Information Services
2019 Benefits Realization Analysis

State of Corporate Information Services Supplement

Penn Medicine

PURPOSE OF THE REPORT

Now in its third edition (edition I debuted in 2015 and edition II in 2017), the 2019 Penn Medicine Benefits Realization report reviews twenty-seven (27) high-profile, high-quality projects implemented in fiscal years 2018 and 2019. The Penn Medicine Information Services (IS) team collaborated with operational and clinical partners to generate substantial financial and qualitative benefits in this year's report. The projects are grouped into four different categories that define key strategic goals of Penn Medicine: Empowering Technologies, Digital Healthcare, Making Data Meaningful, and Making the Connection.

The mission of Information Services is to transform data into value to support our caregivers, business administrators and patients. During 2018 and 2019, IS initiated more than 500 projects with an average of over 200 projects active in each month in support of this mission. As projects are completed, Penn Medicine has realized substantial value from the investments of time, resources, and empowering technology in terms of:

- Quality patient care and safety;
- Patient, family, staff, and physician satisfaction with the care and services provided; and
- Education and research support.

To assess the direct patient care value realized from IS projects, many of the projects feature measured and evaluated financial and qualitative returns derived from these investments.

MESSAGE FROM THE CIO

Penn Medicine's core mission of world class patient care, education and research is the primary focus of the IS team.

This report documents key projects in 2018 and 2019 that resulted in substantial operational savings, future cost avoidance and/or qualitative benefits. The Penn Medicine Information Services (IS) team leveraged integration and interoperability at new levels to enable improvements in patient care and accelerate research. Our institutional cornerstones consisting of robust executive support, governance/prioritization, operational collaboration and a high powered IS team continues to position Penn Medicine as an industry leader and influencer in today's healthcare industry.

The 2018 – 2019 edition of the Penn Medicine IS Benefits Realization report highlights the importance of driving benefits through the organization's support of _common system solutions_ that are _centrally managed_ and _collaboratively implemented_. The 3C approach provides Penn Medicine with institutional direction, a solid foundation, and most importantly, results that generate significant economies of scale in the deployment and support of information technology. We have discovered at Penn Medicine that technology itself does not transform data into knowledge and value. It is the combination of a common institutional vision along with strong leadership and an ability to deliver and execute in a precise manner that is truly Penn Medicine's secret sauce. These capabilities are enabled through ongoing investment in all of our employees through custom leadership training which facilitates employee centered enrichment programs. Together, talented IS, operational, and clinical leaders create a balance at Penn Medicine. This approach results in a significantly higher than average employee retention rate that translates into significant on-going benefits realization.

Michael Restuccia
Senior Vice President and Chief Information Officer

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COMPLETE REVIEW OF FINANCIAL IMPACT

EMPOWERING TECHNOLOGIES

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Technology Integration Program Consolidates Resources and Integrates LGH	$20,316,058	$30,793,587	$30,793,587
Legacy System Sunset Lends Cost Avoidance with Replacement Solutions	$1,866,376	$4,669,142	$4,669,142
Penn Medicine Completes Email Integration, Realizes Substantial Cost Savings	$4,550,000	$2,900,000	$1,450,000
Savings Recognized from Contracting	$1,367,800	$2,441,600	$2,459,600
Penn Medicine Princeton Health Realizes Savings and Improves Operations from New Integrated Systems	$1,250,000	$2,500,000	$2,500,000
Link EHR Insourcing	$750,000	$1,500,000	$750,000
New Interface Engine Efficiently Links Data Across Penn Medicine's Clinical Systems	$304,000	$640,000	$320,000
Optimizing the Organization Through Service Desk Improvement and Introducing Isaac	$195,000	$390,000	$390,000
Penn Medicine Information Security Implements Full Disk Encryption Software	QUALITATIVE	QUALITATIVE	QUALITATIVE
Penn Medicine Completes Enterprise Integration of Information Security Initiative	QUALITATIVE	QUALITATIVE	QUALITATIVE
Real-Time Privacy Monitoring Automates Support to Privacy Office to Ensure Data Protection	QUALITATIVE	QUALITATIVE	QUALITATIVE
Refresh and Expansion of High-Performance Computing	QUALITATIVE	QUALITATIVE	QUALITATIVE
Sustaining Cash Collections with an Integrated EHR	QUALITATIVE	QUALITATIVE	QUALITATIVE
SAVINGS	**$30,599,234**	**$45,834,329**	**$43,332,329**

DIGITAL HEALTHCARE

PROJECT NAME	YEAR 1	YEARS 2-3	YEARS 4-5
Penn Medicine's Telehealth Programs Streamline Workflow, Saving Time & Costs with Integrated Platform	$7,500,000	$3,000,000	$3,000,000
Improved Convenience for Employees with Penn Medicine On-Demand Virtual Access to Care	$1,635,445	$3,270,890	$1,635,445
PennChart Integrates Further with Implementations & Expansions	$1,126,189	$133,000	$133,000
Realizing the Value of our PennChart Integrated EHR through Expansions, Upgrades, and Enhancements	$57,967	$115,933	$57,967
Our Commitment and Investment in Creating Positive Patient Experiences	$35,000	$30,000	$30,000
PennChart Financial Tools Empower Patients and Providers with Convenience and Transparency	QUALITATIVE	QUALITATIVE	QUALITATIVE
Penn Medicine's Novel Use of Real-Time Data Dashboards in the ICU Improves Ventilator Weaning	QUALITATIVE	QUALITATIVE	QUALITATIVE
Penn Medicine 1st in PA Using Incident Management Tool for Emergency Response Bed Tracking	QUALITATIVE	QUALITATIVE	QUALITATIVE
SAVINGS	**$10,354,601**	**$6,549,823**	**$4,856,412**

MAKING DATA MEANINGFUL

PROJECT NAME	YEAR 1	YEARS 2-3	YEARS 4-5
PennChart Contributes to Improved Health System Readmission Rates	QUALITATIVE	QUALITATIVE	QUALITATIVE
Penn Medicine's Integrated Systems Approach to Manage Opioids and Controlled Substances	QUALITATIVE	QUALITATIVE	QUALITATIVE
Cloud Technology Breakthrough for BrainIAK Application Real Time Attention Study of Depression	QUALITATIVE	QUALITATIVE	QUALITATIVE
Penn Data Store II - Catalyst for Penn Medicine's Do-It-Yourself Data Analytics	QUALITATIVE	QUALITATIVE	QUALITATIVE

MAKING THE CONNECTION

PROJECT NAME	YEAR 1	YEARS 2-3	YEARS 4-5
Penn Medicine PCP's Leverage Encounter Notification Site to Achieve Value Based Care Initiatives	QUALITATIVE	QUALITATIVE	QUALITATIVE
New PhysicianLink - a Regional First, Offers Radiology Image Viewing for External/Referring Providers	QUALITATIVE	QUALITATIVE	QUALITATIVE

SAVINGS AND AVOIDANCE BREAKDOWN

	TOTAL
Cost Savings	$101,459,287
Cost Avoidance	$40,017,440
New Revenue	$50,000
TOTALS	**$141,526,727**

TOTAL FINANCIAL IMPACT

	YEAR 1	YEARS 2-3	YEARS 4-5	TOTAL
Total Financial Impact	$40,953,835	$52,384,152	$48,188,741	$141,526,727
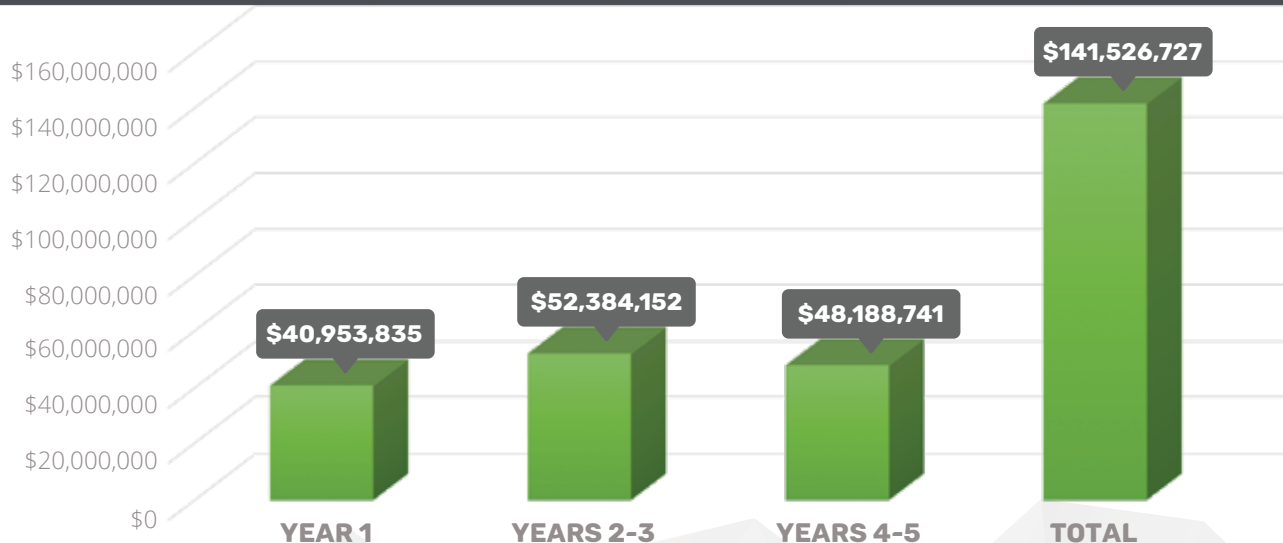
BREAKDOWN OF SAVINGS CATEGORY
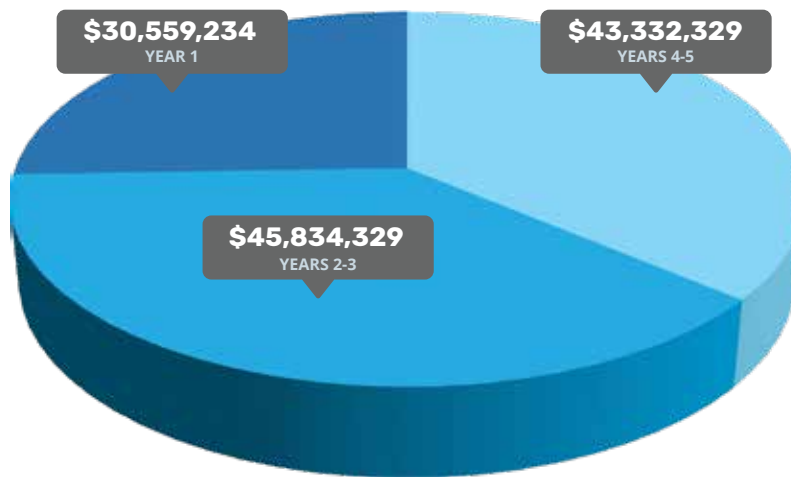
$30,559,234
YEAR 1

$43,332,329
YEARS 4-5

$45,834,329
YEARS 2-3

EMPOWERING TECHNOLOGIES

These projects are focused on technologies and processes to address the administrative and physical infrastructure that includes financial services, operations, human resources, managed care, contracting, billing, materials management and others.

TOTAL FINANCIAL IMPACT
$119.8 Million
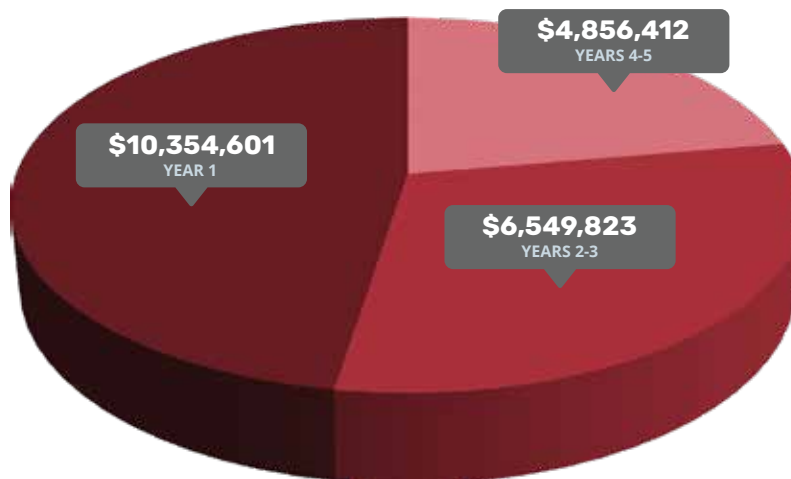
$4,856,412
YEARS 4-5

$10,354,601
YEAR 1

$6,549,823
YEARS 2-3

DIGITAL HEALTHCARE

These projects are focused on implementation and enhancement of the Electronic Medical Records applications in which clinical documentation is captured and used to support patient care delivery. Mobile Health and Patient Engagement tools are also represented.

TOTAL FINANCIAL IMPACT
$21.8 Million

SAVINGS AND COST AVOIDANCE BREAKDOWN

$101,459,287

SAVINGS

Changes to the current cost structure of the organization which lowers the expense run rate of a given service or department. This data is relevant to the following projects: Technology Integration Program Consolidates Resources and Integrates LGH, Savings Recognized from Contracting, Penn Medicine Completes Email Integration, Realizes Substantial Cost Savings, Penn Medicine Princeton Health Realizes Savings and Improved Operations from New Integrated Systems, Optimizing the Organization Through Service Desk Improvement and Introducing ISAAC, Improved Convenience for Employees with Penn Medicine On-Demand Virtual Access to Care, PennChart Integrates Further with Implementations and Expansions, Realizing the Value of our PennChart Integrated EHR through Expansions, Upgrades, and Enhancements, and Our Commitment and Investment in Creating Positive Patient Experiences.

TOTAL SAVINGS: $101.5 Million

$40,017,440

COST AVOIDANCE

Avoided specified costs due to changes in practice or operations. The projects associated are: Legacy System Sunset Lends Cost Avoidance with Replacement Solutions, Savings Recognized from Contracting, Penn Medicine Completes Email Integration, Realizes Substantial Cost Savings, LinkEHR Sale / Insourcing, New Interface Engine Efficiently Links Data Across Penn Medicine's Clinical Systems, Improved Convenience for Employees with Penn Medicine On-Demand Virtual Access to Care, Telehealth Transition, and Our Commitment and Investment in Creating Positive Patient Experiences.

TOTAL COST AVOIDANCE: $40 Million

EMPOWERING TECHNOLOGIES

These projects are focused on technologies and processes to address the administrative and physical infrastructure that includes financial services, operations, human resources, managed care contracting, billing , materials management and others.

YEAR 1	YEARS 2-3	YEARS 4-5	TOTAL
$30,599,234	$45,834,329	$43,332,329	$119,765,892

SUSTAINING CASH COLLECTIONS WITH AN INTEGRATED EHR

BACKGROUND DESCRIPTION

Penn Medicine completed its implementation of PennChart (Epic) inpatient, outpatient and home care / hospice modules in 2017. From a revenue cycle perspective, the goal was to sustain pre-go live outcomes immediately after go live and realize significantly improved outcomes after attaining stable operations. Penn Medicine achieved its revenue goals (charge capture) versus baseline within 21 days of go live, a goal that exceeded industry benchmarks among other academic medical centers completing the same transition. The organization successfully mitigated the risk of cash disruption during the transition. Three-months post implementation, cash collections improved from pre-go live baseline metrics. At the one-year post go live, Penn Medicine continued to surpass charge capture goals achieving 110% of the target in FY2018 and sustaining cash collections against pre-go live baseline metrics. Sustaining cash collections using the new PennChart system is a balance of utilizing charge accuracy revenue reconciliation tools and providing departments with the information to achieve accountability by managing variances. Departments have familiarized with the new processes and tools, realizing a sustained target of 104% in FY2019. Additionally, Penn Medicine Princeton Health began utilizing the new system and processes in FY2019 and achieved a target of 103%.

BENEFITS REALIZED

CUMULATIVE TOTAL CHARGES (% OF BASELINE)

Graph depicts ten (10) months; July 2017 – April 2018

The increase in efficiency through PennChart's charge capture automation have solidified and debunked a common major question asked in the healthcare industry; 'does the investment in an EHR ever pay off or achieve a return on investment?'. Penn Medicine can say with confidence that they have achieved a positive ROI from their EHR investment through the outcomes of this project in 2019, early upon the initial investment and implementation dates of PennChart.

« AS OF APRIL 2018

— **PENN MEDICINE**
— **AVERAGE OF EPIC CUSTOMERS IN THE TOP QUARTILE**
— **AVERAGE OF ALL EPIC CUSTOMERS**

CASH COLLECTIONS TRENDING PRE AND POST PENNCHART IMPLEMENTATION

The graph below depicts the organization's steady increase in cash collection performance pre, during and post PennChart implementation.

SUSTAINING CASH COLLECTIONS WITH AN INTEGRATED EHR

3.7

2.8

3.0

OURS	MEDIAN	TOP 25%
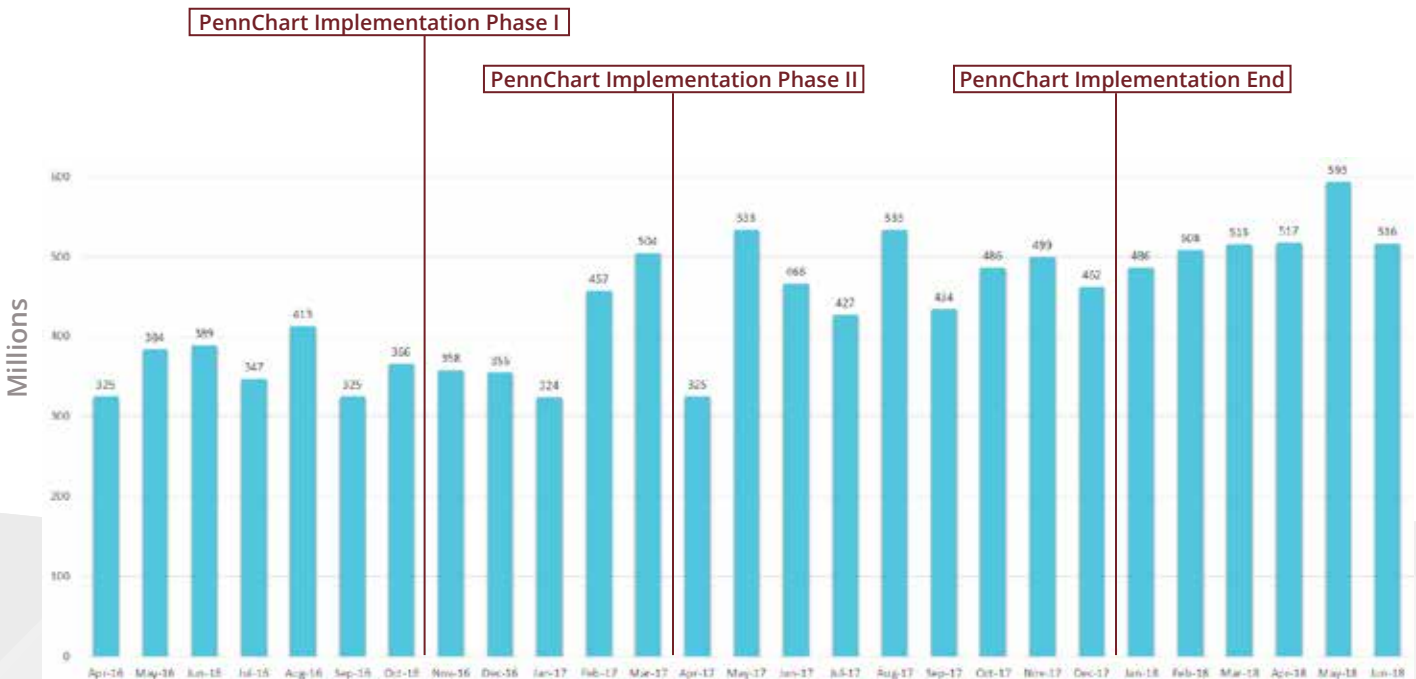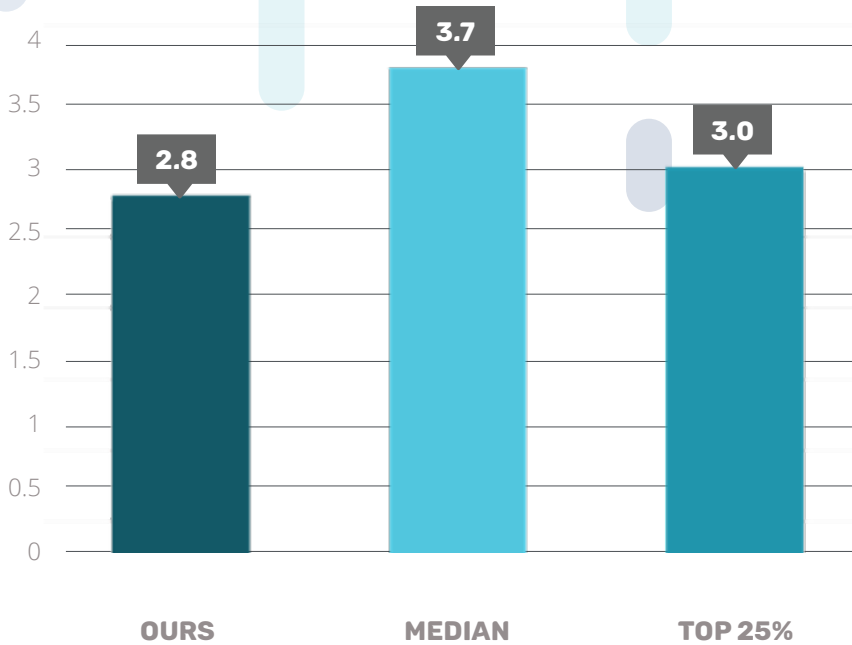
CFB DAYS

- CFB (Candidate for Billing) represents accounts that are eligible for billing to third party payers.
- CFB days are defined as the number of days it takes to resolve edits that prevent accounts from billing after the initial hold bill days have elapsed.
- Graph depicts UPHS CFB days (2.8) to other Epic customers and to the industry top quartile.

0.6

0.5

0.2

OURS	MEDIAN	TOP 25%
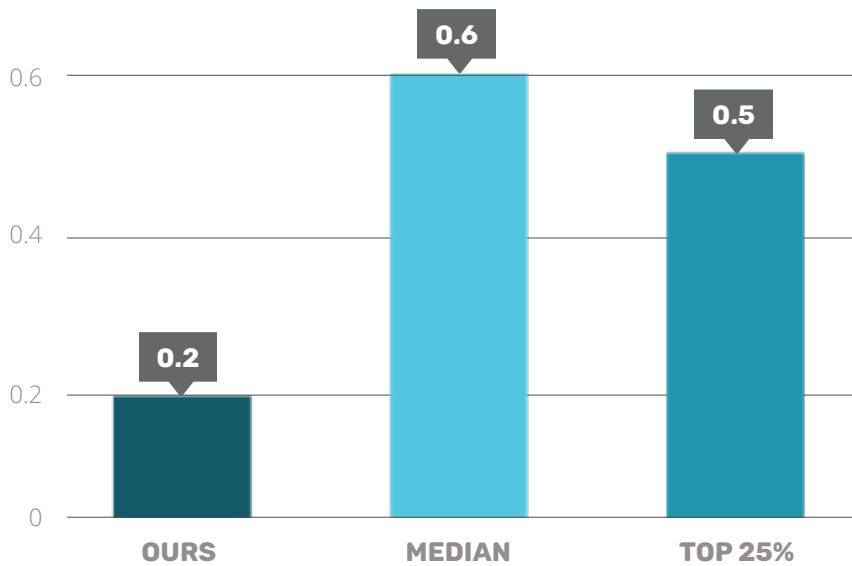
CLAIM ERROR DAYS

- Claim Error Days represents the number of days to resolve errors identified on claims stopping submission to third party payers.
- