WHITE PAPER

Remote Diagnostic Imaging

Improving Access to Ultrasound Imaging

Health City

Remote Diagnostic Imaging: Improving Access to Ultrasound Imaging

Background: The Issue

Accessing specialized and acute care is a challenge for many residents of rural and remote areas across Alberta and Canada. In the 2015 Rural Health Services Review Final Report, Albertans in rural communities described access to specialized service as an "ongoing challenge" that puts them at a considerable disadvantage for receiving such services and any follow-up treatment.[1]

By definition, specialty services typically require specific skill-sets or training. Diagnostic procedures such as x-ray and ultrasound commonly demand specialized training, making them less readily available to rural and remote communities in Alberta due to difficulties recruiting and retaining highly trained specialized individuals. As a result, in an effort to decrease healthcare spending, ultrasound and x-ray machines have been removed from many small rural settings. These changes often result in additional travelling and cost for patients and families who need to travel longer distances in order to access adequate healthcare.

When the Rural Health Services Review was conducted in 2015, communities in rural Alberta believed that mobile services, and new technologies for diagnostic procedures have the potential to improve access to specialized services. Ultrasound hardware is becoming more portable and inexpensive. Unlike other imaging modalities, a handheld ultrasound probe can be deployed at any point of care; however, acquiring and understanding the generated images is difficult, and currently requires scarce and costly human expertise. This is where Medo's technology comes in offering a simple, reliable, and viable solution.

The Solution: Medo's intelligent ultrasound

Medo, an artificial intelligence technology start-up company dual-headquartered in Edmonton and Singapore, developed a technology that pairs an artificial intelligence app with ultrasound devices to facilitate novice users' ability to conduct ultrasound in community clinical settings. The technology addresses the need for specialists, such as radiologists, in rural and remote communities.

By combining portable ultrasound with artificial intelligence, Medo is striving to remove the most common barriers to diagnostic procedures in rural and remote areas of Alberta. Indeed, ultrasound is affordable, portable, and non-invasive but, alone, not enough to solve accessibility issues because of the required skill to acquire and interpret images. That's the main reason why Medo is building the artificial intelligence necessary to operate the ultrasound devices at scale. Dornoosh Zonoobi, one of Medo's founders, described their ultrasound technology as "the 21st

[1] Rural Health Services Review Committee. Rural health services review final report. Government of Alberta.; 2015.

century stethoscope." Like a stethoscope, the portable ultrasound device could be easily deployed to hard-to-reach communities in Alberta and Canada. As importantly, it could be used by various healthcare providers with little training because of the capabilities enabled by artificial intelligence.

What it means for patients and the healthcare system: Example of hip dysplasia

One of the conditions for which Medo's ultrasound diagnostic assistance technology has demonstrated success, and received clearance from the United States of America Food and Drug Administration (FDA) is developmental dysplasia of the hip.[2,3,4] Developmental Dysplasia of the Hip (DDH) is a hip problem an infant is born with or that happens in the first year of life. In this condition, the femoral head (top of the thigh bone) doesn't fit securely into the acetabulum (hip socket).

DDH is found in 1.6 to 28.5 of 1000 infants. The incidence is up to 30 times higher among Indigenous infants, possibly due to a combination of genetics and swaddling practices.[5] Infants who are females, firstborns; have a family history of DDH; and breech presentation at delivery are also more likely to present DDH.[6]

When accurately diagnosed in infants (<6 months), DDH can be treated in 85-95% of the cases with the use of a Pavlik harness (a brace with fabric straps and fasteners that keep the infant's legs in the correct position for normal development).[3] Pavlik is a non-invasive, low-cost harness (approximately $900) that effectively treats DDH.

In contrast, when missed in infancy and not treated appropriately, DDH represents the number one cause of premature hip osteoarthritis (OA) among women under 40 years of age,[7] and is

[2] MEDO.ai receives FDA approval to automatically detect hip dysplasia, preventing the leading cause of early hip osteoarthritis and hip replacement surgery [press release]. Edmonton,2020. Available at https://www.globenewswire.com/news-release/2020/06/16/2048856/0/en/MEDO-ai-receives-FDA-approval-to-automatically-detect-hip-dysplasia-preventing-the-leading-cause-of-early-hip-osteoarthritis-and-hip-replacement-surgery.html.

[3] Mostofi E, Chahal B, Zonoobi D, Hareendranathan A, Roshandeh KP, Dulai SK, et al. Reliability of 2D and 3D ultrasound for infant hip dysplasia in the hands of novice users. Eur Radiol. 2019;29(3):1489-95.

