetes Prevention study

The biggest and most meticulous deterrence trial to date is the Diabetes Prevention Program (DPP). Figure 4 shows that the DPP selected 3234 individuals age 25-75 with IGT. In contrast to previous investigations, which examined individuals with homogeneous traits, nearly half of the DPP individuals were from the minority groups. Individuals were randomized into one of three categories: an intense lifestyle intervention, a medication intervention, or a medication placebo control category. At the conclusion of 3 years, trial data justified a premature end of the investigation. Individuals in the lifestyle category had a 58% decline in risk of forming diabetes, and individuals in the medication section had a 31% decline when rivaled to control individuals. Furthermore, the interventions were beneficial irrespective of race or age [1].

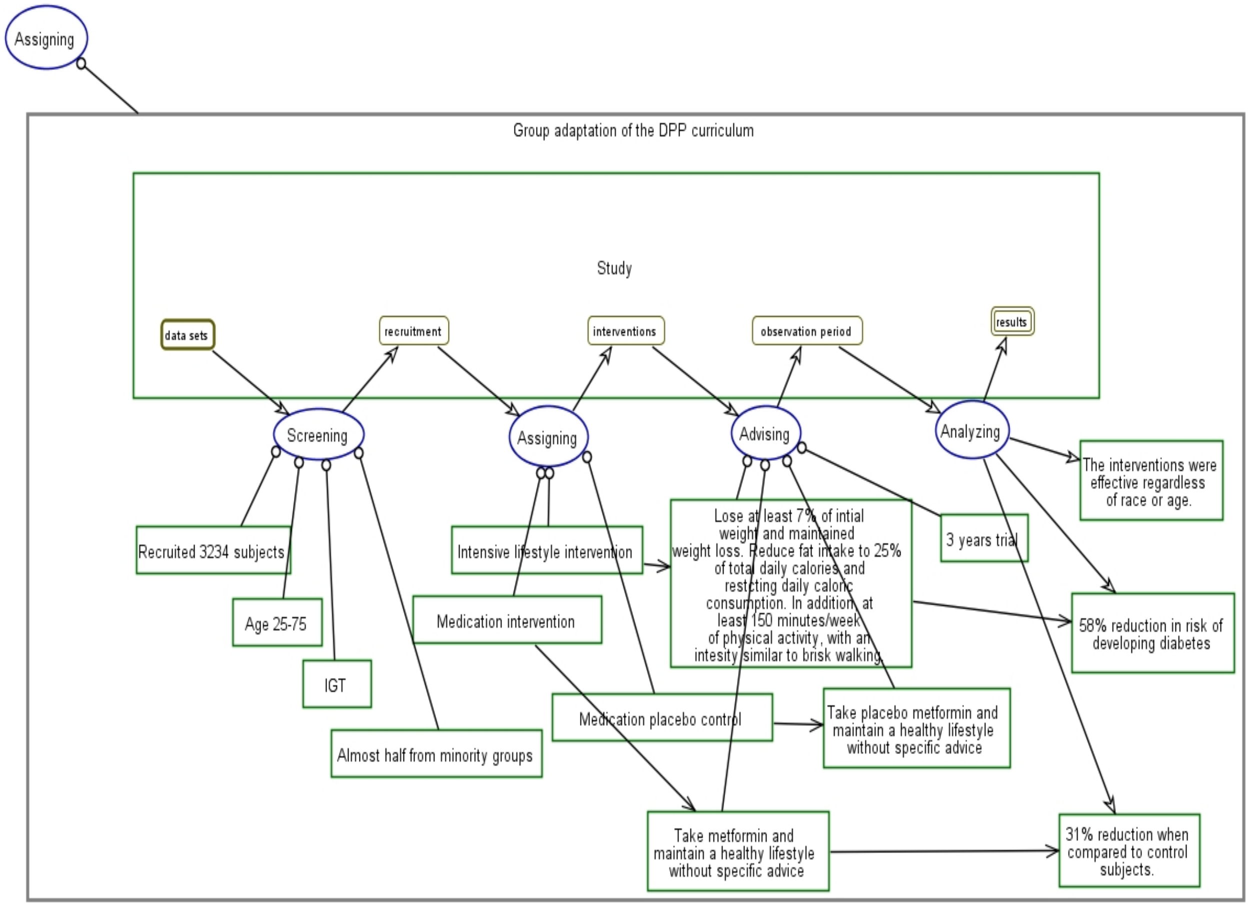


Fig. 4 OPD model for the group adaptation of the DPP curriculum

The intervention model utilized in the DPP was tailored for dispense in groups using reduced expense “lay leaders” employed by the YMCA. Furthermore, curriculums can be applied at lower cost since the YMCA functions on a fee retrieval basis instead of for revenue. Besides, the YMCA has the prospective for extensive scope; there are more than 2600 YMCA in the United States includes more than 46 million individuals residing within 3 miles of a YMCA facility. The expense for providing the 16 part DPP program utilizing the YMCA was a portion of that needed when the initial DPP intervention was applied; $205 dollars per individual instead of $1476 needed in the initial investigation. Figure 5 shows that individuals in the group intervention attained a 6% weight loss that was retained at 6 and 14 months post intervention follow-up [1].

