INL (Part 2)

Execution, Closure & Impact Realization

Date: 12-10-2021

Work performed by:

Hazim Hazim

Joseph Newman

Lars Compagne

Martin Eriksson

Morvarid Binesh Tarigh

a) Risk Analysis

Appendix A

Criteria	**Option 1** Implementation of IV pumps as smart (with DERS[1]) in Wi-Fi clinical areas and as dumb (without DERS) in non-Wi-Fi clinical areas ***Clarification:*** smart where we can, dumb where we cant, uppgrade to smart when wifi available - phased transition. *assumption: in all options- all the equipment is purchased in the beginning. The options discuss how implementation and use of the pumps is to be done.	**Option 2** Implementation of IV pumps as smart (with DERS) in all clinical areas (Wi-Fi required ***Clarification:*** smart pumps everywhere from the start. Need to invest in wifi infra. from start- 1 big transition immediately.	**Option 3** Implementation of IV pumps as dumb (without DERS) in all clinical areas, then going smart (with DERS) when Wi-Fi is available ***Clarification:*** all dumb to start, upgrade to smart when wifi available. 1 big transition later on.	**points:** **3 for strongest option** **1 for weakest per row**
Benefits from the project investment	● Allows flexibility to implement change from the beginning where technology infrastructure exists. ● Fits within current budget- additional costs to upgrade can be taken later when desired.	● benefit from DERS from the moment the change has gone though. ● The system will be finalized from the start and won't change anymore ● No difference in working principle in different areas of the hospital ● Relieves staff from several issues identified with current work practices ● Ensures Single Statewide solution.	● The change to smart pumps will happen later on- the process is not rushed. ● Flexibility to implement change when other infra. is in place ● Short term cost is minimal	O1=2 O2=3 O3=1
Deployment strategy for Wi-Fi	● WiFi installation to be done in multiple phases until the whole facility has wifi. More expensive ● State ministry wants a uniform statewide solution- though this could be a phased transition with the goal of implementing smart systems statewide eventually. ● Wi-Fi installation in non-Wi-Fi clinical areas could be delayed because there is no priority anymore.	● WiFi infrastructure not set up in time when patients are moved with smart pumps ● implementation will be done once instead of in stages risk of too much change at the same time with single delivery. ● if issues arise with the new system- no option of temporarily falling back on the old system. ● disturbances during transitional period- teething issues with wifi. ● High costs to implement	● Medication error could be extremely high until WiFi becomes available ● Implementation of smart pumps depends on the availability of Wi-Fi, while smart pumps should be the priority. ● Results in order to justify the investment on smart pumps are not seen until shifting to smart pumps (WiFi availability) -delayed results-	O1=3 O2=1 O3=2

Cost of training programs	• This phased approach would involve 2 types of training and implementation. Systematic work practices for dumb pumps, as well as for Smart pumps and future practices with them.- Higher cost.	• Focus here can be entirely on future, systematic use of the smart pumps. Since being replaced, current practices with dumb pumps can be left. • All workers need to be trained but it is a one time investment.	• Training programs required multiple times, once when pumps are implemented as dumb (so that the whole staff operates them uniformly), and once again when going smart, i.e. higher cost	O1=1 O2=3 O3=1
Impact of changes in transition from dumb to smart pump	• A phased transition allows for gradual learning and adapting to changes. This may suit some staff well • Benefits of the smart pumps are delivered slower- so unsustainable practices may continue to exist • Risk of confusion while 2 systems are in place- (thinking a dumb pump is a smart pump etc)	• high impact because all pumps being implemented as smart from start- one big change • Staff may resist fast change in working practices • Learning and adapting to the new system must happen quickly without phased transition. • no risk of confusion since only one system are in place	• Staff may have to adjust to new routines twice. Just as staff get used to working with "dumb" pumps the transicion to smart occurs. • Benefits of the smart pumps are delivered slower- so unsustainable practices may continue to exist • no risk of confusion since only one system are in place	O1=2 O2=3 O3=1
Security in drug administration	• Security against errors limited to pumps in clinical areas with WiFi • Risk of confusion while 2 systems are in place- (thinking a dumb pump is a smart pump etc) • Not enough data/Data not accurate in the library as all pumps in the facility are not connected • Medication error risk remains high until WiFi becomes available	• With all pumps being smart, there must be a lot of effort into cyber security. No backup if something happens to drug library	• Security/Drug library introduced very late i.e. after the facility has WiFi • Medication error risk remains high until WiFi becomes available	O1 =1 O2=3 O3=2
Impact on resources	Costs • **Initial**: Medium, due to partial the implementation of smart pumps and wifi infrastructure • **Long term**: Medium, remaining partial implementation of smart	Costs: • **Initial**: very high due to full implementation of wifi infrastructure • **Long term**: Low, as the only thing needed is maintenance • Initial estimated cost known	Costs: • **Initial**: low, as WiFi infrastructure and DERS are not required initially • **Long term**: high, due to full implementation of WiFi and smart pumps (DERS)	Costs: O1 =3 O2=2 O3=1

