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|  |  | **Barrier relevance to technology innovation deployment process** | | | | | | | |
|  |  | Initiation (pre-adoption) | | | | Implementation (post-adoption) | | | |
|  |  | Barrier | Cause | Effect | Source | Barrier | Cause | Effect | Source |
| **Owner of deployment barrier** | Individual | Task-technology fit:   * *Technology needs to streamline physician’s job or help them treat patients more effectively (CDE1\_A1\_DI, Pos. 46)* * *The technology gets in the way of physicians accomplishing their task (PV2\_CDE3\_DI Pos. 30)  “I mean, I’ve got 17 people standing in my emergency department waiting room that I need to get through, and there’s all these steps of, you know, arriving them and getting their history and documenting their vital signs and having the nurse see them and it’s like, they’re bleeding for goodness’s sake. So, it’s like just bring them in, and it’s not like that anymore, you know, you can’t just bring them in and start doing things to people [quote].”* | *It is hard to find a balance between treating patients, i.e., doing the core task, and managing the data, alerts, documentation, billing, etc. to support the core work (PV2\_CDE3\_DI Pos. 30)* | There is no time left to take care of the patients (PV2\_CDE3\_DI Pos. 30) | CDE1\_A1\_DI, Pos. 46  PV2\_CDE3\_DI Pos. 30 | Task-technology fit:   * *Technology needs to streamline physician’s job or help them treat patients more effectively (CDE1\_A1\_DI, Pos. 46)* * Often the application of the technology requires too many additional clicks by the physician that impedes them from patient care (PV1\_DI, Pos. 30) [not in Ex\_ExEff as it is about a misfit of technology design and task] * The data is not organized in a user-friendly way so that physicians can do their job [not in the adoption category as such issues usually surface after technology adoption decision] (PV3\_ETC2\_DI, Pos. 10) * *The technology gets in the way of physicians accomplishing their task (PV2\_CDE3\_DI Pos. 30)*  *“I mean, I’ve got 17 people standing in my emergency department waiting room that I need to get through, and there’s all these steps of, you know, arriving them and getting their history and documenting their vital signs and having the nurse see them and it’s like, they’re bleeding for goodness’s sake. So, it’s like just bring them in, and it’s not like that anymore, you know, you can’t just bring them in and start doing things to people [quote].”* | * Often health IT is not developed by clinicians (PV1\_DI, Pos. 30) * *It is hard to find a balance between treating patients, i.e., doing the core task, and managing the data, alerts, documentation, billing, etc. to support the core work (PV2\_CDE3\_DI Pos. 30)* | * There is no time left to take care of the patients (PV2\_CDE3\_DI Pos. 30) | CDE1\_A1\_DI, Pos. 46  PV1\_DI, Pos. 30 |
| Organization | Task-technology fit:  For some departments the EMR is not a good fit (HITV1\_DI, Pos. 22) |  | Those departments do not adopt the EMR or a more basic version of it (HITV1\_DI, Pos. 22) | HITV1\_DI, Pos. 22 |  |  |  |  |
| Magnitude of performance:   * The fact that an idea is pareto superior is not sufficient for adoption (CS1\_DI, Pos. 22) * Incentives in terms of efficiency gains and patient outcomes are not big enough (PY2\_DI, Pos. 26-28)  “Like when we look around, you know, healthcare system, it’s not uncommon to see a fax machine being heavily used, you know, by organization and that’s not because there’s not better technologies, it’s just because like the incentives really aren’t there to motivate people to embrace some of those changes [quote].” * The impact of many innovations is hard to quantify (PY2\_DI, Pos. 26) | * There are opportunity costs [see Pr\_Fin] (CS1\_DI, Pos. 22) * Many decision makers are risk-averse (PY2\_DI, Pos. 26) [see Pr\_OrgInnov] |  | CS1\_DI, Pos. 22  PY2\_DI, Pos. 26-28  PY2\_DI, Pos. 26 |  |  |  |  |
|  |  |  |  | Functional performance-unspecified:   * After a node has been spun up synching issues can arise (ETC1\_DI, Pos. 24) * Software error (HITV1\_DI, Pos. 22) * The big health IT vendors will merely try to find consensus of the least common denominator (PYV1\_DI, Pos. 22-24) * Onboarding of existing patients into new EMRs is challenging (HITV1\_DI, Pos. 16) * The issue of conversion in new EMRs, i.e., uploading any old data into the new format of the new system (HITV1\_DI, Pos. 16) |  | * Organization needs to figure out what’s wrong and nodes are kind of a black box; need to reach consensus with other nodes, i.e., requires coordination with others (ETC1\_DI, Pos. 24) * Physicians do not trust the EMR systems (HITV1\_DI, Pos. 22) [see Pr\_RiskTrust] * It is difficult for the customers and users of these service products to govern the technology roadmap, i.e., no user agency (PYV1\_DI, Pos. 22-24) * If erroneous at the next patient’s visit the data does not flow seamlessly (HITV1\_DI, Pos. 16) | ETC1\_DI, Pos. 24  HITV1\_DI, Pos. 22  PYV1\_DI, Pos. 22-24  HITV1\_DI, Pos. 16 |
| System |  |  |  |  | Task-technology fit:   * The data flow on patient care is through EHR systems and providers have started to work around the billing system rather than develop an electronic health record system that’s best used for patient care (PV1\_DI, Pos. 2-8) * It is organized in a way to make sure that systems can bill for patient care (PV3\_ETC2\_DI, Pos. 10) | * EHR systems were initially built based for billing only, i.e., making sure that they get reimbursed by the payers who have very stringent criteria (PV1\_DI, Pos. 2-8) | * EHR systems are cumbersome (PV1\_DI, Pos. 2-8) * It does not lead to better outcomes for patients but to more money being made for large health systems and payers (PV3\_ETC2\_DI, Pos. 10) | PV1\_DI, Pos. 2-8  PV3\_ETC2\_DI, Pos. 10 |
| Functional performance-Scalability issues:   * *HIEs and QHINs are not scalable (CS1\_DI, Pos. 10)* | * *Lack of standardization and ubiquity (incl. workflow standardization) (CS1\_DI, Pos. 10; PV2\_CDE3\_DI, Pos. 32)* * *Lack of incentive alignment (PV2\_CDE3\_DI, Pos. 32)* |  | CS1\_DI, Pos. 10  PV2\_CDE3\_DI, Pos. 32 | Functional performance-Scalability issues:   * *HIEs and QHINs are not scalable (CS1\_DI, Pos. 10)* * Providers to points of aggregation flows are not scalable (CS1\_DI, Pos. 10) * EMRs have scalability issues: Creating a technology that is flexible enough to be applied and used in every place and allows for simple onboarding is challenging (HITV1\_DI, Pos. 16-18) * Limited functionality that is available to stakeholders (FA1\_DI, Pos. 44) * Clinical data does not flow (CS1\_DI, Pos. 45, 1035-1085) | * *Lack of standardization (incl. workflow standardization) (CS1\_DI, Pos. 10; PV2\_CDE3\_DI, Pos. 32)* * *Lack of incentive alignment (PV2\_CDE3\_DI, Pos. 32)* * Stakeholders have the capability to be connected but they are not on the same version / update of the standard (FA1\_DI, Pos. 44) | * The more complex the system, the more one runs into downstream issues of how to get people on board (HITV1\_DI, Pos. 16-18) * Take payment data and use it for clinical purposes (CS1\_DI, Pos. 45, 1035-1085) [see Pr\_PriorTech] | CS1\_DI, Pos. 10  HITV1\_DI, Pos. 16-18  PV2\_CDE3\_DI, Pos. 32  FA1\_DI, Pos. 44  CS1\_DI, Pos. 45, 1035-1085 |
| Functional performance-Technical interoperability:   * There were no systems that could work with the new data standards (CS1\_DI, Pos. 18/428-537) * *Until the Cures Act with the introduction of the USCDI [United States Core Data for Interoperability] there was no standardized, ubiquitous format (CS1\_DI, Pos. 18/459-463; CS2\_A2\_DI, Pos. 8)  “Well, Meaningful Use was mandated. And there was actually enforcement. I mean, you wanted part of the Meaningful Use was you got back a bunch of money’s spent as a hospital and buying a new and implementing a new EMR. You don’t do meaningful use, you won’t get that money, a good enforcement, a good incentive. The problem is there was no standard, and there was tremendous incentives on the part of most of the actors. This means the vendors producing the EMRs, Cerner, Epic, Allscripts, and the hospitals involved cannot support interoperability. [quote]”* * *Requires APIs between the two connecting parties (CDE1\_A1\_DI, Pos. 32)* | * *Non-profit organizations were unwilling to create a standard strong enough that it could be practically used for the ubiquitous transfer of data (CS1\_DI, Pos. 18/459-463)* * *Little incentive for everybody to get on the same set of standards (in contrast to administrative data, i.e., billing and getting pai) (CS2\_A2\_DI, Pos. 8)* * *Lack of enforcement of mandates (CS1\_DI, Pos. 45, 1035-1085) [see Pr\_StakeAlign]* | * *No interoperability (CS1\_DI, Pos. 18/428-537; CS1\_DI, Pos. 18/459-463)* * *Parties either have to build the API themselves or partner with an API offering interoperability company (CDE1\_A1\_DI, Pos. 32)* | CS1\_DI, Pos. 18/428-537  CS1\_DI, Pos. 18/459-463  CDE1\_A1\_DI, Pos. 32  PYV1\_DI, Pos. 18  CS2\_A2\_DI, Pos. 8  CS1\_DI, Pos. 45, 1035-1085  CS1\_DI, Pos. 6 | Functional performance-Technical interoperability:   * *Until the Cures Act with the introduction of the USCDI [United* *States Core Data for Interoperability] there was no standardized, ubiquitous format (CS1\_DI, Pos. 18/459-463; CS2\_A2\_DI, Pos. 8)*  *“Well, Meaningful Use was mandated. And there was actually enforcement. I mean, you wanted part of the Meaningful Use was you got back a bunch of money’s spent as a hospital and buying a new and* *implementing a new EMR. You don’t do meaningful use, you won’t get that money, a good enforcement, a good incentive. The problem is there was no standard, and there was tremendous incentives on the part of most of the actors. This means the vendors producing the EMRs, Cerner, Epic, Allscripts, and the hospitals involved cannot* support interoperability. [quote]” * *Requires APIs between the two connecting parties (CDE1\_A1\_DI, Pos. 32)* * There is more variability across platforms that store clinical data than necessary: There are still many subjective rather than objective elements (CS2\_A2\_DI, Pos. 22; CS2\_A2\_DI, Pos. 32) * No technical interoperability within health IT systems (CS2\_A2\_DI, Pos. 30) * Health IT systems are purposefully not easy interoperable (PV1\_DI, Pos. 4) [see Pr\_StakeAlign] | * *Non-profit organizations were unwilling to create a standard strong enough that it could be practically used for the ubiquitous transfer of data (CS1\_DI, Pos. 18/459-463)* * *Little incentive for everybody to get on the same set of standards (in contrast to administrative data, i.e., billing and getting paid) (CS2\_A2\_DI, Pos. 8)* * Systems are customized for various stakeholders within hospitals and if a hospital has already written its own customized code over it, system updates for more interoperability would delete the code depending on how it was architected (CS2\_A2\_DI, Pos. 30) * Health IT vendors do not want to provide other parties access to their systems for security reasons (PV1\_DI, Pos. 4) [see Pr\_StakeAlign] * Garbage in (low quality, not timely