A View of the Diabetic Foot from the Continent on Which Man First Walked

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DFCon 2018, Diabetic Foot Global Conference, Royal Sonesta Hotel, Houston, 11th to 13th October 2018

Dr. Z. G Abbas
Thank You

DFCon 2018, Diabetic Foot Global Conference, Royal Sonesta Hotel, Houston

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Introduction
Introduction

- Studies of human genomes have shown that our ancestors emerged from Africa roughly 150,000 to 200,000 years ago.

- The earliest fossils of recognizably modern *Homo sapiens* appear in the fossil record at Omo Kibish in Ethiopia, around 200,000 years ago.

- According to the genetic and paleontological record, we only started to leave Africa between 60,000 and 70,000 years ago.

- A little later 50,000 years ago 2nd group set for Middle East & Central Asia and then followed Northern Asia, Europe and beyond.
Africa Region

Africa, the second largest continent in the World / Asia
3 X the size of Europe

Home to 1000 ethnic groups /
Speaking more than 1000 languages

- 54 Nations in Africa
- 46 Nations in SSA
- 20 fall poor of the poorest

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Africa Region

Africa, the second largest continent in the World / Asia
3 X the size of Europe

Home to 1000 ethnic groups / Speaking more than 1000 languages

<table>
<thead>
<tr>
<th>Population</th>
<th>%</th>
<th>2018 / Population in 2050</th>
<th>Region Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa:</td>
<td>1.2 B</td>
<td>16.5%</td>
<td>2.4 billion in 2050</td>
</tr>
<tr>
<td>Asia:</td>
<td>4.4 B</td>
<td>59.5%</td>
<td>(80% of diabetics from this region)</td>
</tr>
<tr>
<td>Total:</td>
<td>5.6 B</td>
<td>76%</td>
<td>(Europe, North, Central &amp; South America, Caribbean &amp; Australia)</td>
</tr>
<tr>
<td>Rest:</td>
<td>1.7 B</td>
<td>24%</td>
<td>7.3 B 100%</td>
</tr>
</tbody>
</table>

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Tanzania Land of ….

Kilimanjaro

Serengeti

Ngorongoro Crater

Zanzibar Stone Town

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Introduction

- Diabetes is a challenging health problem
- By end of 2017, 424.9 Million with diabetes globally
- By 2045 this will increase to 642 Million people
- >80% with diabetes live in low or middle
- In South East Asia, South & Central America, Caribbean, China & Africa will double in decade

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Diabetes Prevalence in Africa

2000: 7.1 million
2017: 16 million
2045: 40.7 million - ↑156%

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Foot Complication 1

- World wide – there is parallel increase in diabetes complications
- Of these complications foot are predominant
- Major public health problems
- Main cause of prolong hospital admission
- Cost not sustainable
- Commonly have infectious etiology
- Associated with PN & PAD
Foot Complication 2

- Approximately 15% of all people with diabetes
- Across the globe 40-60%
- Up to 85% of amputations
- 50% risk of developing 2nd limb within 2 years
- 50% mortality rate in the 5 years
- 85% of all diabetic foot related problems are preventable

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Economic Burden of the Diabetic Foot
The locations and the co-authors

Dr. Chris Attinger
Washington DC, USA

Dr. Zulfiqarali Abbas
Dar es Salam, Tanzania

Dr. Arun Bal
Mumbai, India

Dr. Zhang-Rong Xu
Beijing, China

Dr. Nina Rojas
Chile
### GDP Per Capita in International $

http://siteresources.worldbank.org /

<table>
<thead>
<tr>
<th>World Rank</th>
<th>Country</th>
<th>GDP per capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>US</td>
<td>Int$47,244</td>
</tr>
<tr>
<td>49</td>
<td>Chile</td>
<td>Int$16,659</td>
</tr>
<tr>
<td>94</td>
<td>PRC</td>
<td>Int$8,268</td>
</tr>
<tr>
<td>138</td>
<td>India</td>
<td>Int$3,419</td>
</tr>
<tr>
<td>167</td>
<td>Tanzania</td>
<td>Int$1,481</td>
</tr>
</tbody>
</table>

Think of this quantity as an index of the annual ability to pay for treatment.

