



# Evidence Summary

Addressing Non-Communicable  
Diseases: Effectiveness of  
Interventions Aiming at  
Reducing the Burden of Type 2  
Diabetes Mellitus

K2P Evidence summaries use global research evidence to provide insight on public health priority topics that are ambiguous and have important uncertainty. This 3–5 page document informs policymakers and other stakeholders by synthesizing the best available evidence and presenting its relevance to local contexts. Evidence summaries do not provide recommendations but rather articulate evidence in a clear, objective and factual manner.



# Evidence Summary

+ Included



**Synthesis** of evidence on a priority question or topic



Local context

x Not Included



Does not provide **recommendations**



**Faculty of Health Sciences**  
Knowledge to Policy | K2P | Center

## **K2P Evidence Summary**

# Addressing Non-Communicable Diseases: Effectiveness of Interventions Aiming at Reducing the Burden of Type 2 Diabetes Mellitus

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# Key Messages

# Key Messages

## The Problem

- The high and rising prevalence of type 2 diabetes mellitus is a global health problem
- Diabetes inflicts 9% of the global population and 12% of the Lebanese population (around half a million people)
- This disease is responsible for 1.5 million deaths and 89 million DALYs, and inflicts a significant burden on the medical, social, and economic levels
- Obesity, smoking, physical inactivity, aging, illiteracy, and poverty are among the leading factors strongly linked to diabetes mellitus
- Existing health system arrangements are not sufficiently addressing these underlying factors which leads to increased prevalence of diabetes mellitus

## Interventions Effectiveness

### → Patient Level

- Significant effects on diabetes prevention and control were observed when physical activity was combined with dietary changes
- Self-monitoring of blood glucose exerted non-sustained improvement of glycemic control
- Intensive blood pressure control was associated with a significant reduction in retinopathy, a non-significant trend towards reduction in total mortality, and no evident impact on the occurrences of stroke, myocardial infarction, or congestive heart failure
- Intensive blood sugar control was associated with a significant reduction in the incidence of neuropathy
- Psychological interventions resulted in inconclusive results regarding glycemic control despite improvement in co-existing depression
- Some Chinese herbal medicines exerted a favorable effect on diabetes prevention, glycemic control, and neuropathy recovery

### → Health System Arrangement Level

#### **Governance Level**

- Adoption and implementation of the case management model of care, which includes self-management support interventions and use of technology, resulted in an improvement in glycemic control

#### **Financing Level**

- Incentives had differential effects at different levels. Patient-targeted financial incentives induced favourable behavioural change, provider financial incentives modestly improved disease control, whereas simultaneous patient and provider financial incentives improved HbA1c, LDL, and blood pressure, and adequate screening and medications intake

### **Delivery level**

- Task shifting and incorporation of diabetes specialist nurse had favorable effects on disease outcomes including glycemic and blood pressure control, patient satisfaction, hospital admission, and mortality
- Home telehealth reduced the number of hospitalized patients and length of stay
- Patient education resulted in improvement in HbA1c levels, patients' self-care behavior, foot care knowledge, diagnosis, monitoring, hypoglycemia and hyperglycemia rates, medication intake, fasting blood glucose levels, body weight, systolic blood pressure, and need for diabetes medications
- Both patient focused interventions such as counselling, education, reminders, feedback, reinforcement, and care management and practitioner-focused interventions such as electronic feedback system resulted in improved adherence to medications

### → **Multi-level interventions**

- Integrated care approach, combining two or more of the above mentioned strategies on at least two different levels of care: the patient, the healthcare provider, or the structure of health care, demonstrated a significant and cost-effective reduction in lower extremity amputations and foot ulcers.
- Multifaceted professional interventions, such as postgraduate education, reminders, audit and feedback, local consensus processes, central computerized tracking systems, or nurses support, enhanced the performance of care providers and lead to improved delivery of care

### **Insights for Action**

#### → **Patient Level**

- Implement lifestyle modification aiming at weight loss, physical activity, dietary restrictions, and psychological well-being
- Comply with diabetes treatment with the possibility of using certain kinds of Chinese herbal medicine
- Apply firm blood pressure and glucose monitoring practices

#### → **System Arrangement Level**

- Adopt new programs or practices that incorporate the case management model, technology, and task shifting among health professionals
- Empower patients through education and encourage patient self-management
- Provide financial incentives for patients and providers

# Content

# Problem

## Problem Definition

The high and excruciatingly rising prevalence of type 2 diabetes mellitus is a global health problem. As such, diabetes mellitus inflicts a huge burden on the population at the medical, social, and economic levels.

## Size of the Problem

The global prevalence of diabetes was estimated to be 9% in 2014, with the highest rate of 14% noticed in the WHO Region of the Eastern Mediterranean Region and lowest rate of around 8% noted in the European and Western Pacific Regions (Beagley et al, 2014). Diabetes prevalence increased lately in most regions of the world, stabilized in some regions, but has not decreased in any region (Danaei et al, 2011).