	pumps and wifi infrastructure and maintenance. ● Cost spread throughout the time period, easier to reflect and re-estimate.		● Full estimated cost not known until the end	
	Staffing: ● Different workload on different departments in the hospital (some have smart some have dumb) ● Opens up to confusions for staff going between different departments ● Without having Wi-fi, there would be no drug library, so more human errors could happen	Staffing: ● More workload initially, because of being trained and handling the daily affairs at the same time ● Even workload between the departments (all smart) ● Less workload since the pumps are uniform, modern and smart.	Staffing: ● Even workload between departments ● Higher worklaod overall since all pumps are dumb ● Without having Wi-fi, there would be no drug library, so more human errors could happen	Staffing: O1=1 O2=3 O3=2
	Infrastructure: ● Not a lot of additional resources needed since the Wi-Fi that is already available is used.	Infrastructure: ● Wi-Fi must be installed everywhere.	Infrastructure: ● No initial wifi needed since all pumps are implemented as dumb	Infrastructure: O1=3 O2=1 O3=2 **Total:** **TO1 = 7** **TO2 = 6** **TO3 = 5**
Impact on time	● Gives flexibility to continue using current practices and upgrading when possible. ● Practices on new equipment can be initiated from the start and will be constant over time. ● Time for the full implementation is dependent on Infrastructure development ● Risk that the work on Wi-Fi infrastructure loses urgency, resulting in delays of pump implementation.	● Could cause delays to opening of new facilities (Glen & MGH) due to issues with wifi installment. (HIGH IMPACT) ● The process will be intensive at the start and will take some time, but if the implementation of smart pumps is done no additional work is required. ● High urgency to install Wi-Fi so transition to smart will be quicker.	● Long term and short term aspects: LT process since the shift from dumb to smart will happen only once there is Wi-Fi everywhere. However, the dumb practices can start quickly. ● Risk that the work on Wi-Fi infrastructure loses urgency, resulting in delays of pump implementation.	O1 =2 O2=3 O3=1
Impact on institution	● Different practices followed for some time within the institution i.e. both smart and dumb- Inconsistent working methods continue. ● Having 2 sets of working practices could place stress on management- to make and maintain, as well as,	● Reputation of Glen and major projects risk being damaged by long delays. (*note this is a likely and important consequence, however we make the **assumption** that if option 2 is taken, increased budget should ensure that wifi infrastructure development is	● The institution is not perceived as “state-of-the-art” at the beginning until smart pumps are in use. ● Higher risk of error initially, since none of the pumps are used as	O1 =2 O2=3 O3=1

	staff- having to work with a combination. ● Stress placed on staff could in the worst case lead to conflict or leaving. ● Risk of error initially,due to having multiple work practices. A medical administrative mistake could have a huge	sped up to ensure implementation can be done as desired on the project timeline) ● Big pressure on the management team in order to finish the Wi-Fi in time. ● Positive having state of the art equipment- if the project goes to plan.	smart. A medical administrative mistake could have a huge negative impact on the org. reputation.	
Points total (Higher = Stronger)	**20 points total**	**25 points total**	**14 points total**	
Notes: [1]DERS: Dose Error Reduction System				