Case: Urban Treatment Costs in Int$

CASE: Patient’s Financial Burden in Urban Clinic Expressed as Months of Income*

*C*Calculated as 12* (Patient co-pay in Int$/per capita PPP-adjusted GDP)

Pathogenesis of Diabetic Foot Ulcers
Complex interplay of various risk factors, includes:
- Peripheral neuropathy
- Peripheral arterial disease
- Neuro-ischemia
- Infection
- Culture / social factors
- Non-ulcerative lesions
- Biomechanics / local trauma
- Metabolic Factors
- Immunological Factor
- Health care workers (training, skills)
Diabetic Peripheral Neuropathy (PN)

- 5-80% prevalence in the West
- 25-32% in Tanzania
- 31% in Zambia
- 28-42% in South Africa
- 58% in Nigeria
- 84% in Algeria
- Major underlying risk factor for ulcers/infection

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## Prevalence of DPN Africa

<table>
<thead>
<tr>
<th>Pub. Yr.</th>
<th>Author</th>
<th>Country</th>
<th>No.</th>
<th>PN%</th>
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<tbody>
<tr>
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<td>Awadalla H</td>
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<td>424</td>
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<td>Nigeria</td>
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<td>37</td>
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<td>2015</td>
<td>Kuate-Tegueu C</td>
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<td>306</td>
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<tr>
<td>2012</td>
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<td>Nigeria</td>
<td>277</td>
<td>71</td>
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<tr>
<td>2011</td>
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<td>Ethiopia</td>
<td>384</td>
<td>48.2</td>
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<tr>
<td>2009</td>
<td>Abbas ZG</td>
<td>Tanzania</td>
<td>708</td>
<td>81</td>
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<tr>
<td>2009</td>
<td>Mugambi N</td>
<td>Kenya</td>
<td>542</td>
<td>42</td>
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<tr>
<td>2008</td>
<td>Gill G</td>
<td>Ethiopia</td>
<td>105</td>
<td>41</td>
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<tr>
<td>2006</td>
<td>Ndip EA</td>
<td>Cameroon</td>
<td>300</td>
<td>27.3</td>
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Abbas ZG, et al Epidemiology of Diabetic Foot in Africa, Medical Science Monitor, 2005; 11 (08): RA262-70

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**Diabetic Ulceration Recurrent Study (DURST)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Germany¹</th>
<th>Tanzania²</th>
<th>India³</th>
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<tbody>
<tr>
<td>PN</td>
<td>89 (78%)</td>
<td>60 (82%)</td>
<td>147 (82%)</td>
</tr>
<tr>
<td>PAD</td>
<td>55 (48%)*²³</td>
<td>9 (12%)</td>
<td>23 (13%)</td>
</tr>
<tr>
<td>Retinopathy</td>
<td>55 (48%)*²³</td>
<td>7 (10%)*³</td>
<td>50 (28%)</td>
</tr>
<tr>
<td>Living alone</td>
<td>23 (20%)*²³</td>
<td>0</td>
<td>1 (0.6%)</td>
</tr>
<tr>
<td>Shoe injury</td>
<td>22 (19%)*²³</td>
<td>3 (4%)</td>
<td>11 (6%)</td>
</tr>
<tr>
<td>Burns/Boils</td>
<td>1 (0.1%)</td>
<td>5 (7%)</td>
<td>9 (5%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>19 (17%)</td>
<td>16 (22%)</td>
<td>16 (9%)</td>
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</table>

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Peripheral Arterial Disease

- PAD rates are increasing in Africa
- Associated with increased urbanization
- Rates vary across Africa but trend upwards
- Examples of increasing PAD trends (next slide)...