Likewise regionally, high prevalence exists for diabetes and higher is anticipated in the years 2010–2030. The estimated prevalence is 18.7–21.4% United Arab Emirates, 16.8–18.9% in Kingdom of Saudi Arabia, 15.4–17.3% in Bahrain, 14.6–16.9% in Kuwait and 13.4–14.9% in Oman (IDF, 2009).

In Lebanon, 5.9% of surveyed aged 25-64 self-reported having ever been diagnosed with diabetes (Sibai et al, 2010). In another recent estimate, 12.2% of Lebanese adults were estimated to have diabetes, mounting to around 462 thousand patients (IDF, 2015). Such data might serve as an underestimate of the true prevalence of the disease due to under-reporting and the large proportion of undiagnosed diabetics who might not be captured through several estimation methods.

## Problem Consequences

In the absence of adequate preventive and counter strategies that match the size of the problem, this increased prevalence is problematic due to many reasons:

- Being a major killer: Diabetes was globally responsible for 1.5 million deaths in 2012 (Beagley et al, 2014) and ranked fourth in Lebanon among the leading causes of death (WHO and UN, 2015)
- Being a major cause of disability: Diabetes, along with cardiovascular diseases, was globally responsible for 89 million DALYs in 2012 (Beagley et al, 2014), and ranked first in Lebanon among the top causes of DALYs (WHO

# Background to Evidence Summary

*A K2P Evidence Summary uses global research evidence to provide insight on public health priority topics that are ambiguous and have important uncertainty. This document informs policymakers and other stakeholders by synthesizing the best available evidence and presenting its relevance to local contexts.*

*Evidence summaries do not provide recommendations but rather articulate evidence in a clear, objective and factual manner.*

## The preparation of this K2P Evidence Summary involved the following steps:

- 1) *Identifying and selecting a relevant topic according to K2P criteria.*
- 2) *Appraising and synthesizing relevant research evidence about the problem.*
- 3) *Drafting the Evidence Summary in such a way as to present global and local research evidence concisely and in an accessible language.*
- 4) *Undergoing merit review.*
- 5) *Finalizing the Evidence Summary based on the input of merit reviewers.*
- 6) *Submitting finalized Evidence Summary for translation into Arabic, validating the translation and Dissemination*

and UN, 2015).

- Being a major prerequisite for complications and co-morbidities: Diabetes is well recognized for its associations with cardiovascular disease, kidney failure, blindness and lower-limb amputation (Levitan et al, 2004).
- Bearing a solid impact on social and human development: There is strong evidence linking poverty, lack of education and other social inequities to diabetes (WHO, 2011).
- Bearing a solid impact on household income and economic development: Diabetes leads to loss of household income from unhealthy behaviors, poor physical capacity, long-term treatment, and high cost of health care. Concurrently, because of the magnitude of the illness, the disabilities, the premature deaths, and the long-term care required, diabetes reduces productivity and increases health care costs, thereby weakening national economic development (WHO, 2011).

### **Underlying Factors**

Obesity, smoking, physical inactivity, aging, illiteracy, and poverty are among the leading factors strongly linked to diabetes. Health system arrangements are accountable for the deficiency in tackling these elements, and thus can be held responsible for the increased prevalence of diabetes. Health system arrangements include: governance, financing, and delivery arrangements. In Lebanon, the features of these arrangements are described below:

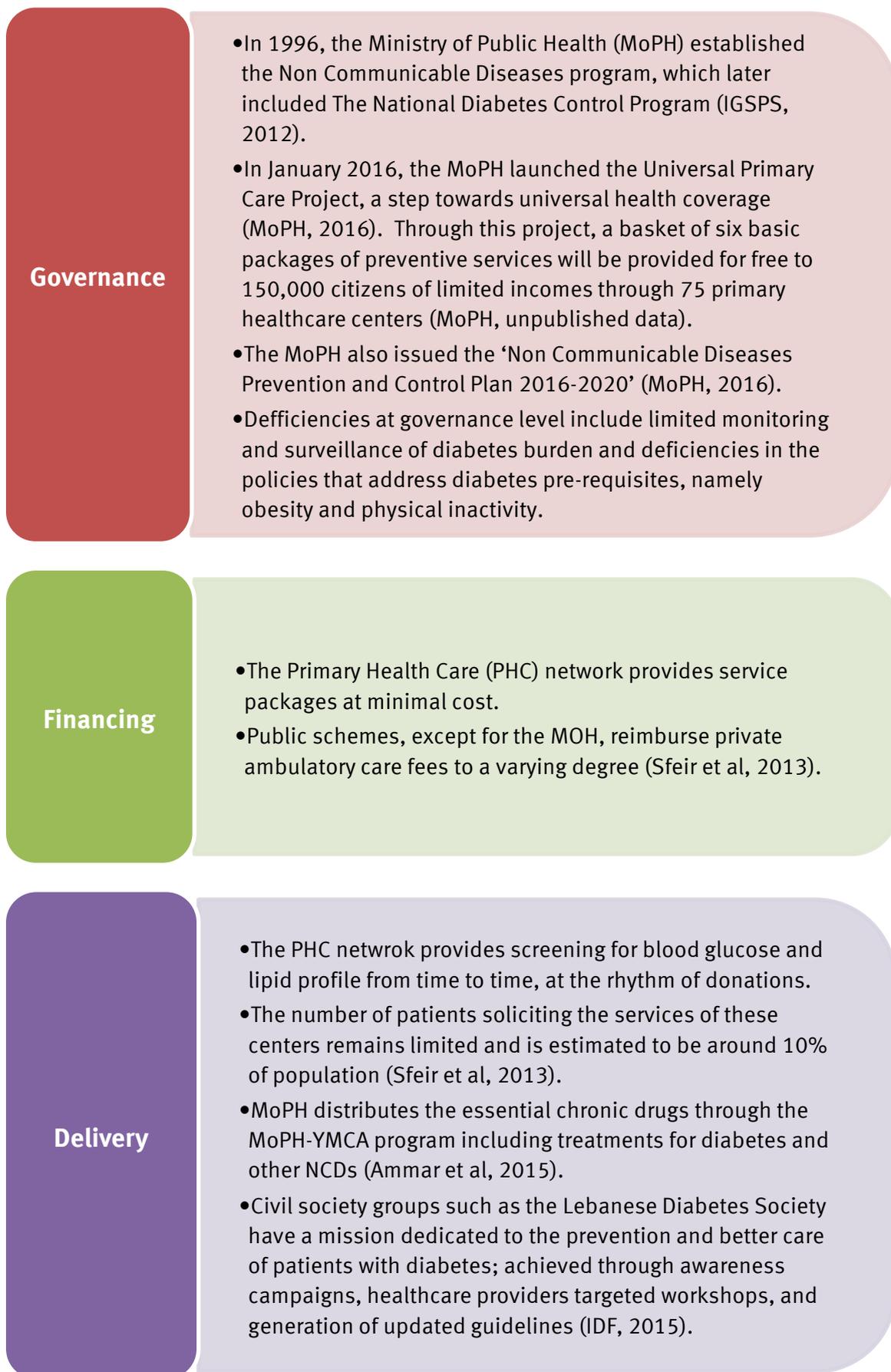


Figure 1 **Lebanese Context: Health System Arrangements for Type 2 Diabetes Mellitus**

# Evidence of Interventions Effectiveness

We conducted a thorough search for interventions aiming at reducing the burden of type 2 diabetes mellitus. Review of literature revealed 62 systematic reviews that presented interventions aiming at the prevention and multi-level management of type 2 diabetes mellitus. Search findings are summarized below.

## Patient Level

### Interventions Aiming at Primary Prevention

(Please see Annex, Table 1a for more information)

- For women with prior gestational diabetes, there is limited evidence to support the success of **dietary and physical activity programs** in preventing the progression into diabetes (Gilinsky et al, 2015).
- Significant effects on diabetes prevention were observed when **physical activity** was coupled with **dietary** changes (Norris et al, 2005; Orozco et al, 2008).
- **Chinese herbal medicines**, particularly when combined with lifestyle interventions, exerted a favorable effect on fasting plasma glucose (Grant et al, 2009).
- There was insufficient evidence to support a role for **zinc supplementation** (El Dib et al, 2015) or **whole grain foods intake** (Priebe et al, 2008).

### Interventions Aiming at Secondary Prevention

(Please see Annex, Table 1b for more information)

- **Self-monitoring** of blood glucose exerted non-sustained improvement of glycemic control (Malanda et al, 2012).
- Glycemic control, as measured by HbA1c levels, was significantly improved with the combination of **physical activity and dietary programs** (Nield et al, 2007); whereas the effect was less pronounced when independently considering each intervention (Umpierre et al, 2011; (Nield et al, 2007).
- **Psychological interventions**, particularly those delivered by a psychological specialist, resulted in improvement in HbA1c (Alam et al, 2008).

## Search Strategy

*The following databases were searched:*

- The Cochrane Library, where the search focused on systematic reviews addressing interventions at the patient level.
- Health Evidence and Health Systems Evidence databases where interventions at the level of the health system arrangement were explored. Except for systematic reviews addressing financing arrangements, only systematic reviews with strong quality ratings (AMSTAR ≥ 8) and LMIC focus were included in this evidence summary.
- In the absence of an adequate number of systematic reviews addressing financing arrangements, the search strategy in this field allowed inclusion of studies generally addressing non-communicable diseases, and with no selectivity for specific quality ratings or country focus.

- Favorable effects on glycemic control were noted with **Chinese herbal medicines** (Liu et al, 2002) and **sweet potato** (Ooi and Loke, 2013), whereas **cinnamon** (Leach and Kumar, 2012) and **Omega-3 polyunsaturated fatty acids** (Hartweg et al, 2008) had no significant effect on HbA1c.

### **Interventions Aiming at Tertiary Prevention**

(Please see Annex, Table 1c for more information)

- **Lifestyle interventions** were associated with improvement in many health outcomes including blood pressure, body mass index (Uthman et al, 2015), along with lower rates of stroke, myocardial infarction, amputations, and death (Sumamo et al, 2011).
- **Intensive blood pressure control** was associated with a significant reduction in the incidence of retinopathy (Do et al, 2015), a non-significant trend towards reduction in total mortality, and no evident impact on the occurrences of stroke, myocardial infarction, or congestive heart failure (Arguedas et al, 2013).
- **Intensive blood sugar control** was associated with a significant reduction in the incidence of neuropathy (Callaghan et al, 2012).
- **Psychological interventions** targeting depression showed beneficial effects with inconclusive results regarding glycemic control (Baumeister et al, 2012).
- **Chinese herbal medicine** resulted in improvement in numbness and pain along with changes in nerve conduction velocity (Chen et al, 2013); whereas **selenium supplementation** failed to demonstrate any significant effect (Rees et al, 2013).

### **Health System Arrangement Level**

#### **Governance Level**

(Please see Annex, Table 2a for more information)

- **Self-management support interventions**, including those incorporating the use of technology, resulted in improved glycemic control (Minet et al, 2009) with a small positive effect noticed on cost, hospital use, and quality of life (Panagioti et al, 2014).
- Compared to usual care, **technology-based self-management** resulted in a significant reduction in HbA1c (Tao and Or, 2013; Pal et al, 2013; Coulter et al, 2015). Effect was most significant in the mobile phone subgroup (Pal et al, 2013), with a web-based application, when a mechanism for patients' health data entry is provided, or when the technology can be operated at home or without location restrictions (Tao and Or, 2013).

- Adoption of the **case management model of care** resulted in a positive impact on HbA1c levels, patient, and caregiver satisfaction but no significant benefit on lipid levels, body weight, or mortality rates (Hickam et al, 2013).
- **Case management interventions** produced mixed results in terms of improving patient quality of life and functional status (Hickam et al, 2013).

### Financing Level

(Please see Annex, Table 2b for more information)

- Evidence was inconclusive on whether **increasing resources for primary health care** reduced avoidable hospital admissions for diabetics (Gibson et al, 2013).
- **Personal financial incentives** increased behavior-change, with effects sustained until 18 months from baseline and three months post-incentive removal (Mantzari et al, 2015).
- **Provider financial incentives** were generally associated with modest improvements in patient disease control (Gillam et al 2012; Scott et al, 2011; Langdown and Peckham, 2013).
- Evidence on **multilevel financial incentives** revealed statistically significant improvements HbA1c, LDL, and blood pressure, and adequate screening and medications intake (Tricco et al, 2012).

### Interventions at the Delivery level

(Please see Annex, Table 2c for more information)

- Interventions Involving the Health Provider
  - **Task shifting** resulted in significant reduction in blood pressure and HbA1c levels (Ogedegbe et al, 2014).
  - **Substitution of physicians by nurses** resulted in higher overall patient satisfaction along with reduced systolic blood pressure, hospital admission, and mortality. No statistically significant differences were noted between the groups in the reduction of diastolic blood pressure, total cholesterol, or HbA1c (Martínez-González et al, 2014).
  - **Incorporation of a diabetes specialist nurse** in the delivery of care resulted in a significant decrease in HbA1c at 6 months, but the effect was not sustained at 12 months. There were also significantly less hypoglycemia and hyperglycemia episodes in the intervention group (Loveman et al, 2009).
  - **Pharmacist-provided services** resulted in a small improvement of clinical outcomes such as blood pressure, total cholesterol (Pande et al, 2012; Santschi et al, 2012), triglyceride, glucose (Pande et al, 2012), LDL, and BMI (Santschi et al, 2012). Additionally, there was an

improvement in the quality of life, health services utilization, cost, rate of hospitalization, and emergency room visits (Pande et al, 2012).

→ Interventions Involving the Use of Technology

→ Mixed results in terms of glycemic control were noted for the use of **telephone support** (Polisena et al, 2008; de Jongh, 2012; Saffari et al, 2014).

→ **Home telehealth** reduced the number of hospitalized patients length of stay with possibility of modest effects on quality-of-life and patient satisfaction (Polisena et al, 2008).

→ Interventions Involving Education and Training

→ **Patient education** resulted in improvement in HbA1c levels (Attridge et al, 2014; Deakin et al, 2009), patients' self-care behavior (Dorresteijn et al, 2014, Li et al, 2011), foot care knowledge (Dorresteijn et al, 2014), diagnosis, monitoring, hypoglycemia and hyperglycemia rates, medication intake (Li et al, 2011) fasting blood glucose levels, body weight, systolic blood pressure, and need for diabetes medications (Deakin et al, 2009).

→ Mixed evidence concerning effectiveness of **education** on the incidence of foot ulceration or amputation (Dorresteijn et al, 2014) and neutral effects on health-related quality of life measures were noted (Attridge et al, 2014).

→ **Diverse educational programs** in type 2 diabetes did not yield consistent results (Loveman et al, 2003).

