MATERIALS AND METHODS
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According to recent estimates, the human population worldwide appears to be in the midst of an epidemic of diabetes. This marked escalation in diabetes may be attributed to rapid changes in lifestyle and economic progress in India. Different approaches have been used to reduce the incidence rate of the disease and to cure diabetes. The most popular approaches are the drug therapy, dietary therapy, lifestyle modifications and recently the spices and the natural products therapy. Results of available studies support a role of fruit and vegetables in the prevention of T2DM independent of other dietary and lifestyle factors. In the management of diabetes mellitus, botanicals with antihyperglycemic activities are increasingly sought by diabetic patients and health care professionals. Many people with diabetes are not knowledgeable about the illness or about proper self management and may not view diabetes care as a priority in their lives. Diabetes education empowers people with diabetes by encouraging them to take responsibility for their health and enabling them to manage their condition themselves.

Thus the present study was planned with the major objectives

1) To determine the fruit and vegetable consumption pattern among the Indians in Vadodara city; in three different seasons i.e. summer, winter and monsoon.

2) To study the impact of phytochemical rich fruit (amla) in the management of type 2 diabetes mellitus.

3) To asses the knowledge of T2DM subjects regarding various aspects of diabetes mellitus and

4) To study the impact of interpersonal counselling on the knowledge and physiological indicators (blood sugar, glycated haemoglobin and lipid profile) of T2DM patients after 2 and 4 months of intervention.

The present study was carried out in four phases.
Phase I  To study the fruit and vegetable consumption pattern among the population of Vadodara city in three seasons i.e. summer, monsoon and winter

Phase II  To study the impact of phytochemical rich fruit supplement (Amla) in the management of type 2 diabetes mellitus.

Phase III  To assess the knowledge and practices of the NIDDM patients related to their disease

Phase IV  To study the impact of interpersonal counselling on the knowledge and lifestyle related risk factors of NIDDM patients

PHASE I : FRUIT AND VEGETABLE CONSUMPTION PATTERN IN THE VADODARA CITY IN THREE SEASONS

Fruit and vegetable consumption pattern was determined among the residents of Vadodara city. In all 100 families from high-income group (HIG) and middle income group (MIG) were enrolled for the study. The city was divided into four zones and from each zone one housing society was purposively selected. From each of these colonies every 10th household was included in the study. In all there were 100 families comprising of 365 subjects. Information regarding their economic status, level of education, medical history and anthropometric measurements was collected using structured pre tested questionnaire (Appendix I). Information on fruit and vegetable consumption pattern, quantity and frequency of fruit and vegetables consumed was collected from all the subjects residing in a family, in all the three seasons using the food frequency method.

PHASE II : IMPACT OF PHYTOCHEMICAL RICH FRUIT (AMLA) SUPPLEMENTATION IN THE MANAGEMENT OF TYPE 2 DIABETES MELLITUS

The impact of amla supplementation was seen in T2DM subjects. The duration of the supplementation was 60 days. The methodology of this phase is described in two sections.

1. Nutrient analysis of amla
2. Supplementation trial in humans
Section I: Nutrient Analysis of Amla

The nutrient analysis of Amla was carried out in the following manner:

1. Obtaining a representative sub-sample for analysis

The amla samples were purchased from three different markets of Vadodara city. Equal weights of each were pooled together to obtain a primary sample out of which a sub-sample was drawn which was then used for preparations. The flow chart is depicted in Figure 3.1.

2. Converting the components into a form that permits an assay.

The amla was subjected to processing for various analysis.

Processing

(i) Homogenisation: Fresh homogenates were used for the ascorbic acid estimation. The sample was mixed with chilled Meta Phosphoric Acid – Acetic Acid mixture. From this, suitable aliquots were taken for the analysis of ascorbic acid.

(ii) Ashing:

The amla sample was accurately weighed in duplicates in preweighed and preignited crucibles. They were heated in a muffle furnace at 600° C for 6 hours, cooled in a dessicator and weighed. This process of heating and cooling was repeated till two consecutive weights were identical and the ash was almost white or greyish white in colour.

Preparation of the ash solution

The ash was moistened with 1 ml deionised water and 5 ml of concentrated HCl. Mixture was evaporated to dryness on a sand bath. After evaporation, the
Figure 3.1
Sampling for Amla Analysis

AML A

Market 1
1 kg

Market 2
1 kg

Market 3
1 kg

Edible Portion Mixed

1 Kg Secondary Sample Drawn

Duplicates

1 2

Homogenisation

Duplicates

3 4

Drying and ashing
process was repeated 2 times and the contents were evaporated again. Then 4 ml of concentrated HCl was added with a few drops of deionised water and the solution was warmed over a boiling water bath. After cooling, the volume was made up to 100 ml with deionised water in a volumetric flask.