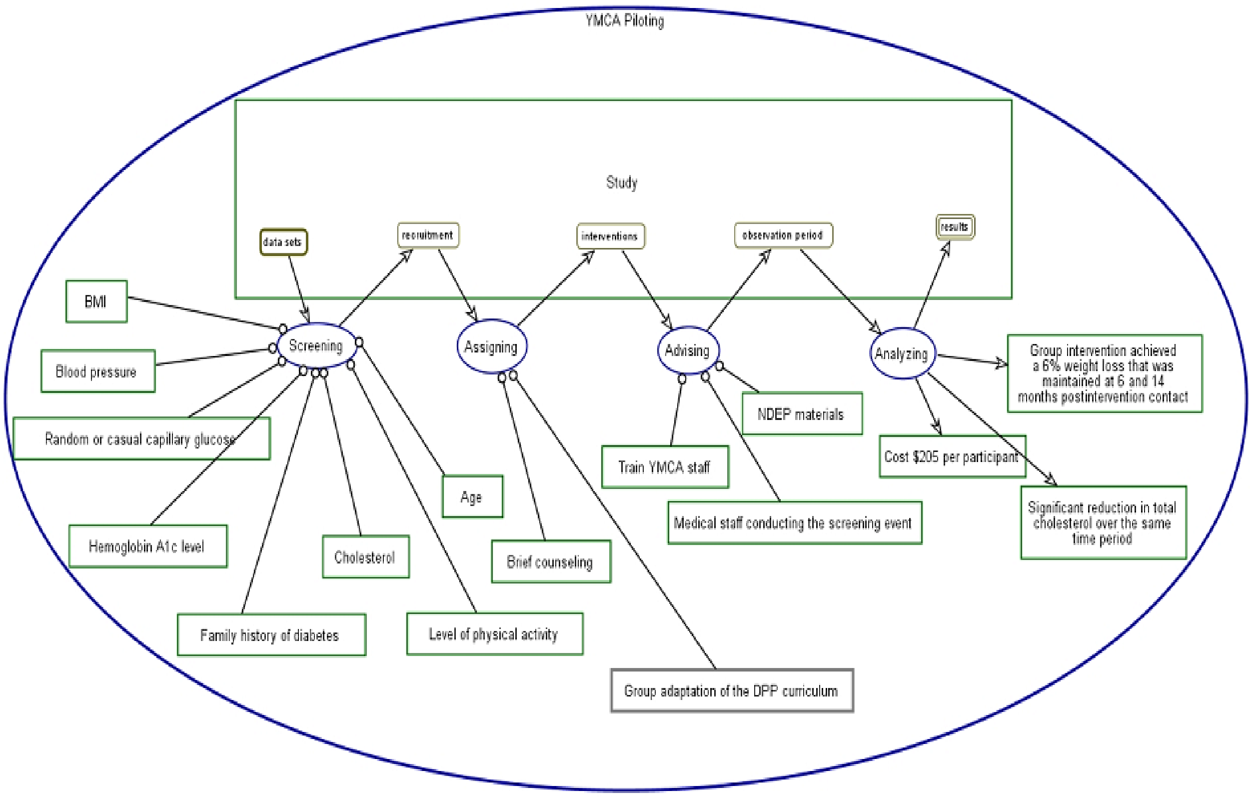
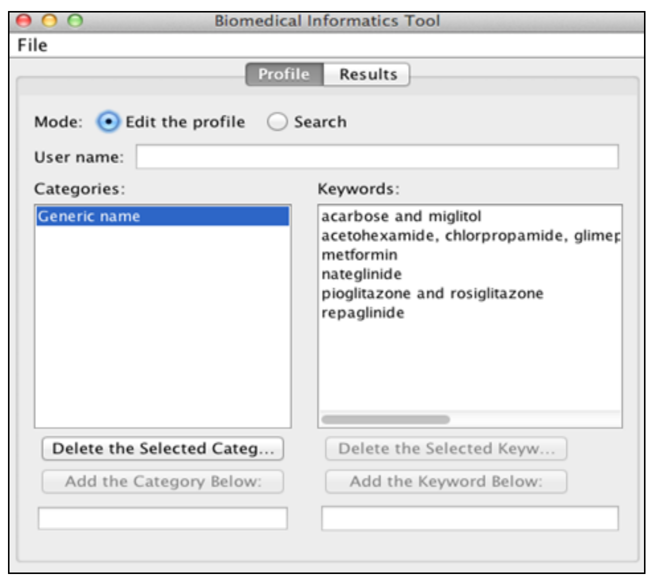


Fig. 5 OPD model for the YMCA pilot study

SEMANTIC WEB APPLICATION

We used our ontology in reference to sample profiles that represents various diabetes patients. To construct a Semantic Web application, we leveraged an open source, Java-based OWL API that is proving popular with many developers around the world. OWL files are accessible via the OWL API, which was developed at the University Of Manchester. This is a very clean API that closely follows the OWL specification and the parser is optimized to be faster and use less memory [4, 6]. To request relevance medical information, we utilized the European Bioinformatics Institute's (EBI) CiteXplore Web Service, a Simple Object Access Protocol (SOAP) based service, to fetch data from the Citation database. The CiteXplore literature database offers integrated databases of literature information from a range of resources and contains references to biological databases, text mining findings and links to locations of the abstract or full text version of the citation [5].



Our Semantic Web Application

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