→ There was no significant difference between **individual and group educational interventions** (Duke et al, 2009).

→ Interventions Targeting Adherence to Treatment

→ Patient focused **interventions such as counseling, education, reminders, feedback and reinforcement, and care management** and **practitioner-focused interventions** such as **electronic feedback system** resulted in improved adherence to medications (Schoenthaler, 2013).

→ **Nurse led interventions, home aids, diabetes education, pharmacy led interventions, and adaptation of dosing and frequency of medication** taking did not show significant effect or harm on a variety of outcomes including HbA1c (Vermeire et al, 2005; Nieuwlaat et al, 2014).

### **Multi-level interventions**

(Please see Annex, Table 3 for more information)

→ **Integrated care approach**, which combines different strategies at different levels (organizational, professional and financial levels),

demonstrated a significant and cost-effective reduction in lower extremity amputations and foot ulcers (Hoogeveen et al, 2015).

.....➤ **Multifaceted professional interventions** enhanced the performance of care providers and lead to improved delivery of care for patients with diabetes. The effect on control of disease, cardiovascular risk factors, and wellbeing was less clear (Renders et al, 2009).

# Insights for Action

Based on the Lebanese context and the specific available evidence described in this summary, the following measures can act as a step towards alleviating the high burden of type 2 diabetes mellitus:

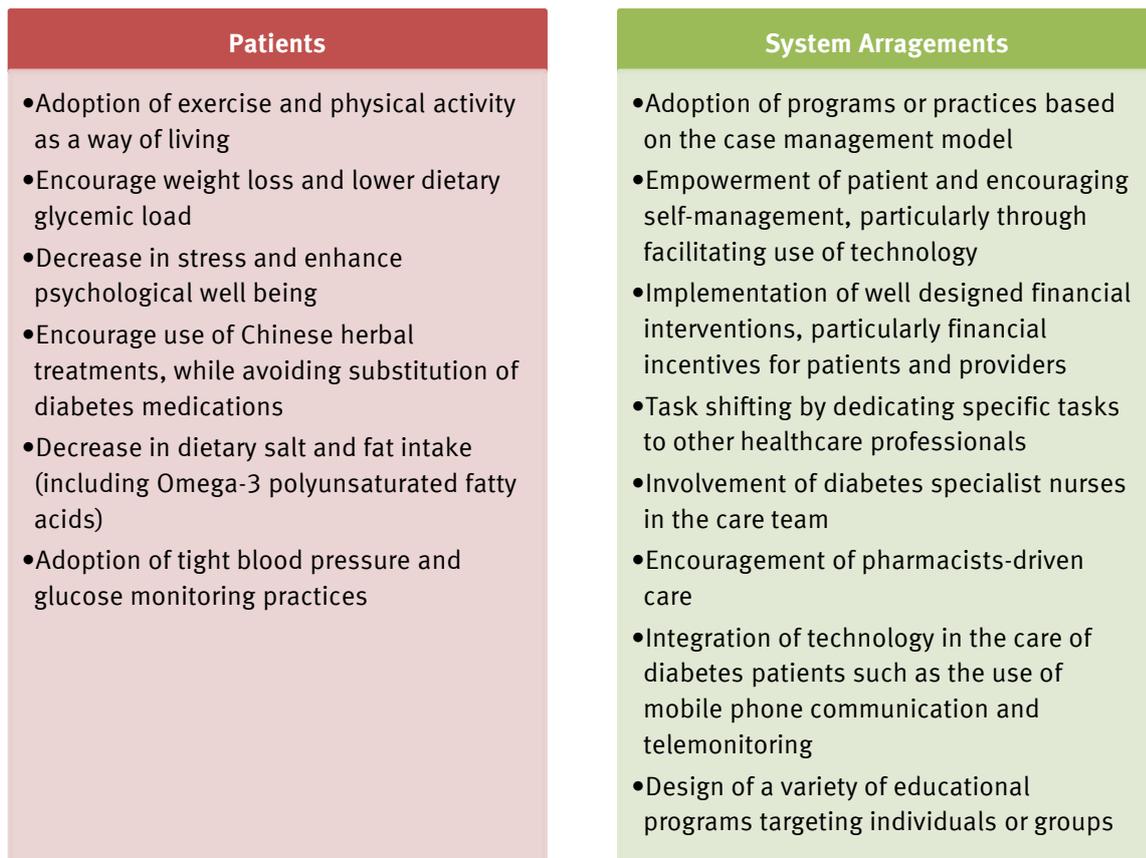


Figure 2 **Action at different levels**

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# Annexes

# Annexes

Table 1 **Interventions at the Patient Level**

Table 1a **Interventions Aiming at Primary Prevention**

Intervention	Impact
Life style modification (dietary and physical activity interventions)	<ul style="list-style-type: none"> <li>-For women with prior gestational diabetes, there is limited evidence to support the success of dietary and physical activity programs in preventing the progression into diabetes (Gilinsky et al, 2015).</li> <li>-One systematic review demonstrated weight loss of around 3.3% after 1 year. This was accompanied with modest improvements in glycemic control, blood pressure, and lipid concentrations (Norris et al, 2005).</li> <li>-Exercise plus diet interventions reduced the risk of diabetes compared with standard recommendations with a relative risk reduction of 0.63</li> <li>-No statistical significant effects on diabetes incidence were observed when comparing exercise only interventions either with standard recommendations or with diet only interventions (Orozco et al 2008).</li> </ul>
Zinc supplementation	Insufficient evidence to recommend zinc supplementation for the prevention of type 2 diabetes mellitus (El Dib et al, 2015).
Whole grain foods	Evidence too weak to be able to draw a definite conclusion about the preventive effect of whole grain foods on the development of diabetes (Priebe et al, 2008).
Chinese herbal medicines	Patients receiving Chinese herbal medicines combined with lifestyle modification were more than twice as likely to have their fasting plasma glucose levels return to normal levels and less likely to progress to diabetes compared to lifestyle modification alone (Grant et al, 2009).

Table 1b **Interventions Aiming at Secondary Prevention**

Intervention	Impact
Self-monitoring of blood glucose	<ul style="list-style-type: none"> <li>-Effect on glycemic control is small up to six months after initiation and subsides after 12 months.</li> <li>-There is no evidence that self-monitoring affects patient satisfaction, general well-being, or general health-related quality of life (Malanda et al, 2012).</li> </ul>

Intervention	Impact
Physical activity	<p>-In 3 reviews, exercise significantly improved glycemic control as indicated by a decrease in HbA<sub>1c</sub> levels of 0.6% (Thomas et al, 2006) and 0.45% (Conn et al, 2007), and 0.67% (Umpierre et al, 2011).</p> <p>- In one study, physical activity advice alone was not associated with HbA<sub>1c</sub> changes. (Umpierre et al, 2011)</p> <p>-Another systematic review assessing effect of dietary interventions reported the absence of high quality data on their efficacy in patients with type 2 diabetes, however the data indicated that the adoption of exercise appears to improve HbA<sub>1c</sub> at six and twelve months (Nield et al, 2007).</p>
Dietary programs	<p>-In one review, pooled weight loss for any intervention in comparison to usual care was 1.7 kg, or 3.1% of baseline body weight. Changes in HbA<sub>1c</sub> corresponded to changes in weight but were not significant (Norris et al, 2005)</p> <p>-Diets with low glycemic index were associated a significant decrease in HbA<sub>1c</sub> levels with a weighted mean difference of -0.5 % (Thomas and Elliott, 2008).</p>
Smoking cessation interventions	Non-significant higher biochemically-verified smoking cessation rates were noted in patients who received more intensive interventions (Nagrebetsky et al, 2014).
Psychological interventions	Interventions delivered by diabeticians or general clinicians reduced HbA <sub>1c</sub> by 0.51% whereas interventions delivered by psychological specialists reduced HbA <sub>1c</sub> by 0.57% (Alam et al, 2008).
Omega-3 polyunsaturated fatty acids supplementation	Evidence suggests lowering of triglycerides and VLDL cholesterol, but the possibility of raising LDL cholesterol. However, no statistically significant effect on glycemic control or fasting insulin (Hartweg et al, 2008).
Cinnamon	No statistically significant difference between cinnamon and placebo in levels of fasting or postprandial glucose levels or rate of adverse events (Leach and Kumar, 2012).
Chinese herbal medicines	Result of systematic review revealed significant glucose-lowering effects with the use of some herbal mixtures. Definite conclusions could not be drawn due to due to methodological deficiencies (Liu et al, 2002).
Sweet potato	Evidence demonstrated a statistically significant improvement in HbA <sub>1c</sub> at 3-5 months with 4 g/day sweet potato preparation compared to placebo (Ooi and Loke, 2013).