[4] Zonoobi D, Hareendranathan A, Mostofi E, Mabee M, Pasha S, Cobzas D, et al. Developmental Hip Dysplasia Diagnosis at Three-dimensional US: A Multicenter Study. Radiology. 2018;287(3):1003-15.

[5] Loder RT, Skopelja EN. The epidemiology and demographics of hip dysplasia. ISRN Orthop. 2011;2011:238607.

[6] Goiano EO, Akkari M, Pupin JP, Santili C. The Epidemiology of Developmental Dysplasia of the Hip in Males. Acta Ortop Bras. 2020;28(1):26-30.

[7] Shaw BA, Segal LS, Section On O. Evaluation and Referral for Developmental Dysplasia of the Hip in Infants. Pediatrics. 2016;138(6).

responsible for one third of total hip replacements (THR) in adults under the age of sixty.[8] Not only is the cost of THR tenfold higher than the early treatment of DDH, but also the development of early OA translates into productivity loss among adults, adding up to approximately $4 billion in Canada and $450 million in Alberta in less than 10 years (2003 – 2010).[9,10] Additionally, hip OA is a cause of chronic pain and disability that increases the risk of opioid dependency, particularly in vulnerable populations.

How Medo's technology can improve diagnostic procedures

As an example, for DDH ultrasonography is the preferred, least invasive method of diagnostic imaging. Yet, ultrasonography presents a high interobserver and interscan variability, especially when the infant is scanned by a nonexpert.

When it comes to improving accessibility to diagnostic imaging, ultrasound, when combined with Medo's AI technology, can be successfully performed by users with varying levels of imaging experience. A non-specialized, trained healthcare provider would likely be incapable of doing a conventional ultrasound accurately; however, with as little as 1.5h of training medical students were able to correctly diagnose more than 98% of cases of ultrasound sweeps.[11]

As such, Medo's AI technology can facilitate the accurate diagnosis of health conditions at the point-of-care across various rural and remote clinical settings in Alberta (Canada and worldwide) because novice users can use the technology to more easily acquire and interpret scans than any other conventional ultrasound approaches. This, combined with the low cost, portability, and non-invasive nature of ultrasound yields a powerful tool with potential to enable the best diagnosis and treatment of many health conditions, including but not limited to DDH.

Strategic Partnership

With the incredible potential to bring diagnostic imaging to rural and remote communities, historically disadvantaged because of their geographical location and unique needs, a collaboration between WestView Primary Care Network (PCN), Medo and Health City in Edmonton Zone was established. It has resulted in a multi-year screening project that has received funding by Alberta Innovates.

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[8] Furnes O, Lie SA, Espehaug B, Vollset SE, Engesaeter LB, Havelin LI. Hip disease and the prognosis of total hip replacements. A review of 53,698 primary total hip replacements reported to the Norwegian Arthroplasty Register 1987-99. J Bone Joint Surg Br. 2001;83(4):579-86.

[9] Nho SJ, Kymes SM, Callaghan JJ, Felson DT. The burden of hip osteoarthritis in the United States: epidemiologic and economic considerations. J Am Acad Orthop Surg. 2013;21 Suppl 1:S1-6.

[10] Sharif B, Garner R, Hennessy D, Sanmartin C, Flanagan WM, Marshall DA. Productivity costs of work loss associated with osteoarthritis in Canada from 2010 to 2013. Osteoarthritis Cartilage. 2017;25(2):249-58.

[11] Mostofi E, Chahal B, Zonoobi D, Hareendranathan A, Roshandeh KP, Dulai SK, et al. Reliability of 2D and 3D ultrasound for infant hip dysplasia in the hands of novice users. Eur Radiol. 2019;29(3):1489-95.

The goals of the project in the collaboration between WestView Primary Care Network (PCN), Medo and Health City are: (i) to deliver ultrasound at the point of care in primary care settings; (ii) to enable non-conventional ultrasound practitioners to use Medo's AI-enabled ultrasound tools, and (iii) to deploy and evaluate the utility of AI-enabled ultrasound tools in screening for pediatric hip dysplasia. Details about the project's phased approach can be found in Appendix A.

