TELEMEDICINE IN CHRONIC DISEASE MANAGEMENT – THE WAY FORWARD

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INTRODUCTION

An electronic health record platform with telemedicine and data analytics capabilities is a powerful platform that can help make a difference in chronic disease management by various care providers.

Chronic Disease Management System or CDMS is one such product. CDMS is a comprehensive medical and health record web application that provides the platform for the multi-disciplinary group of care providers to share their resources and communicate, as well as using telemedicine as enabler of communication that is important to ensure timeliness and effectiveness of information presentation for patient care and intervention of chronic diseases.

Diabetes, hypertension, hyperlipidemia and other chronic diseases are common in Malaysia. Results from the National Health Morbidity Survey in 2015 for adults aged 18 years or older, 3.5 million adults were found to have diabetes, 6.1 million had hypertension and 9.6 million had hypercholesterolemia. There was also an alarming rate of undiagnosed diseases; 9.2% for diabetes, 17.2% for hypertension and 38.6% for hypercholesterolemia. Patients with chronic diseases require lifetime care. They may develop complications such as diabetic retinopathy, diabetic nephropathy, diabetic foot problems, cardiovascular disease, etc if their conditions are not controlled or treated early.

Data from the 1997 Diabetes Info Series I published by the Ministry of Health Malaysia and Academy of Medicine indicates that diabetic retinopathy is one of the leading causes of blindness amongst Malaysian adults. More than half of diabetic patients will have pathological changes in both eyes in a matter of years which will eventually lead to blindness. From the MOH Diabetic Retinopathy registry 2008, among 19,632 diabetics seen for the first time at MOH Ophthalmology clinics, 9% of eyes were blind (VA worse than 3/60), 27% has low vision and 34.6% has some form of DR. In addition, diabetes mellitus also accounted for more than half of the primary renal disease among new dialysis patients in the last 10 years, with 61% in 2014.

Comprehensive care by multi-disciplinary team of care providers shows marked improvement in chronic disease control.(1) Locally, several Telemedicine based cardiovascular Risk Factors Intervention Strategies (CORIS) study had shown that the proportion of patients achieving target Blood Pressure in patients with hypertension is significantly higher than those receiving normal care.(2)

METHOD

Chronic Disease Management System or CDMS is a comprehensive medical and health record web application that includes many modules as below to cater for the multi-disciplinary group of care providers at local site as well as specialists who are at hospital.

The clinic module is used by the team at the clinic.

Clinic Module

The Clinic module enables multi-disciplinary team at clinic that provides direct care to patients, communicate and share their data with the various forms and real time reports presented in the system. Some of the support flow is built into the system to guide better, consistent care to patients. Data collection includes demographics, social history, medical history, complications, allergy, physical examination, drug prescription, adverse event reporting, lab examination, clinical events, case notes of various groups of care providers, alert on Tel-Consulting review feedback, patient self-monitoring result, etc.

The tele medicine module enables remote consultation by various specialists as follows to ensure timeliness and effectiveness of information presentation for patient care and intervention of chronic diseases.

Tele DR By Ophthalmologist

The TeleDR (Tele Diabetic Retinopathy) module used telemedicine with mydriatic cameras to capture fundus images. Through the images that are auto transferred to CDMS, fundus camera oparates as review and identifies urgent / non urgent cases as well as identify eye diseases of patients, in particular stages of diabetic retinopathy, maculopathy, glaucoma, age related macular degeneration and others. Patients with non urgent problem will continue regular follow up at local clinic while urgent cases are referred to ophthalmologist at hospital. Ophthalmologist at hospital also has access to the system to review patient’s information and update the outcome of the patient.

Tele OP By Orthopedist

The TeleOP (Tele Diabetic Foot) module used telemedicine to synchronise photo of patient’s foot to the CDMS system. Through clinical decision support feature, foot problems detected during physical examination through a series of flows of care and review if necessary, referred to Orthopedist at hospital. Orthopedist at hospital also has access to the system to review patient’s information, foot photo and update the outcome of the patient in the system.

Tele NEP By Nephrologist

With built in analytics algorithm that analyses various lab data, vital signs data and physical examination data, the TeleNEP (Tele Nephrology) module auto generates list of patients at risks to nephrologist

Tele Diet By Dietitian/Nutritionist

The TeleDiet (Tele Dietary Advice and Counseling) module auto generates list of patients at risk to either the local dietitian or diabetes nurse educator, or nutritionist at state hospital.

Tele ECG By Cardiologist

The TeleECG (Tele Electrocardiogram) module used telemedicine with ECG machine to enable remote screening by cardiologist to determine whether it is an urgent case that require immediate referral to cardiologist at hospital.

Cardiovascular Risk Assessment

Various cardiovascular risk scores are presented to the specialists and health personnel who needs this information for planning suitable treatment for patient.

Identifying patients at risk early is important to enable patients to receive appropriate treatment and education early, i.e prevention is better than cure.