Table 1c **Interventions Aiming at Tertiary Prevention**

Intervention	Impact
Health promotion interventions	<p>-The pooled effect in 1 systematic review indicated a reduction in blood pressure, body mass index, and waist circumference with a mean difference of -6.72/-4.40 mmHg, -0.76 kg/m<sup>2</sup>, and -3.31 cm respectively (Uthman et al, 2015)</p> <p>-Another review, which included medication as part of the lifestyle interventions, found that the intervention decreased the number of nonfatal strokes, nonfatal myocardial infarctions, amputations, and death at 13.3 years of follow up. However, there was also a difference between groups in the progression of autonomic neuropathy in favor of the lifestyle intervention (Sumamo et al, 2011).</p>
Intensive blood pressure control	<p>-One systematic review revealed a non-significant trend towards reduction in total mortality in the group assigned to the lower diastolic blood pressure target, mainly due to a trend to lower non-cardiovascular mortality. There was no difference in stroke, myocardial infarction, or congestive heart failure (Arguedas et al, 2013).</p> <p>-Intensive blood pressure control was associated with a protective RR of diabetic retinopathy of 0.80 after 5 years of follow up. Moreover, the combined outcome of incidence and progression of retinopathy was also lower with strict blood pressure control with an estimated RR of 0.78 (Do et al, 2015).</p>
Enhanced glucose control	<p>Annualized risk reduction of developing clinical neuropathy in the group receiving enhanced glucose control was -0.58% (Callaghan et al, 2012).</p>
Low salt intake	<p>Salt restriction resulted in a median reduction in urinary sodium of 125 mmol/ 24 h (7.3 g/day) and BP reduction by -6.90/-2.87 mm Hg (Suckling et al, 2010).</p>
Selenium supplementation	<p>-There were no statistically significant effects of selenium supplementation on all cause mortality, cardiovascular disease, non-fatal cardiovascular events, or all cardiovascular events (Rees et al, 2013).</p> <p>-There was a small increased risk of type 2 diabetes with selenium supplementation but this increase did not reach statistical significance (Rees et al, 2013).</p>
Chinese herbal medicine	<p>-Results from one systematic review revealed global symptom improvement, which included improvement in numbness and pain along with changes in nerve conduction velocity (Chen et al, 2013).</p> <p>-However, the positive results described were of low</p>

Intervention	Impact
Psychological and pharmacological interventions	<p>quality and therefore questionable significance (Chen et al, 2013).</p> <p>-Psychological intervention studies showed beneficial effects on depression severity (Baumeister et al, 2012).</p> <p>-Evidence regarding glycemic control was heterogeneous and inconclusive (Baumeister et al, 2012).</p>

Table 2 **Interventions at the Health System Arrangement Level**

Table 2a **Interventions at the Governance Level**

Intervention	Impact
Self management	<p>-In one systematic review, self-management support interventions had a small but positive impact on health outcomes, with only a small minority of studies included in the review reporting decrements in cost, hospital use, and quality of life (Panagioti et al, 2014).</p> <p>-Another review revealed 0.36% improvement in glycemic control in people who received self-care management (Minet et al, 2009).</p>
Technology-based self management	<p>-Results revealed significant reduction in HbA<sub>1c</sub> compared to usual care, with a pooled standardized mean difference in three studies of 0.30% (Tao and Or, 2013), 0.2% (Pal et al, 2013), and 0.24% (Coulter et al, 2015).</p> <p>-The effect size on HbA<sub>1c</sub> was larger in:</p> <ul style="list-style-type: none"> <li>-The mobile phone subgroup with a mean decrease in HbA<sub>1c</sub> of 0.5% (Pal et al, 2013);</li> <li>-When the technology is a web-based application, when a mechanism for patients' health data entry is provided, and when the technology can be operated at home or without location restrictions (Tao and Or, 2013).</li> </ul>
Case management	<p>-Case management had a positive impact on HbA<sub>1c</sub> levels, patient, and caregiver satisfaction but has not been found to have a significant benefit for improving lipid levels, body weight, or mortality rates (Hickam et al, 2013).</p> <p>-Case management interventions produced mixed results in terms of improving patient quality of life and functional status (Hickam et al, 2013).</p>

Table 2b **Interventions at the Financing Level**

Intervention	Impact
Resourcing of primary health care	Evidence was inconclusive on whether increasing resources for primary health care reduced avoidable hospital admissions for people with diabetes (Gibson et al, 2013)
Multilevel financial incentives (targeting health systems, health-care professionals, or patients)	-Results revealed statistically significant improvements HbA <sub>1c</sub> , LDL, and blood pressure -The likelihood of patients receiving aspirin and anti-hypertensive drugs was also statistically significantly higher as was the rate of screening for retinopathy, renal function and foot abnormalities. -There were no statistically significant differences in statin use, hypertension control, or smoking cessation (Tricco et al, 2012).
Personal financial incentives	Financial incentives increased behavior-change, with effects sustained until 18 months from baseline and three months post-incentive removal (Mantzari et al, 2015)
Provider financial rewards for achieving standards	In one review, financial incentives were associated with improvements in patient disease control with effect size of 0.40 (Weingarten et al, 2002), whereas three other reviews found only modest effects at best (Gillam et al 2012; Scott et al, 2011; Langdown and Peckham, 2013)

Table 2c **Interventions at the Delivery Level**

Intervention	Impact
<b>Interventions Involving the Health Provider</b>	
Task shifting	-Studies reporting on hypertension reported a significant mean blood pressure reduction (between 2/1 mm Hg and 30/15 mm Hg). -The diabetes trial reported a reduction in the HbA <sub>1c</sub> levels of 1.87% (Ogedegbe et al, 2014).
Role of pharmacists	-Pharmacist-provided services resulted in a small improvement of clinical outcomes such as blood pressure, total cholesterol (Pande et al, 2012; Santschi et al, 2012), triglyceride, glucose (Pande et al, 2012), LDL, and BMI (Santschi et al, 2012). -There was an improvement in the quality of life, health services utilization, cost, rate of hospitalization, and emergency room visits (Pande et al, 2012).
Role of diabetes specialist nurses	HbA <sub>1c</sub> in the intervention group decreased significantly at 6 months, but the effect was not sustained at 12-