The ash solution was used for the estimation of minerals like calcium, iron, phosphorous, sodium and potassium. (AOAC, 1984).

3. Performing the assay
This deals with the chemical analysis of amla. The various nutrients and non-nutrients were estimated using standard analytical procedures.

STANDARDIZATION OF THE ANALYTICAL METHODS

Ascorbic Acid

Ascorbic acid content of the samples was estimated using the 2, 6, dichlorophenol indophenol dye (2,6 DCPIP) method (AOAC, 1984).

**Principle:** The dichlorophenol indophenol dye is a blue coloured dye. On reaction with ascorbic acid present in the food sample, the dye gets reduced to a leuco base, which is colourless, and ascorbic acid in turn gets oxidised to dehydroascorbic acid. Excess of dye gives a pink colour, which is taken as the end point.

**Estimation:** Fresh homogenates of the fruits were used for the estimation of ascorbic acid. Each fruit was freshly cut and mixed with a known amount of Meta-Phosphoric Acid – Acetic Acid mixture in a stainless steel jar. The total volume of the homogenate was recorded, and this was then filtered through a sieve. The contents were centrifuged and the volume of the supernatant was noted and then transferred to a clean conical flask. Duplicate aliquots of 7 ml each were taken for titration. The sample was titrated against the dichlorophenol indophenol (DCPIP) dye until a distinct pink colour persisted for at least 30 seconds. Ascorbic acid standards were also titrated by taking suitable aliquots against the dye. About 7 ml of meta-phosphoric acid – acetic acid (MPA-AA)
mixture was taken as sample blank. After subtracting the average blank values from standard titrations, calculations were made to express concentration of indophenol solution as mg ascorbic acid equivalent to 1 ml reagent. Indophenol solution was standardised daily with freshly prepared ascorbic acid solution.

The ascorbic acid content of amla was calculated as follows:

**Calculation:**

\[
\text{Calculation:} \\
\text{Ascorbic acid content of the fruit (mg/100g)} = \frac{\text{Titre value (ml)} \times 0.1 \times \text{Volume of supernatant (ml)}}{\text{mg} \times \frac{100}{7} \times \text{Aliquot taken (ml)}}
\]

* = Value obtained based on standardisation.

**Tannic Acid**

Tannic acid in the sample was extracted with methanol and assayed using the modified vanillin-reaction method (Price et al, 1978). Since catechin was used as the standard, the values were expressed as catechin equivalents.

**Principle:** Tannic acid forms a pink coloured complex with vanillin in acid medium, which can be estimated colorimetrically at 500 nm.

**Extraction of Tannins in Solution:** Duplicates of 1g samples were weighed accurately and were extracted in 10 ml of distilled methanol by placing the conical flasks, in the shaker water bath for half an hour. They were centrifuged for 10 min at 5000 rpm and the supernatant was used for the assay at 30° C.

**Estimation:** All the reagents as well as the sample supernatants were kept at 30 °C in a water bath, prior to the estimation. Vanillin reagent was prepared freshly by mixing equal volumes of 1% vanillin in distilled methanol and 8% concentration HCl in methanol. From the sample supernatant, two replicate
aliquots of 1 ml each were taken in the test tubes and 5 ml of the vanillin HCl reagent was added to the tubes at 1 min interval at 30 °C. For sample blank, another 1 ml aliquot of the sample solution was taken in a test tube and 5 ml of 4% HCl in distilled methanol was added at 1 minute interval. Reagent blank consisted of 1 ml of distilled methanol and 5 ml of vanillin- HCl reagent. All the test tubes were kept in water bath at 30 °C for 20 minutes after which, they were removed one by one and the absorbance was read at 500 nm in a spectrophotometer.

A standard curve was constructed using catechin (Chemika Chemicals) standard (up to 0.5 mg concentration).

Tannin content of amla was calculated as follows:

**Calculation:**

\[
\text{Tannic Acid} = \frac{\text{Reading of sample}}{\text{Reading of Standard}} \times \frac{\text{Concentration of Standard (mg)}}{\text{X 10 X Wt. of fruit (mg)}}
\]

**Polyphenols**

Polyphenol content of amla was estimated by the method of Malik and Singh (1971).