Table. Analysis of strategic options

b) Recommendation

Intro

Having narrowed the project decision down to three major options we proceed here by assessing which risks exist in the implementation of each strategy. These risks can then be evaluated and a comparison performed to determine which option to put forward as our final recommendation for the project to implement. In identifying which risks exist, it was first important for us as a team to clarify exactly what we collectively as a team understand each option to be. Widely accepted in management and team theory -most recently as presented by guest lecturer Peter Roos on this ME2016 course- clarity of what tasks are to be performed ('what') as well as agreement on the method ('how') to execute it are crucial, thus we felt it important to ensure which assumptions we are all making in carrying out our work here and basing our recommendation on. These are as follows:

Option 1: Is a mixed and phased transition into the use of Smart pumps. Here all pumps are purchased from the beginning, and where wifi infrastructure is available, the pump use is to be smart (using DERS technology), whilst where this is unavailable the same pumps will be used without the DERS functions. As and when wifi infrastructure is installed, departments can then implement use of smart pump practices.

Option 2: Simple smart pumps to be purchased and DERS technology implemented into clinical practices everywhere from the start. This requires investments and the installment of wifi infrastructure in all facilities prior to implementation of the project.

Option 3: New pumps will be purchased in the beginning as in the other options. However, irrespective of if wifi is available or not- DERS technology will not be used until wifi infrastructure is available in all hospital facilities. When this becomes available, one transition will occur to implement the use of smart pumps simultaneously in all hospital facilities.

In each row of the appendix above we identified all significant risks/ benefits connected with the implementation of that option. In various cases some are more significant than others. We used these to come to an agreement on which option was the best for each section with an allocated points system used to make a total which- though the final recommendation would not be solely based upon it, could be used to influence and facilitate this decision making process. In the following report we will go through each category of risks/benefits and use this as a basis for comparison. To conclude, we will summarize and make a final recommendation on which option we believe should be chosen based on our empirical analysis.

Benefits from the project investment

The first option has some benefits with respect to the others, namely the ability to be flexible. If the implementation of smart pumps does not fit in the budget, it can be moved on to the next fiscal period. However, the fact that the system in option 2 is already finalized from the start is a huge benefit as well. It means that a one time investment is required after which the whole site runs on smart pumps which ensures clarity among staff and patients as well as for the government who want a single statewide solution for pumps. The third option has the benefit that the investment for Wi-Fi and smart pumps can be made after the relocation and thus in a new fiscal period. Also since all the other infrastructure is finalized by then, the implementation can happen more efficiently. However, since option 2 has the most benefits, this is the recommended option for the project investment.

[In this case, considering the PENG model can make the final result more clarified. This model consists of three steps; preparations, execution and quality assurance. This model can lead to an early focus on benefits which results in a better performance of both managers and employees. Consequently, we believe choosing the second option will be the most beneficial, since an overview of the full investment can be seen much clearer from the beginning.]

Deployment strategy for Wi-Fi

The deployment of Wi-Fi in the first option will happen phased which can make the process less efficient. Besides there is the risk of losing priority since the part of pumps that runs dumb can be considered sufficient after some time. However, all the available smart pumps are also being used so the maximum capacity is taken advantage of. For the second option, the Wi-Fi will be installed at once and all the pumps rely on this. This brings a huge risk since any delay in the Wi-Fi installation results in delay for the practices. Also the costs can be very high since Wi-Fi must be installed everywhere at once and delay must be reduced which involves high costs. The third option has the benefit that the switch to smart is made at once once Wi-Fi is available everywhere which is clear for everyone. However, available Wi-Fi is not used until the very end which is a spill of resources. Also there is the risk of making errors because dumb pumps are being used despite smart pumps could have been used. Because of all this, option 1 is the best option for the deployment strategy of Wi-Fi.