Stepping Into the Future

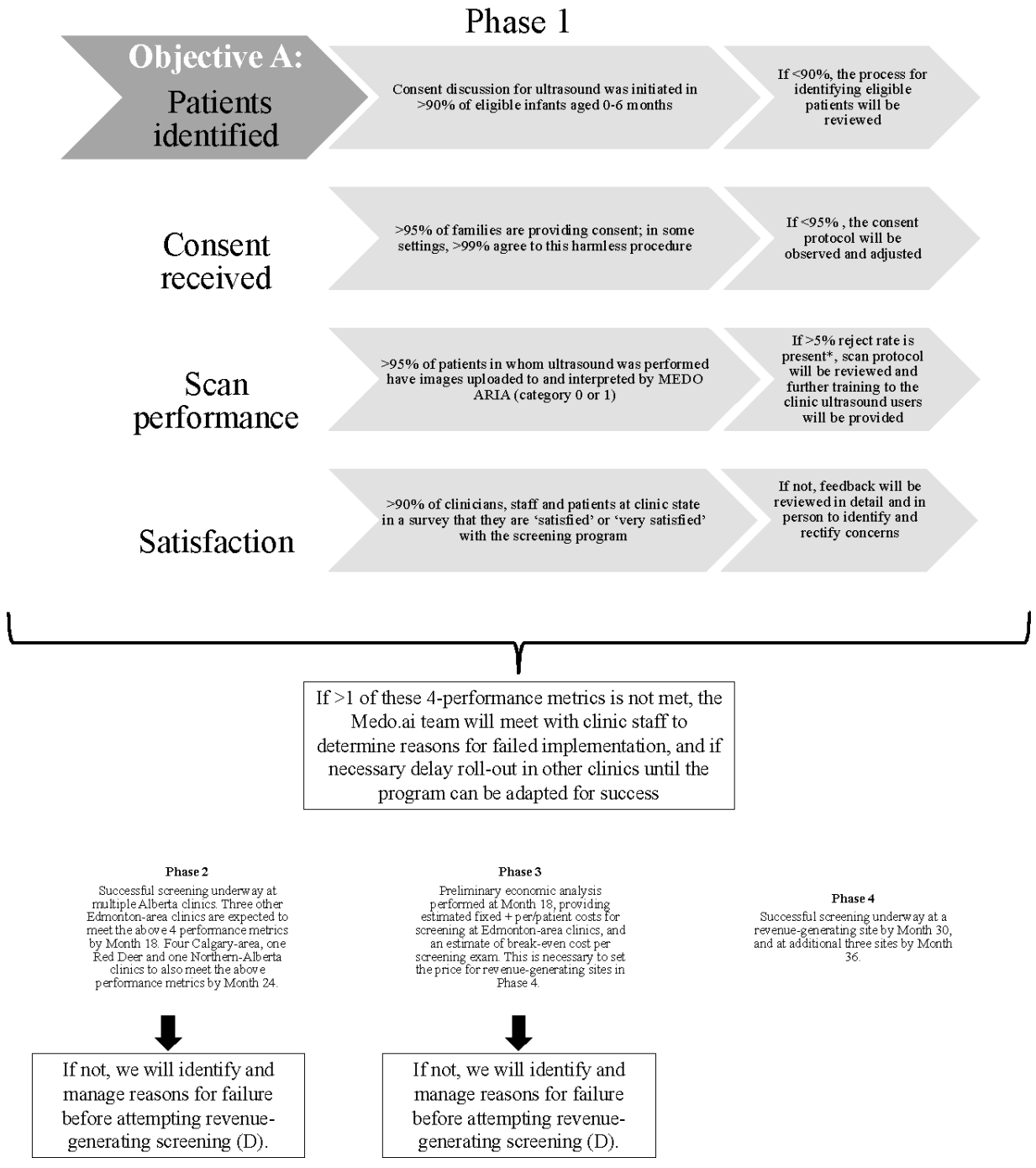
This multi-year project with key performance indicators and targets has the potential to be scaled and spread to other Alberta-based clinics and international sites, offering clinicians the ability to quickly and accurately use ultrasound to diagnose hip dysplasia during routine infant check-ups. Medo's goal is to have every infant in Alberta scanned for this condition near birth, thereby preventing a lifetime of morbidity, suffering for millions of people, decreased productivity, and increased healthcare cost.

Beyond that, Medo will be significantly advancing its ultimate goal of making ultrasound the "the 21st century stethoscope." DDH is one of many applications Medo is exploring for its AI-assisted ultrasound technology. The successful implementation of Medo's technology showcases potential to be scaled to assist the detection of many other common and critical conditions at the point of care, driving better health outcomes and supporting economic development in the Edmonton region and beyond.

Appendix A

Project Phased Approach

A detailed phased approach will be used to ensure that lessons learned in each phase are carefully taken into consideration and addressed in order to achieve optimal patient-centered results, and to secure appropriate funding for future phases. The four phases will consist of the following:



Health City is a Canadian not-for-profit Corporation that works with clinicians, innovators, philanthropic organizations, and companies to develop new pathways of care that can drive better health outcomes and economic development in the health sector. Our focus is on transforming innovations from our health sector into solutions that have commercial application and global relevance, adopting them for impact locally and scaling them for export to global markets.

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