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## Peripheral Arterial Disease: In Africa (I)

<table>
<thead>
<tr>
<th>Pub. Yr</th>
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<td>2016</td>
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<td>Benin</td>
<td>401</td>
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<td>2009</td>
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<td>2003</td>
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<td>Tanzania</td>
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<td>3</td>
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<tr>
<td>1971</td>
<td>Osuntokun BD</td>
<td>Nigeria</td>
<td>832</td>
<td>4.4</td>
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<td>1970</td>
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<td>Ethiopia</td>
<td>94</td>
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</tr>
</tbody>
</table>

Abbas ZG, et al Epidemiology of Diabetic Foot in Africa, Medical Science Monitor, 2005; 11 (08): RA262-70

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African and Asian Patients: Similarities

- Age (median: 54 vs. 52 years)
- Duration of DM (median: 4 vs. 5 years)
- Delay in seeking medical attention (median: 10 vs. 13 days)
- PAD (26% vs. 34%, P=NS)
- PN (80% vs. 81%, P=NS)
- Neuro-ischaemia (22% vs. 30%, P=NS)

Time is Tissue in the Diabetic Foot

Diabetic Foot Attack

Time is not tissue – these feet have history of weeks and months of ulcers, inability to walk, infection, misdiagnose and treatment

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Typical Sequential timeline of patient’s decision to seek medical help

- **1st**: patient initiates treatment at home: e.g., herbal baths, use of razor blade to cut callosities
- **2nd**: visit to herbal, faith healer, or traditional healer
- **3rd**: visit to primary health centre
- **4th**: visit to the district / regional health centre

Thus, by the time patient is finally referred to hospital, it is often too late to save the foot or prevent death

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*Abbas ZG. Preventing foot care and reducing amputation: a step in right direction for diabetes care, Future Medicine Diabetes Manage, September (2013) 3 (5), 1-9*
Diabetic Foot Infection
Infection in Diabetic Foot

- The burden of diabetic foot cannot be addressed without a discussion of infection.

- Foot infections are common, complex and serious problem in diabetics.

- Foot lesions in less-developed countries commonly have infectious etiology with underlying PN or PAD or both.

- Cause of prolonged hospital admission, morbidity & mortality.

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Diabetic Foot Infection

Three most important clinical categories are:

- Cellulitis (least invasive infection)
- Deep soft tissue infection (involves Soft tissue)
- Chronic osteomyelitis (Involves Bone)
Microbiology Diagnostics
Objectives

- To determine the utility of Gram staining versus cultures in guiding antimicrobial therapy of infected limb ulcer

Abbas ZG, Lutale J, and Archibald LK. The Utility of Gram Staining and Culture in the management of Limb Ulcers in Persons with Diabetes Int Wound J. 2012 Feb
Results

- Over all the predictive value positive of Gram staining for any bacterial growth was 93%

Abbas ZG, Lutale J, and Archibald LK. The Utility of Gram Staining and Culture in the management of Limb Ulcers in Persons with Diabetes Int Wound J. 2012 Feb

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We showed that …

In regions with limited microbiology resources…

- A Gram stain alone of a deep biopsy of an ulcer is largely predictive of the microorganism causing underlying infection
- Routine Gram stains are much cheaper than cultures and likely sustainable
- Routine cultures of tissue does not give any additional information

Abbas ZG, Lutale J, and Archibald LK. The Utility of Gram Staining and Culture in the management of Limb Ulcers in Persons with Diabetes Int Wound J. 2012 Feb

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Moreover, we established that...