Cost of training program

For the first option the cost of training will be high due to two types of training that needs to be performed, one for “dumb” one for “smart”. The benefit from this type of implementation strategy is that it can be performed during a longer period of time which can be convenient for staff but also contribute to extended costs and confusion among staff, (which type method was i supposed to use on this pump). For the second option all training will be performed once, the cost will be high but there will be no lagging costs for the future. There is a risk that it will put a lot of workload on the staff because a lot of training is conducted at once. For the third option the two types of training need to be conducted but in two separate occasions. First training need to be conducted when all pumps is implemented as “dumb” and the other training will come when transitioning to smart. This will lead to high costs twice during the implementation and it can also be that just as the staff gets used to the dumb type of practise the transition occure and new traning have to be conducted. With all this in mind the option that is the best is the second option. It will have a big one time cost and a lot of training at once but the benefits from having one unanimous practice that is state of the art is evens it out.

[As presented by Bo Karlson in his lecture on project budgeting methods: To ensure clarity with the budget and that products/services delivered actually amount to the cost spent- the Earned Value method could be applied here. This helps both track the performance progress of the project work, but also ensures that the situation doesn’t misleadingly look better than reality if all of the budget hasn’t been spent- since the actual costs can be compared to actual deliveries rather than comparing with the total budget]

Impact of changes in transition from dumb to smart pump

For the first implementation option the transition will be more spread out during a longer period of time which may suit some staff more than others. For some staff this “slower” change will result in a more gradual learning and convenient adapting tempo. However since there are two different practices in place at the same time there is risk of confusion among staff. Some staff may think that they are treating a patient with a smart pump but in reality it is a pump used as dumb which needs more supervision. One risk is also that unsustainable work habits will continue to exist until the whole transition has gone through. For the second option the impact will be very big at first since all pumps have changed but will decrease over time. There is a risk that some staff think that it is too much to cope with at the same time and resist the change. There is also no fallback plan during this big change, all staff need to learn the new system as fast as possible.

[Naturally having no fallback plan in a project can leave an organization in a volatile/risk filled position. However- in certain projects this is an unavoidable consequence of implementation and as such must be taken. When this is the case due diligence must be taken to ensure successful implementation. In this instance, were option 2 to be taken then we believe this is the case since the project has been performed thoroughly through all phases of the project lifecycle and thus this slight risk factor associated with option 2 should be tolerated]

The benefit is that the whole hospital will have a unanimous practice which can lead to less human errors and a calmer environment among staff. For the third implementation option there will be less impact in the beginning and bigger once the wifi is available. Although there is new pumps staff are more used to working with them as dumb which is good, there will be more pumps availible but since they are not connected to wifi human error are likely to occure.

Since this type of practice is more similar to previous, the risk of having the same unsustainable practices as before still exists. Also according to the knowledge paradox presented by Anna Jerbrant,

as well as, by Bo Karlson during this course: you will have a lot of knowledge late in the project but it's very hard to influence the outcome(more expensive), i.e. if something goes wrong in the late implementation of the pumps the possibility to correct the error is much harder.
The option to go with this question is the second option. There will be a big impact on staff in the beginning of this huge change but in the long term, having state of the art equipment available from the start is worth it.

Security in Drug Administration

The security in drug administration correlates to the implementation of DERS and availability of WiFi. For the first option, where WiFi & DERS is available but in selected clinical areas, security against errors would also be limited to pumps in those areas. Having both, pumps with DERS and pumps without DERS, would create a conusions between two systems, which would also increase the risk for errors. Moreover, having the drug library system in only a few parts, would result in less data to be gathered and hence the functionality of the system would also not be efficient as compared to a library system being used for all pumps through the facility. For the second option, all pumps would be connected to DERS and hence have enhanced security in drug administration. However, since no pumps are used using the old methods (i.e. dumb) there wouldn't be any fallback option if something goes wrong with DERS. To mitigate that, more effort in building a reliable library system and more effort cyber security would be required. For the third option, DERS would be introduced later on i.e. when the whole facility would have WiFi, this means the security features provided by DERS would not be usable until then and hence posing a greater risk for errors. With this in mind our decision is that the second option is the best strongest one, because you have to remember what Tonnquist says "all risk responses cost money" and the second option has the least amount of risks.

