AIDA overview

This document gives an overview of the Analytic Imaging Diagnostics Arena (AIDA). The description will cover the rationale and background for the AIDA initiative, its mission and its organization. The document is intended for any reader with general interest in AIDA, but also for stakeholders from academia, healthcare and industry that are interested in actively participating in the arena.

In short, AIDA is a national arena for research and innovation on analytic image-based diagnostics. AIDA is a cross-disciplinary and cross-sectoral collaboration aiming for large-scale usefulness from Artificial Intelligence (AI) in healthcare. The arena scope includes tailormade IT systems and relevant human expertise, firmly rooted in a realistic healthcare environment.

AIDA is part of the national Strategic Innovation Program Medtech4Health, a joint initiative by VINNOVA, Formas and the Swedish Energy Agency.

Background

The technical development of various branches of AI has been extremely strong in recent years. The area in focus here is population-level analyses using modern machine learning (e g deep learning) – which we refer to as Big Data Analytics. These opportunities are revolutionary for healthcare. Traditional image analysis techniques for diagnostic support can be made much more powerful, both in terms of higher efficiency and higher accuracy in the assessments. It is also about new work practices. Current image review is based on the visual patterns that a human expert can be trained to perceive. A machine algorithm does not have the same limitation, but can find new patterns freely and can also analyze far larger amounts of data. This gives new knowledge and thus new diagnostic possibilities.

Modern AI is a toolbox that fits perfectly into the healthcare vision of "precision medicine", the fully tailored treatment for each patient. Big data analytics is a complement to traditional evidence creation (clinical studies) that instead directly utilizes knowledge that is recorded in the information routinely stored for all previous patients. This means that it is possible to provide decision support for each new patient through large-scale analyses on comparable previous patients in a routine setting.

AIDA mission

In recent years, many examples of good results from individual methods have been found to achieve a precision comparable to physician assessments, for instance applying deep learning to diagnostic imaging. The big challenge is no longer in doing more such studies in a sandboxed lab environment. Today, instead, the challenge lies in creating complete solutions that can be put to actual use in healthcare. This is a demanding systemic challenge that requires both interdisciplinary and cross-sectoral collaboration. Unlike the lab environment, the "clinical wilderness" requires robust handling of all situations, even where incoming data is of poor quality, contradictory or incomplete, as well as managing constant change of, for example, the set of data sources and operators. Even the most powerful algorithms need to be carefully put in context with innovations in workflows and interaction schemes to be beneficial. While there are plenty of deep learning algorithms, almost no-one has reached routine healthcare because of these challenges.

This systemic challenge has different dimensions. The technical challenge is partly to refine AI algorithms to suit a clinical environment, but also to create a new type of IT infrastructure where these algorithms can work efficiently. It also means that healthcare needs to develop new ways of working without compromising patient safety. One reason for the limited use so far is that healthcare stakeholders have insufficient knowledge about the possibilities and limitations of technology, so they need to be better educated to inform academia and industry about their needs. In addition, traditional views on evidence and patient integrity must be refined and supplemented.

The cornerstones of AIDA are:
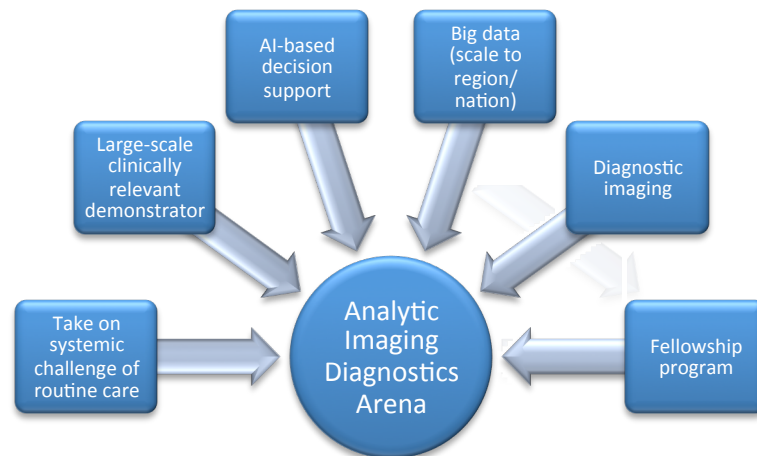
AIDA addresses the system challenge described above, and aims to lead Big Data Analytics to real benefit in healthcare. This is done by creating a large-scale demonstrator, that is, an IT system launched in an environment as similar to a diagnostic department as possible with patients, equipment, personnel, etc. The diagnostic tools developed within AIDA consist of decision support based on AI methods, emphasizing man-machine interaction. The scale in terms of number of patients should be so large that further scaling up to the entire region or even a whole country should be straightforward.