inputs) leads to garbage out, in particular as when data gets transmitted there is always lost a little bit (CDE1\_A1\_DI, Pos. 18) * *Lack of enforcement of mandates (CS1\_DI, Pos. 45, 1035-1085) [see Pr\_StakeAlign]* | * *No interoperability (CS1\_DI, Pos. 18/428-537; CS1\_DI, Pos. 18/459-463)* * *Parties either have to build the API themselves or partner with an API offering interoperability company (CDE1\_A1\_DI, Pos. 32)* | CS1\_DI, Pos. 18/459-463  CDE1\_A1\_DI, Pos. 32  PYV1\_DI, Pos. 18  CS2\_A2\_DI, Pos. 8  CS2\_A2\_DI, Pos. 22  CS2\_A2\_DI, Pos. 30  CS2\_A2\_DI, Pos. 32  PV1\_DI, Pos. 4  CDE1\_A1\_DI, Pos. 18  CS1\_DI, Pos. 45, 1035-1085  CS1\_DI, Pos. 6 |
| Functional performance-Semantic interoperability:   * *The current technologies are not there yet fully but the Cures Act with TEFCA is expected to get us closer (includes free text form clinical notes) (CS1\_DI, Pos. 28)* | *Clinical data requires context (CS1\_DI, Pos. 28)* |  | CS1\_DI, Pos. 28 | Functional performance-Semantic interoperability:  *The current technologies are not there yet fully but the Cures Act with TEFCA is expected to get us closer (includes free text form clinical notes) (CS1\_DI, Pos. 28)* | *Clinical data requires context (CS1\_DI, Pos. 28)* |  | CS1\_DI, Pos. 28 |
| Functional performance-unspecified:   * Deciding on design questions such as whether to use a public or private chain, privacy & security, scalability questions (PY2\_DI, Pos. 30) |  |  | PY2\_DI, Pos. 30 |  |  |  |  |
|  |  |  | CS2\_A2\_DI, Pos. 20 | Non-functional performance:   * Data is not timely (PY1\_A3\_DI, Pos. 12; PY1\_A3\_DI, Pos. 16; PY1\_A3\_DI, Pos. 45; CDE1\_A1\_DI, Pos. 12; CDE1\_A1\_DI, Pos. 18) * Data is inaccurate: Over- und under-coding is common business practice, where the information registered is not truthful, e.g., recording a different diagnosis than the patient actually had, which results in a higher DRG [diagnostic-related group] payment from the payer; risk adjustment, i.e., saying that a patient is sicker than he his (CDE1\_A1\_DI, Pos. 12; CS1\_DI, Pos. 28) * Data is incomplete: Providers do not have all data about a patient at their disposal which could be useful for their treatment [providers cannot be sure that the HI about a patient is complete] (PY1\_A3\_DI, Pos. 55) * Data is not secure: Patient information is not sufficiently protected (CDE1\_A1\_DI, Pos. 12; PYV1\_DI, Pos. 6) * Data is not actionable, i.e., the information shared is not really used to change physicians’ or other stakeholders’ behavior (CDE1\_A1\_DI, Pos. 12) | * Payers do not share all health information they have about a patient with providers to uphold patient privacy (PY1\_A3\_DI, Pos. 55) * The way today’s software systems communicate makes it seem as if there was never the design goal of keeping conversations confidential, i.e., not knowing that they even happened (PYV1\_DI, Pos. 6) * Lack of privacy and security (CS2\_A2\_DI, Pos. 20) * Fraud and abuse (CDE1\_A1\_DI, Pos. 12) * HIPAA and PCI [payment card industry] are not abided by sufficiently rigorously (CDE1\_A1\_DI, Pos. 12) | * Physician do not know that they have approval and cannot perform the treatment timely (PY1\_A3\_DI, Pos. 12; PY1\_A3\_DI, Pos. 16) * Constant increase in new data needs, e.g., new treatments coming out, are not accounted for in the system (PY1\_A3\_DI, Pos. 45) * Waste, e.g., by getting more money from the government to treat the patient (CDE1\_A1\_DI, Pos. 12) * Healthcare data breaches have been expanding in the US (CS2\_A2\_DI, Pos. 20) | PY1\_A3\_DI, Pos. 12  PY1\_A3\_DI, Pos. 16  PY1\_A3\_DI, Pos. 45  PY1\_A3\_DI, Pos. 55  CS1\_DI, Pos. 28  PYV1\_DI, Pos. 6  CS2\_A2\_DI, Pos. 20  CDE1\_A1\_DI, Pos. 12 |