- Management of infected diabetic limb ulcers should include at least a Gram stain of deep tissue **NOT** a swab of the ulcer
- Broad-spectrum empiric therapy should cover both Gram-positive and Gram-negative pathogens
- Neither mycobacteria nor HIV appear to be playing any role in diabetic ulcer pathogenesis this population

*Abbas ZG, Lutale J, and Archibald LK. The Utility of Gram Staining and Culture in the management of Limb Ulcers in Persons with Diabetes*  
*Int Wound J. 2012 Feb*
Socioeconomic Factors

- Bare foot walking
- Inappropriate foot wear
- Lack of awareness – patients and healthcare workers
- Podiatry services non-existent
- Home treatment
- Tendency of patient to see first faith healers, herbal doctors, etc
- Poor living conditions (crowding) – rodent / rat bites

Non-Ulcerative Pathology of Ulcers

- Callus
- Fungal Infections
- Corns
- Dry skin Fissure and Cracks
- Gross deformity of nails
- Hypertrophic growth of nail
- Traditional Marks
- Blisters / Bullae

Biomechanics and Foot Wear

- Biomechanical abnormalities are frequently consequences of diabetic neuropathy and leads to abnormal plantar foot pressure

- A combination of foot deformity and neuropathy increases the risk of Plantar ulcer – Infection

- Foot wear

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Relief of Pressure

- Biomechanics and Foot Wear
  - Shoes and inserts should be inspected frequently and replace when necessary

- A patient should never return to footwear which has caused ulceration

- Appropriate foot-wear (adopted to high pressure, deformities, and/or lesions present in the foot) has been associated with significantly fewer recurrence and development of ulceration

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Metabolic Factors

- Insulin secretary defects impaired glycogen synthesis causes hyperglycaemia

- The glycation of proteins associated with diabetes also contributes to both micro-vascular and macrovascular derangements

- Catabolic state, and negative nitrogen balance caused by gluconeogenesis from protein breakdown impairs synthesis of proteins (Fibroblasts, collagens)

- All inhibits healing of the wound - Infections

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Metabolic Control

- Fluctuating blood glucose have been risk factors for non-traumatic amputation

- Short-term control related to wound healing

- It has been shown improve when normoglycemia metabolic control has been achieved and optimal nutritional status are desirable to improve wound healing

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Immunological Disturbance

- Defects in host immune defences
- Diminished leukocyte function such as migration, phagocytosis, intracellular killing and chemotaxis
- Cellular immune responses are impaired
- All caused by poorly controlled diabetes

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Diabetic Foot Education
Health Care Workers / Patients
Education is very important. Otherwise we start using things upside down!!!
Need for Specific Emphasis on Education

- Education is the only tool we have in the developing world which is free to patients.
- Education falls under two categories:
  - Preventive
  - Therapeutic
- Education directed at two groups:
  - People with diabetes / relatives / friends
  - Professional involved in management
Various studies have shown that the following are important in protecting the feet from complications:

- Simple education
- Care
- Motivation
- Action by persons with diabetes themselves

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Basic Education
Which people should we target for foot care education?

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Evidence-based Stratification of Services

Grade 3: Highly / 1-3
Grade 2: High 3/12
Grade 1: Low 6/12
Grade 0: Annually

Ulcer

High-risk foot
Intensive foot education
Previous amputation or ulcer
Peripheral Arterial disease
Neuropathy, deformity
Neuropathy, no PAD, Previous Amp. or ulcer
No neuropathy
General information

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Educating Patients

I am getting Headache

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Education of Health Care Providers

- One of these programs was the *Step by Step Foot Project*, which was piloted and carried out in Tanzania and India.
- This program showed that ulceration, infection and limb amputation are potentially preventable.
“Step by Step Foot Project 2003”

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How to go about?

Very Important to Hit the Target

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Results I

- Over the entire study period (i.e., 2001 – 2008), the mean annual amputation rate among referrals was 17.6%
- Before the Step by Step program, trends in rates of amputation were upward
- By beginning of 2005, amputation rates had increased to >1 standard deviation (SD) below the mean

Effectiveness of “Step by Step” Project in Reducing Amputation Rates

Step by Step
Trends in Foot Problems, Tanzania

![Graph showing trends in foot problems and foot ulcers in Tanzania between Pre-2009, Jan-Dec 2009, and Jan-Jun 2010. The graph indicates an increase in foot problems and a decrease in foot ulcers over time.](image-url)
Step by Step
Trends in Outcomes, Tanzania
One diabetic foot clinic in Dar es Salaam, Tanzania