AIDA aims to be at the cutting edge internationally in terms of the core platform, such as providing large-scale training data for AI algorithms, being able to use these for large-scale training, and to evaluate them extensively in clinically relevant environments. In addition, AIDA will stand out by covering the entire chain in the same environment, bringing positive synergies to all the different components. Individual subprojects are expected to result in methods that brings the field forward also on the international level. Another part of the AIDA mission is to expose radiologists and pathologists for future decision support so that they have the skills to implement such tools in practice but also to be knowledgeable sounding boards for continued development of AI methods for their benefit.

For technical researchers in this field, AIDA intends to provide an attractive environment with broad support from technical and human infrastructure that creates synergies and lowers the threshold of pioneering progress. AIDA also aims to provide great value in the medico-technical knowledge exchange, for the benefit of both physicians and technical researchers in the environment.

AIDA objectives

The quantitative goals for AIDA relates to several areas: high researcher user experience, high volume of AIDA stakeholders and contributors, and large impact of scientific publications. Gender equality is also an explicit goal, both in terms of staffing in AIDA as a whole and each of its parts, and in terms of considering gender aspects in project contents.

A large part of AIDA consists of subprojects run by research & innovation groups throughout the country. The specific aims for these subprojects are reflected in the criteria for evaluating such proposals:

- Topic relevance for AIDA
- Potential for clinical usefulness
- Scientific excellence
- Practical feasibility (such as time plan, access to relevant expertise etc)
- Gender equality
- Value of AIDA environment for subproject
- Potential for exchange with other AIDA parties (requires physical presence at AIDA)
- Contribution to AIDA core
- Previous successful AIDA efforts or constituting a new AIDA party

AIDA organization

AIDA essentially consists of two parts, the inner core and the outer subprojects. The core contains the technical infrastructure and human expertise to underpin the AIDA efforts. The core is provided by three Linköping-based partners: Center for Medical Image Science and Visualization (CMIV, Linköping University), Sectra AB, and Region Östergötland. The physical location of the AIDA arena is CMIV. For the outer subprojects, AIDA welcomes proposals from any organization working in the area in Sweden, such as those engaged in the Medtech4Health program, both from academia, industry and healthcare.

AIDA is organized into a number of work packages:
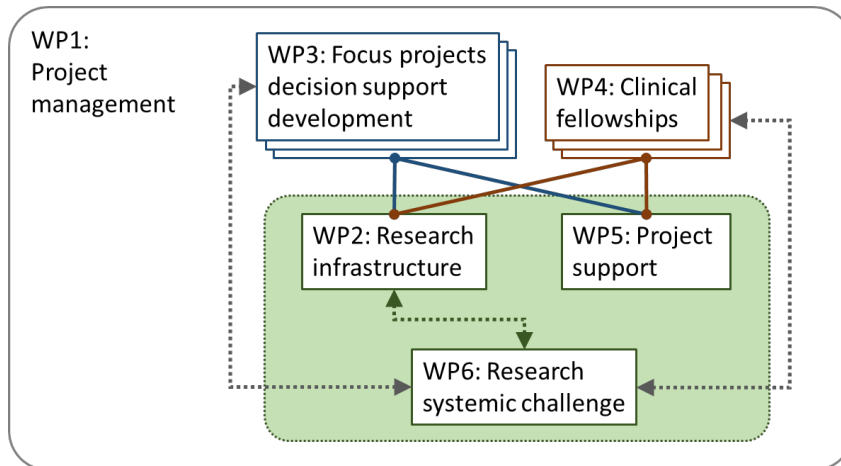
WP1 consists of main project management. The AIDA core, corresponding to the permanent environment in Linköping, is shown in green. WP2 concerns development and operation of the research infrastructure, which is used by the outer subprojects: focus projects for AI-based decision support (WP3) and clinical fellowships (WP4). WP 3 and 4 are intended to be led by stakeholders outside the core partners. WP5 are different forms of project support specifically for WP 3 and 4, so that they can use the environment efficiently and achieve synergies between different initiatives. While WP 3 and 4 will typically focus on niched applications, WP6 will address interdisciplinary issues of the systemic challenge with future AI-based decision support in image diagnostics. The dotted arrows show the extensive exchange between WP6 and WP 2, 3 and 4.