**Principle:** Polyphenols in the sample were extracted using 0.3N HCl, made to react with Folin and Ciocalteau's phenol reagent in presence of sodium carbonate. The intensity of blue colour was noted colorimetrically at 620 nm.

**Estimation:** 100 mg dry fruit sample was mixed with 25 ml 0.3N HCl and shaken for about 1 hour. After shaking, crude extract was centrifuged at 8000 rpm for about 10 minutes. The supernatant obtained was evaporated to dryness in a water bath. To the residue, hot water was added and the final volume was adjusted to 100 ml with distilled water. 1 ml of the above aliquot was taken in the test tube. To this 1 ml each of Folin and Ciocalteau's phenol reagent (diluted 1:2)
and 1 ml of 35% sodium carbonate was added. After 1 hour, 2 ml of distilled water was added to adjust the final volume to 5 ml.

Blank was prepared by taking 3 ml distilled water, 1 ml of Folin and ciocalteau’s reagent and 1 ml of 35% sodium carbonate. Standards were prepared by taking 5-20 μg of gallic acid, 1 ml of Folin and Ciocalteau reagent, 1 ml of 35% sodium carbonate, and volume was made to 5 ml with distilled water. Blanks and standards were run along with the sample. Polyphenol content in the beverages was calculated as follows:

**Calculation:**

\[
\text{Polyphenol (mg/100g)} = \frac{\text{Reading of sample}}{\text{Reading of standard}} \times \frac{\text{Concentration of Standard}}{\frac{\text{Total Volume}}{1000} \times \frac{1}{\text{Dilution factor}} \times \frac{\text{Aliquots taken for estimation (ml)}}{\text{Weight of fruit}}}
\]

**Potassium**

The ash solution was used for the estimation of potassium.

Potassium was estimated for amla by Flame Spectrophotometric technique (Ward and Johnston, 1962).

**Principle:** Potassium in solution was atomised into an oxyhydrogen of oxyacetylene flame. The flame exerts atoms of sodium and potassium causing them to emit radiation at specific wave length (598 nm and 786 nm respectively). The amount of radiation emitted is measured on a spectrophotometer under standard conditions and it is proportional to the concentration of sodium or potassium in the solution.
With sodium in solution, the colour of the flame is golden yellow and with potassium in solution, the colour of the flame is lilac.

**Estimation:** For estimating the sodium and potassium content of sample solutions, following procedure was followed. An aliquot of the ash solution was diluted (if required) so that it contained less than 150 ppm potassium and less than 100 ppm sodium. The distilled extract was atomised in a calibrated flame photometer with transmittance set at 100% for the 2 minerals and with the wavelength dial set at 598 nm for sodium and 768 nm for potassium. The concentration of the sample was noted from the standard curve.

**Calculation:** The sodium and potassium content of amla was calculated using the following formula:

\[
\text{Potassium (K)} \quad \text{or Sodium (Na)} = \text{Concentration} \times \text{Volume}
\]

\[
\text{obtained from} \quad \text{made up}
\]

\[
\text{curve (µg/ml)} \quad (ml)
\]

\[
\text{dilution (if any)} \times 100
\]

\[
\text{X} \quad \frac{1000}{\text{Weight of the sample (gm)}}
\]

**Quality Control Measures**

The following quality control measures were taken for the present study:

- **Replication of Analysis:** This eliminates some of the errors resulting from sampling, from heterogeneity of sampled material and from accidental or random errors in the assays.

- **Recovery Method:** Known amounts of a pure substance were added to a series of sample of the material to be analysed and the assay procedure was applied to those samples.
- Coefficient of Variation (C.V.): The coefficient of variation was calculated to determine the precision of an analytical procedure. The C.V. was calculated as follows:
  \[ \text{C.V.} = \frac{\text{S.D.}}{\text{Amount present}} \times 100 \]

**Section II: Supplementation with Amla**

The criteria for selection of subjects included:

1. Confirmed diabetics
2. Resident of Vadodara city.
3. No apparent complication.
4. Willingness to participate

For the study, 49 stable NIDDM patients were enrolled from the diabetic clinic of the Vadodara city. The study was undertaken under the supervision of a diabetologist. The general information, anthropometric measurements and 24 hour dietary recall were recorded using a pre tested questionnaire (Appendix II). From the 49 patients, 19 patients were taken as controls and no supplementation was given to them. The remaining 30 patients were given a medium sized amla (approximately 35 g) on a daily basis for 60 consecutive days. The amla was procured from the local vegetable markets of Baroda city. They were asked to consume the fruit in a raw form daily after lunch. During the course of supplementation no modification in the diet or medication was made. Data was collected with regard to the patient's general information, clinical profile, dietary profile and biochemical parameters like fasting blood glucose, glycated haemoglobin and lipid profile. The detailed experimental plan is given in the following figure (Figure 3.2)
Figure 3.2

EXPERIMENTAL DESIGN

49 stable diabetics

n=19
Control Group

n = 30
Experimental Group

BASELINE INFORMATION
General Information
Anthropometric Measurements
24 hour Dietary Recall
Biochemical Indicators

No Intervention

Amla Supplementation
(35g)
60 days

POST DATA
Biochemical Indicators
24 hour Dietary Recall
Anthropometric Measurements
BASELINE INFORMATION

The baseline profile of the subjects included the anthropometric measurements using standard procedures and medical history:
1. Height
2. Weight
3. BMI
4. Waist
5. Hip
6. Waist hip ratio
7. Medical History

DIETARY INTAKE

Dietary profile of the subjects was taken by a detailed 24-hour dietary recall method. Also the type of oil which they consumed was recorded. Accordingly the calorie, fat, protein, fibre, vitamin A, iron and vitamin C intake was calculated using the nutritive value of Indian foods by Gopalan (1989)

ANALYTICAL PROCEDURE

After the overnight fast, venous blood sample was collected in a serum tube and then the serum was separated for further analysis.

1. Estimation of blood sugar:

It was estimated by the GOD/POD method using an enzymatic kit procured from Glaxo, India. Glucose is oxidised by glucose oxidase (GOD) into gluconic acid and hydrogen peroxide. Hydrogen peroxide in presence of peroxidase (POD) oxidises the chromogen, 4-aminoantipyrine/phenolic compound to a red coloured compound. The intensity of the redo coloured compound is proportional to the glucose concentration and is measured at 505nm (490-530nm).
2. **Estimation of Total Cholesterol**

Cholesterol was estimated using enzymatic kits [Chema] by the enzymatic end-point method. Cholesterol esters are hydrolysed to free cholesterol and fatty acid by cholesterol esterase (CHE). The free cholesterol is then oxidised by cholesterol oxidase (CHOD) to cholest-4-en-one and hydrogen peroxide. Liberated hydrogen peroxide reacts with 4-aminoantipyrine and phenol in the presence of peroxidase (POD) to produce quinonimine, a red coloured complex. The intensity of colour produced is directly proportional to the total cholesterol in the sample, which is measured at 500nm (Hg 546nm). The final colour is stable for 60 minutes.

(a) Cholesterol esters \( \xrightarrow{\text{CE}} \) Cholesterol + Fatty acids

(b) Cholesterol + \( \text{O}_2 \) \( \xrightarrow{\text{CO}} \) Cholesterol 4en-3 one +\( \text{H}_2\text{O}_2 \)

(c) \( 2\text{H}_2\text{O}_2 + 4 \text{Aminoantipyrine} + \text{Phenol} \xrightarrow{\text{Peroxidase}} 5 \text{Quinoneimine} + 4\text{H}_2\text{O} \)

3. **Estimation of High Density Lipoprotein (HDL)- Cholesterol**

Enzymatic kits procured from Glaxo India was used for Direct HDL-cholesterol estimations. The assay consists of two distinct reaction steps. Firstly, cholesterol esterase, cholesterol oxidase and subsequently catalase eliminate the VLDL-cholesterol, LDL-cholesterol and chylomicrons. Secondly, cholesterol ester is hydrolysed by cholesterolesterase to cholesterol and fatty acid. The cholesterol is then oxidised to cholestenone and hydrogen peroxide by cholesterol oxidase. Hydrogen peroxide in the presence of peroxidases reacts with 4-aminoantipyrine and HDAOS to produce a quinone pigment. The intensity of the quinonimine dye produced is directly proportional to the cholesterol concentration when measured at 600nm.

4. **Estimation of Low Density Lipoproteins (LDL) Cholesterol**

The LDL-C values were calculated using the formula.
\[ \text{LDL-C} = \text{TC} - [\text{HDL-C} + (\text{TG}/5)] \]

5. **Estimation of Very Low Density Lipoproteins (VLDL) Cholesterol**

VLDL-C was calculated by dividing triglyceride values by five (TG/5).