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Map Of Tanzania With Regions
2009 Course

We targeted 29 more centres in Tanzania
Now we have
29 + 14 = 43 clinics
more all over Tanzania in
21 regions

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Tanzanian SbS Projects

- 2004 and 2005 Basic & Advanced Course
- 2006 Podiatry Course
- 2008 and 2009 Basic & Advanced Course
- 2010 Podiatry Course
- 2010 & 2012 Surgeon course
Impact of the Course

- 43 foot clinic separate or combined all over the country
- Regular screening program
- Better management
- Reduction of amputation rate
- Teaching other colleagues in the hospital – cascading effect
Step by Step Africa 2004 - 2018
12 Countries 2004-18

Congo 2009-10
Guinea 2010-11
Botswana 2011-12
Malawi 2011-12

Zimbabwe 2015 - 17
Egypt 2009 - 10
Nigeria (82) 2017-18

Others
- S. Africa
- Ethiopia
- Mali

Outside Africa
- India
- St. Lucia
- Nepal
- Barbados
- Bangladesh
- Pakistan
- Dubai

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From Step by Step to ‘Train the Foot Trainer Course’
From Step by Step to ‘Train the Foot Trainer Course’

- TtFT IS a training programme that teaches course structure, organisation delivery methods and evaluation skills.

- TtFT IS a course run for experts to train others to become experts in clinical and education skills and knowledge.

- Three parts:
  - Step by Step Basic course
  - Step by Step Advanced Course
  - Implementation & data collection
Step by Step Foot Projects South America

- 14 Countries
  - Brazil
  - Argentina
  - Bolivia
  - Chile
  - Cuba
  - Colombia
- Mexico
- Panamá
- Paraguay
- Perú
- Uruguay
- Ecuador
- Venezuela
- Republica Dominicana
Caribbean Islands

- **22 Countries**
  - Barbados
  - St. Lucia
  - St. Maarten
  - British Virgin Island
  - Tobago
  - Grenada
  - Bermuda
  - Haiti
  - Jamaica
  - Belize
  - Curacao
  - Trinado
  - Dominica
  - St. Thomas
  - St. Kitty
  - Nevis
  - Antigua
  - Barbuda
  - Guatemala
  - Cayman Island
Step by Step in Europe

- 17 European Countries 2015:
  - Albania
  - Armenia
  - Bosnia
  - Herzegovina
  - Bulgaria
  - Croatia
  - Estonia
  - Greece
  - Kosovo
  - Latvia
  - Lithuania
  - Poland
  - Romania
  - Serbia
  - Slovenia
  - Sweden
  - Turkey
  - Ukraine
Western Pacific

13 Western Pacific Countries

Australia
Cambodia
China
Indonesia
Japan
Philippines
South Korea

Malaysia
Taiwan
Thailand
Vietnam
Mongolia
Singapore
Step by Step Foot Project – Developing Country Model

- Tanzania / India
  - Only unique model on diabetic foot started in Tanzania & India as piolet project and has been exported to several:
    - Developing world
    - 2nd world and now
    - Developed world

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Step by Step 2003 - 2018

Started in 2003
Tanzania / India

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Too Much Information
Five Cornerstones for Prevention

- Regular inspection and examination of feet and footwear
- Identification of the high risk foot
- Education of patients, family and healthcare workers
- Appropriate footwear
- Treatment of non-ulcerative pathology
Conclusion

- Efforts are required to increase awareness of diabetes and its complications amongst the health workers and patients.
- Early detection and treatment of diabetic complications will improve course of disease and reduce morbidity and mortality.
Thank You

Live as if you were to die tomorrow
Learn as if you were to live forever

Mahatma Gandhi

Education is the most powerful weapon which you can use to change the world

Nelson Mandela

Education is the only powerful tool we have it in developing world which is free of charge for the patients and effective if implemented

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