The AIDA research and innovation pipeline addresses a complete range of development steps as shown in the figure below. The expected emphasis of the applied work packages on different parts of the pipeline is also illustrated.
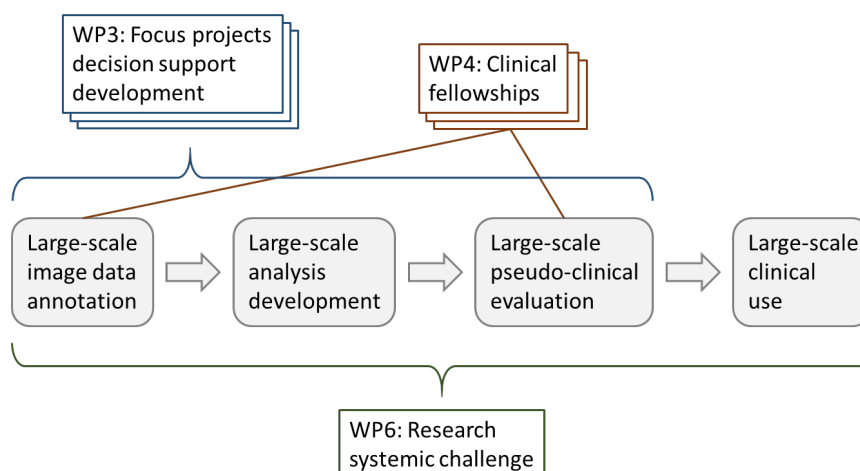
An important prerequisite for AIDA efforts is that there will be no technical bindings to AIDA or the Sectra-provided platform for other use of the developed methods, for instance when it comes to commercialization. AIDA work will be based on distinct software interfaces, according to standards when applicable. Therefore, any developed solution will be possible to integrate with arbitrary clinical system.

AIDA is led by an Arena Director, hired by CMIV. Each work package (including each individual sub-project within WP3 and WP4) will be run by a Work Package Leader. The governing body of AIDA is the Steering Group, consisting of a group of experts in the field with a national spread, appointed by the Medtech4Health Management Group and chaired by the Medtech4Health Director.

Calls for proposals to WP3 and WP4 will be openly announced through Medtech4Health. Incoming proposals are refined in a dialog with the Arena Director. After the dialog, the Arena Director brings the proposal along with his/her recommendation to the AIDA Steering Group for decision on AIDA connection and funding allocation. The proposing party is entitled to request decision from the Steering Group even without positive recommendation from the Arena Director.

There is also an external Advisory Board with international experts in the area, without active collaborations in Sweden. The AIDA Steering Group will request advice from the Advisory Board in general strategic matters and to resolve decision-making in situations of complex personal bias.

There will be two types of agreements. One agreement will describe the formal setup of the AIDA core as a part of Linköping University. The other type agreement is project agreements for the subprojects in WP3 and WP4, between the sub-project parties and the AIDA core (Linköping University). In these agreements, a foundational principle is that intellectual property rights will not be affected by using the arena. For instance, you own the deep learning networks you trained even when they are a result of training in the AIDA environment.

AIDA budget

The current time-wise scope of AIDA is through 2019. (While the intention is for AIDA to be a permanent arena for years to come after 2019, the current budget is based on a first phase of VINNOVA grant limited to the end of 2019.)

The budget is based on two 50/50 principles. First, each party engaged in AIDA will receive 50% of their cost spent in funding from VINNOVA, and thus counter-finances the remaining 50% themselves. The second 50/50 rule is that half the budget is intended for developing the AIDA core (WP1, 2, 6) and half the budget is intended for the outer subprojects and their direct support (WP3, 4, 5).

The total budget for this period is 20 MSEK, thus, the VINNOVA contribution is 10 MSEK. The tentative budget for WP3 projects is 6 MSEK and for WP4 projects 3 MSEK.

To encourage the creation of openly available data (typically images and annotations), CMIV will cover the storage cost for such open data until the end of 2019, as far as the budget for IT operations in WP2 will allow. There may potentially arise needs from WP3 and WP4 projects for more AIDA-related services based on CMIV resources, beyond a proportional part of what is offered through WP2 and WP5. In those cases, CMIV assumes the role of a subcontractor from which these parties can purchase additional services from, for instance using AIDA funds (the cost will in that case be registered within AIDA only within the buying party). This setup is always in force for storage cost of proprietary data within AIDA.