Impact on resources

To analyze the impact on resources, we divided them into 3 categories: Costs, Staffing and Infrastructure. For the first option where pumps are suggested to be used as smart in places where WiFi is available and dumb where it is not, the total costs would be spread throughout the time period until all pumps are smart. The initial costs of implementing some of the smart pumps at the time of the move, would be similar to the costs of implementing the rest of the pumps as smart later on. This would make it easier to manage the budget, and give us time to reflect and re-estimate the budget at each step/milestone. On the other hand, for option 2, where all pumps are suggested to be implemented as smart at once the initial costs would be high and would consist of almost all the costs related to implementing smart pumps except the regular maintenance. Option 3 would be similar to option 2 but the opposite, i.e. low costs initially as pumps won't be implemented as smart but high costs later on when all pumps are converted to smart pumps.

With respect to staffing, having both smart and dumb pumps at the same time would result in discrete practices to be followed between departments. This would result in different workload and confusions amongst the staff. In areas without the drug library, the chance of human error would be high thus affecting the moral and confidence of the staff. In the second option, the staff would face higher workloads initially, as all of the relevant people would need to be trained. After the initial transition phase, the workload is expected to be balanced as uniform practices would be followed. In the third option, initial workload of the staff would be manageable as they won't have to worry about new smart pump technology during the transition phase, but it would increase later on when

all staff needs to be trained for smart pumps when WiFi is implemented. Without having smart pumps initially, the chance for human error would be higher and thus affecting the staff negatively.

Regarding infrastructure, the first option would not have a large need for resources, as it suggests to use the already available WiFi in some areas. Whereas in the second option, there will be a large need for infrastructure related resources as WiFi must be installed everywhere. In the third option, the need for infrastructure resources would almost be none initially, since WiFi would not be used. However, more infrastructure resources would be needed later on to complete the installation of WiFi.

The impact on resources was a complex comparison to make due to the need to assess both long, mid and short term impact as well as different factors- cost, staff and infrastructure. As such we expanded the table into additional sections and gave a score to each system. Largely due to a combination of the flexibility over option 2 as well as avoiding various long term costs incurred by option 3 we found that option 1 prevailed here.

Impact on time

When it comes to use pumps as dumb till wifi becomes available everywhere and implement the smart pumps by having such an infrastructure, there are mainly two effects it can have on time. Firstly, some time-extension might happen, since shifting from dumb to smart is not possible unless wifi is available. Consequently, more time is needed for this shifting. Secondly, when hospitals are using dumb pumps as they did before, there would be no intense urgent for providing wifi, resulting in a long delay for the implementation of smart pumps which is one of the main project goals. The latter , also, can happen in a situation of using smart pumps where wifi is available and using dumb pumps where there is no wifi. Besides, in this option the completed process of smart pump implementation is basically dependent on wifi availability. However, this situation can have some positive points as well. One of which is that current practices can be continued with flexibility and then when it is the proper time this can be replaced. Moreover, this new technology can be practiced from the first and can be constantly continued till the end. In contrast, when using pumps as smart ones is the only existing option, practices on these new pumps would be highly intensive at first, but by passing the time, there would be no more extra work needed to be done, since all smart pumps are implemented. Even Though there are myriad negative impacts on time by using other options, going on with the last option can have a spectacular effect on time. If the only terms and conditions of using pumps would be the availability of wifi everywhere and using pumps as smart ones from the first, it can make the project much longer, since not using pumps means not being able to open the hospitals, and it is the most significant effect on time. Consequently, the second option, the first one and the third one have respectively the most risks for time.

[Since time is a crucial factor in this project- where certain deadlines must be met other project determinants must adapt. According to the Iron triangle method of looking at project scope- consisting of Budget, time and quality, as presented in tonnquist- if a given factor is vital/ must be met, then the others must be moved. Thus if in this case there are non optional deadlines and the quality delivered is also non negotiable given the environment, then where necessary the budget must be enlarged to facilitate that these other requirements are met. If needed this should be raised

by the project manager and additional funds secured to ensure delivery requirements are possible and realistic.]