Intervention	Impact
	months. There were significantly less hypoglycemia and hyperglycemia episodes in the intervention group (Loveman et al, 2009).
Substitution of physicians by nurses	<p>-Pooled results showed higher overall patient satisfaction with nurse-led care associated with reduced hospital admission and mortality (Martínez-González et al, 2014).</p> <p>-Meta-analyses showed greater reductions in systolic blood pressure in favor of nurse-led care, but no statistically significant differences were noted between groups in the reduction of diastolic blood pressure, total cholesterol, or HbA<sub>1c</sub> (Martínez-González et al, 2014).</p>
<b>Interventions Involving the Use of Technology</b>	
Mobile phone messaging	<p>-In one study, no statistical difference was found when comparing text messaging interventions with usual care or email reminders for outcomes such as HbA<sub>1c</sub>, complications, or body weight (de Jongh, 2012)</p> <p>-Another study revealed a 50% reduction in HbA<sub>1c</sub> with mobile text messaging with an effect size greater among studies that used both SMS and internet for health education (Saffari et al, 2014).</p>
Home telehealth	<p>-Home telehealth helps to reduce the number of patients hospitalized and length of stay but was similar or favorable to usual care across studies for quality-of-life and patient satisfaction outcomes (Polisena et al, 2008).</p> <p>-Telemonitoring had a positive effect on glycemic control compared with usual care, with a weighted mean difference of -0.21</p> <p>-Results were mixed for telephone support (Polisena et al, 2008).</p>
<b>Interventions Involving Education and Training</b>	
Education	<p>-Mixed evidence concerning effectiveness of education on the incidence of foot ulceration or amputation (Dorresteijn et al, 2014)</p> <p>-Improvement in patients' self-care behavior was noted (Dorresteijn et al, 2014) in addition to improvement in foot care knowledge (Dorresteijn et al, 2014), diagnosis, monitoring, hypoglycemia and hyperglycemia rates, medication intake, personal health habits, and diet (Li et al, 2011).</p> <p>-Culturally-appropriate health education showed improvement in HbA<sub>1c</sub> at 3 and 6 months, with a less sustained effect at 12 and 24 months (Attridge et al, 2014)</p>

Intervention	Impact
	<ul style="list-style-type: none"> <li>-Neutral effects on health-related quality of life measures were noted (Attridge et al, 2014)</li> <li>-Individual patient education results in a benefit on glycemic control only in the subgroup of patients with a baseline HbA<sub>1c</sub> greater than 8%.</li> <li>-Comparing group and individual education revealed no difference on HbA<sub>1c</sub> at 12 to 18 months (Duke et al, 2009)</li> <li>-In another review, meta-analyses of group-based diabetes education programs resulted in reduction in HbA<sub>1c</sub>, fasting blood glucose levels, body weight, systolic blood pressure, and need for diabetes medications (Deakin et al, 2009).</li> <li>-Diverse educational programs in type 2 diabetes did not yield consistent results (Loveman et al, 2003).</li> </ul>
<b>Interventions Targeting Adherence to Treatment</b>	
Interventions for improving adherence to treatment recommendations	<ul style="list-style-type: none"> <li>-Nurse led interventions, home aids, diabetes education, pharmacy led interventions, adaptation of dosing and frequency of medication taking did not show significant effect or harm on a variety of outcomes including HbA<sub>1c</sub> (Vermeire et al, 2005; Nieuwlaat et al, 2014).</li> <li>-Patient-focused interventions (counseling, education, reminders, feedback and reinforcement, and care management) resulted in improvements in HbA<sub>1c</sub> with medication adherence, with an average reduction of -0.88% (Schoenthaler, 2013).</li> <li>-Practitioner-focused trials involving interventions such as electronic feedback systems revealed that at 15-months of follow-up, patients in the intervention group were significantly more likely to redeem prescriptions for their initial oral medication (Schoenthaler, 2013).</li> </ul>

Table 3: Multilevel Interventions

Intervention	Impact
Integrated care models	<ul style="list-style-type: none"> <li>-Integrated care approach demonstrated a significant and cost-effective reduction of lower extremity amputations and foot ulcers (Hoogeveen et al, 2015).</li> <li>-Multifaceted professional interventions enhanced the performance of care providers and lead to improved delivery of care for patients with diabetes. The effect on control of disease, cardiovascular risk factors, and wellbeing is less clear (Renders et al, 2009).</li> </ul>

Table 4: **List of herbal medicines with proven efficacy on diabetes control**

- Jiangtang Bushen decoction
- Xiaoke huaya tablet
- Qimai jiangtang yin decoction
- Jinqi jiangtang tablets
- Xiaoke yuye decoction
- Liu wei di huang tang
- Tang kang yin decoction
- Jian pi zhi shen huo xue.
- Danzhi jiangtang jiao capsules
- Bofu-Tsusho-San
- Qi wei tang ping capsules
- Yi qi yang yin huo xue

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