6. **Triglycerides**

Enzymatic kits using GPO-PAP method [Chema] were used for triglyceride estimations. Triglycerides are hydrolysed by lipase (LPL) to glycerol and free fatty acids. Glycerol is phosphorylated by ATP in the presence of glycerol kinase (GK) to glycerol-3-phosphate which is oxidised by the enzyme, glycerol-3-phosphate oxidase (GPO) producing hydrogen peroxide. Hydrogen peroxide so formed reacts with 4-aminoantipyrine and p- chlorophenol in the presence of peroxidase (POD) to produce quinonimine, a red coloured complex, which is measured at 500nm (Hg 546nm). The final colour is stable for 60 minutes.

(a) Triglyceride + H₂O \[\xrightarrow{\text{Lipoprotein + Lipase}}\] Glycerol + Fatty acids

(b) Glycerol + ATP \[\xrightarrow{\text{GK}}\] Glycerol – 3 Phosphate + ADP

(c) Glycerol-3-PO₄ + O₂ \[\xrightarrow{\text{G-3-PO₄}}\] H₂O₂ + Dihydroxyacetone Phosphate

(d) H₂O₂ + Aminoantipyrine + DHBS \[\xrightarrow{\text{Peroxidase}}\] Quinoneimine + H₂O

7. **Glycosylated Hemoglobin**

Ion exchange resin method (ACCUREX) was used to estimate the glycosylated hemoglobin (GHb).

**Principle:**

Whole blood is mixed with lysing reagent to prepare a hemoysylate. This is then mixed with a weakly binding cation exchange resin. The non glycosylated hemoglobin binds to the resin leaving the free GHb in the supernatant. The GHb
percentage is determined by measuring the absorbance of the GHb fraction and of the total Hb.

**Step 1: Hemosylate preparation**

0.25 ml of lysing reagent was taken in a test tube. 0.05 ml of the well mixed sample was added to it. It was then allowed to stand at the room temperature for 5 minutes.

**Step 2: GHb separation and assay**

The resin tube is incubated in a water bath. To it 0.1 ml of the hemosylate (from step 1) is added. The resin separator is positioned in the tube so that the rubber sleeve is approximately 3 cm above the resin level. The contents are then mixed continuously on a vortex mixer for five minutes. The resin is allowed to settle for five minutes and then the resin separator is pushed in the tube until the resin is firmly packed. The supernatant is poured directly in the cuvette and the absorbance is measured against deionized water.

**Step 3 Total hemoglobin (THb) assay**

5ml of deionized water is pipetted into a test tube. To it 0.02 ml of hemosylate from step 1 is added. The contents are then mixed and the absorbance is read against deionized water.

**Calculations**

\[ \text{GHb}\% = \frac{A_{\text{GHb}}}{A_{\text{THb}}} \times 10 \times \text{Temp factor (tf)} \]

**PHASE III: KNOWLEDGE OF T2DM PATIENTS ON DIABETES MELLITUS**

For the purpose of the study, 117 patients were enrolled from the outpatient department of various diabetic clinics of Vadodara. From these patients, information pertaining to the knowledge about the disease condition (diabetes) was elicited using a pre tested semi structured questionnaire (Appendix III). Information pertaining to their knowledge with regard to diabetes mellitus was elicited.
Knowledge Index

To measure knowledge index, basic questions related to T2DM were selected. The details of which are given below. For each correct response in the question selected, ‘2’ score was assigned. The questions selected and the maximum score assigned were as follows:

### Knowledge index

<table>
<thead>
<tr>
<th>Key knowledge questions</th>
<th>Maximum score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition of diabetes</td>
<td>2</td>
</tr>
<tr>
<td>Signs and Symptoms</td>
<td>10</td>
</tr>
<tr>
<td>Causes</td>
<td>10</td>
</tr>
<tr>
<td>Complications</td>
<td>12</td>
</tr>
<tr>
<td>Role of drugs</td>
<td>4</td>
</tr>
<tr>
<td>Normal ranges of blood sugar</td>
<td>6</td>
</tr>
<tr>
<td>Importance of monitoring blood glucose</td>
<td>2</td>
</tr>
<tr>
<td>Significance of GHb</td>
<td>2</td>
</tr>
<tr>
<td>BMI-term</td>
<td>2</td>
</tr>
<tr>
<td>Cut off points for BMI</td>
<td>2</td>
</tr>
<tr>
<td>Normal BP values</td>
<td>2</td>
</tr>
<tr>
<td>Foods to be avoided</td>
<td>8</td>
</tr>
<tr>
<td>Foods consumed liberally</td>
<td>8</td>
</tr>
</tbody>
</table>

Each patient’s knowledge score was calculated and the percent score for each subject was then calculated and was categorized as given below:

### Criteria for classification for knowledge score

<table>
<thead>
<tr>
<th>Percent score (%)</th>
<th>≤ 20</th>
<th>20-30</th>
<th>30-40</th>
<th>&gt;40</th>
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<tbody>
<tr>
<td>Category</td>
<td>Low</td>
<td>Average</td>
<td>Good</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

**PHASE IV  EFFICACY OF INTERPERSONAL COUNSELLING ON THE KNOWLEDGE AND LIFE STYLE RELATED RISK FACTORS IN TYPE 2 DIABETES MELLITUS**

Out of the 117 subjects, 60 volunteered to participate in the study. They were then randomly divided into 2 groups control and experimental with 30 patients in each group. The control group did not receive any intervention and the
experimental group received interpersonal counselling by the investigator for a period of 4 months. The investigator carried out the counselling at the patients' residence. The counselling was supported by means of flash cards (Appendix IV) and a booklet (Appendix V). Counselling was done once every month. In all, the investigator counselled the patient three times over a 4 month period. The booklet was given to the patient on the first visit. On an average it took one hour to one hour fifteen minutes to counsel the patient. The patient’s general information, clinical profile, anthropometry and dietary profile was elicited using a pre tested questionnaire (Appendix II). Information was collected at the baseline, 2 months and 4 months of intervention. Biochemical parameters like fasting blood glucose, glycated haemoglobin and lipid profile were also analysed at the baseline, after 2 months and 4 months of the intervention. The detailed experimental plan is given in the following figure (Figure 3.3).

The key components included in the NHE are given in Table 3.1

**Dietary Analysis**

Dietary profile of the subjects was taken by 24-hour dietary recall method. Accordingly the calorie, fat, protein, fibre, vitamin A, iron and vitamin C intake was calculated using the nutritive value of Indian foods by Gopal an (1989).  

**Biochemical Analysis**

After the overnight fast venous blood sample was collected in a serum tube and then the serum was separated for the analysis of glucose, total cholesterol, HDL cholesterol, Triglyceride and glycated haemoglobin. The methods are as cited in phase II of the study.

**STATISTICAL ANALYSIS**

The data was entered in a computer using an excel spreadsheet. The data was cleaned and verified and subjected to appropriate statistical analysis. Mean and standard deviation were calculated. Frequency distribution and percentages were calculated wherever applicable. Paired 't' test and 'F' test were done to find out statistical significance between the groups. All tests were considered significance at P<0.05.
Figure 3.3
EXPERIMENTAL DESIGN
60 stable diabetics

30 Control Group
30 Experimental Group

BASELINE INFORMATION
General Information
Anthropometric Measurements
24 hour Dietary Recall
Biochemical Indicators

No Intervention

Interpersonal Counselling
(Booklet and flash cards)
4 months

POST DATA
Biochemical Indicators
24 hour Dietary Recall
Anthropometric Measurements
### Table 3.1
**Key Components of NHE material**

<table>
<thead>
<tr>
<th>Key Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>About Diabetes</td>
<td>Definition of Diabetes</td>
</tr>
<tr>
<td></td>
<td>Signs and symptoms</td>
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<tr>
<td></td>
<td>Causes</td>
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<tr>
<td></td>
<td>Complications</td>
</tr>
<tr>
<td>Risk factors</td>
<td>Non modifiable risk factors</td>
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<tr>
<td></td>
<td>Modifiable risk factors</td>
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<tr>
<td>Normal values</td>
<td>Anthropometric values</td>
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<tr>
<td></td>
<td>Blood sugar levels</td>
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<tr>
<td></td>
<td>Glycated Hemoglobin</td>
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<tr>
<td></td>
<td>Lipid levels</td>
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<tr>
<td></td>
<td>Blood pressure measurements</td>
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<td>Therapeutic lifestyle changes</td>
<td>Dietary guidelines</td>
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<td>Dietary tips</td>
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<td></td>
<td>Physical activity tips</td>
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<tr>
<td></td>
<td>Tips on improving lifestyle</td>
</tr>
</tbody>
</table>