Impact on institution

As mentioned previously, by using pumps only as smart ones, long delay can be one of the most important effects it could have on time. This delay may result in damaging the reputation of the whole project as well as Glen. For avoiding such an issue to happen, the only way can be exceeding the budget to provide those needed infrastructures in a suitable time. Besides exceeding the budget, staff have to work hard to reach the desired goal by the exact time. This can result in tolerating a high intensive pressure on them. However, by passing from these two harsh steps, the institution would, definitely, have state-of-the-art equipment. While using dumb pumps till by the time no wifi is available cannot lead the institution into having state-of-the-art equipment, unless wifi can be provided. Moreover, not having wifi initially can increase the risk of medical administrative mistakes which can destroy the reputation of the institute. Not only this option leads to face reputation destroy, but also using smart pumps where wifi is available and dumb pumps where there is no wifi can put the organization in such a risk. But there is one difference between these two cases, the former would face this problem initially, while the latter not providing wifi for the areas with no wifi, cause this happening forever. Also in this option, using both methods (smart pumps and dumb pumps) can place stress on management and as well as on staff. Meaning that the management group will not be able to make and maintain these two technologies in a good manner. staff, also, by being stressed may leave the work or have conflict with others. Consequently, the best option to choose in this case can be the second one since it does not have any effect on human lives.

Final recommendation and conclusion

Having investigated and assessed each area of risk and identified the significant risk/benefit factors within them we noted a few things. Various issues were recurring in several categories meanwhile other factors may have a small likelihood but should they occur- the consequences would be disastrous. So whilst we found that our simple points system helped facilitate discussion and the decision making process- these weighty factors must also be taken into account in making our recommendation.

One such recurring factor was the implementation of multiple working practices simultaneously which is entailed with option 1. Not only would this be counter to the direct wishes of the ministry, it would mean that risk of human error remained in medicine administration while DERS technology was not in place, and not only that, but potentially the mixing of working practices could lead to confusion and stress on staff. Again confusion could consolidate and raise the risk of human error, and any increased stress on staff- already potentially unsettled by the large-scale transition underway, may have severe consequences. As such this factor is a major minus against the first option.

The risk of a clinical mistake due to human error is also present in option 3 where for a prolonged period the use of DERS will not be implemented. Not only this but in this option, there is a long wait to realize the benefits of investments in new state of the art equipment, potentially devaluing the impact of the entire project. This is a major negative impact of option 3.

In our analysis we also identified a potential stress on staff who in options 1 and 3 could be made to go through 2 major work practices transitions. As discussed in tonnquist and widely throughout organizational literature- organizational change is a fragile and risk filled operation for an

organization to go through. As such, exposing staff to 2 large transitions in a short space of time could result in major instability in the hospital employees. For this reason both options 1 and 3 are again tainted negatively.

The sole major negative risk incurred with option 2 is that it could potentially cause major delays in the opening of large new facilities due to the need for installing wifi infrastructure in all facilities prior to project implementation. Whilst this presents a risk with significant consequences we deem it to be a lesser issue than the other two options. Not only this, but should option 2 be taken, then the full benefits of DERS are realised with immediate effect at project implementation getting the best value from the investment made.

Not only is the strength of option 2 highlighted in a comparison of the major factors, it also comes out a clear winner in the scoring system we implemented in the table above. This would indicate that on average, when all factors are taken into account equally, or if only issues of key significance are compared then option 2 proves itself to be the strongest.

We therefore put forward as our final recommendation to take option 2- the full deployment and implementation of DERS technology in all clinical areas. We recognise the dependence of prior wifi infrastructure which could lead to potential delay in the opening of facilities, but given the benefits to be gained, and the risks, as identified, which can be avoided we would advise this choice be taken and any negative consequences to be planned for and mitigated accordingly. Such is the benefit that we would suggest it worth it, if required to avoid delays, to make additional investments to speed up the installation of necessary wifi technology where required. On top of this a subproject could also be launched to ensure that this key prerequisite be met in accordance with the main project timeline to ensure a full delivery can be performed on time.

We trust this document has shown a thorough identification, evaluation and comparison of all significant risks entailed with the 3 options for implication of new pumps. And in summary as a group we put forward Option 2 as our final recommendation.