The system is located at a highly secured and state-of-the-art data centre. The application has built in security features that ensures preservation of security, integrity, confidentiality and privacy of patient information. Security features implemented are in line with Health Information Portability and Accountability Act (HIPAA) guidelines. Please contact us for more details.

RESULTS

CDMS has been used for CORIS project by private General Practitioners and by a number of government primary care clinics in state of Terengganu.

To date, there are only publications on tele diabetic retinopathy module. Results from other modules are unavailable due to no analysis has been done or published. Thus comparison is only made against TeleDR module.

Case Study 1: TeleDR Outcome Study from October 2009 to September 2010 from a 2010 presentation ‘TeleDR Outcome Study from Jan 2016 to June 2016’

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Case Study 1 1/16 to 30/6/2016 result from Gradeable photos (condensed both eyes)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total diabetic registered</td>
<td>2127</td>
<td>9443</td>
</tr>
<tr>
<td>2</td>
<td>Total fundus photo taken</td>
<td>1987</td>
<td>5665</td>
</tr>
<tr>
<td>3</td>
<td>Total sites with fundus machine</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>% with at least 1 fundus exam within the year</td>
<td>92.40%</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>Average turn around time those marked URGENT</td>
<td>50% seen within 7 days</td>
<td>63.5% within 3 weeks</td>
</tr>
</tbody>
</table>

From October 2009 to September 2010, only 1997 fundus photos were taken from 7 sites. In comparison, in just 6 months in 2016, the number of fundus photos taken from 15 sites is significantly higher at 9665 photos. More sites were recruited in the hope to achieve more detection coverage.

Every patient enrolled in the system are patients under diabetic program in Klinik Kesihatan in Terengganu state. Hence, there was a 100% achievement of at least 1 fundus exam taken within a year. Some patients had more than 1 fundus exam taken in a year.

The average turn-around time for URGENT cases have improved from 56% to 69.3% seen within 7 days. Based on procedure, Ophthalmologist would review Urgent cases while 1st and 2nd grader would review non urgent cases. It was noted that there were some camera operators who mistakenly marked non urgent cases as urgent. To overcome the problem, initiative has been taken to plan for 2 times course yearly instead of once a year.

Case Study 2: Findings of fundus images from Jan 2016 to June 2016

<table>
<thead>
<tr>
<th>Category</th>
<th>Types Of Photos</th>
<th>1/1/16 to 30/6/2016 result from Gradeable photos (condensed both eyes)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic Retinopathy</td>
<td>No Diabetic Retinopathy</td>
<td>4325</td>
<td>60.90</td>
</tr>
<tr>
<td></td>
<td>Mild NPDR</td>
<td>472</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Moderate NPDR</td>
<td>367</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>Severe NPDR</td>
<td>106</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>PDR</td>
<td>68</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Amy Diabetic Eye Disease</td>
<td>20</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Maculopathy</td>
<td>520</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Glaucoma Suspect</td>
<td>205</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>ARVD</td>
<td>83</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Other Diagnosis</td>
<td>292</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Through the fundus image screening, majority (69%) of the diabetic patients did not have diabetic retinopathy. Thus, they do not need to be seen by ophthalmologist at hospital, which reduces workload of ophthalmologists at state hospital.

Sight threatening cases comprising of patients with severe non proliferative diabetic retinopathy (NPDR), proliferative diabetic retinopathy (PDR), advanced diabetic eye disease and maculopathy were picked up by the system for ophthalmologist to take action. It is hoped that through screening and treatment at an early stage, less patients would progress to blindness.

As additional benefit of the TeleDR, it was not only used for screening for DR but also detected other sight threatening diseases like glaucoma and age related macular disease.

CONCLUSION

Many data are captured routinely in Electronic Health Records. With some data mining and data analytics applied, these data are useful for early prevention or control of patient’s condition with the right intervention. Combined with telemedicine capability, chronic disease management which encompasses many discipline of care may come under one platform to better manage patient’s condition. The benefits of telemedicine in chronic disease management have been outlined in Telemedicine Cuts Costs and Improves Outcomes in Chronic Disease Management (4) and The Empirical Foundations of Telemedicine Interventions for Chronic Disease Management (5) which provided a comprehensive and systematic review of the scientific evidence regarding the benefits and impact of telemedicine.

The CDMS system shows many benefits for chronic disease management:

• as electronic health record (EHR)
• enable ease of care coordination
• improved continuity of care and communication of care among multidisciplinary teams
• provides faster and real time remote assessment of health-related information / images
• facilitate communication and prompt referral from primary care clinics to specialists in tertiary healthcare institutions
• provide tool for patients for self-management
• cuts the costs and time of travelling etc many other benefits.

The system can be used as a whole or just the specific telemedicine component to cater for the specific needs. Eg. User can select to use only CDMS’s TeleDR module for eye screening and referral purpose.

It is hoped that the system can be used to benefit the care of more patients with chronic diseases.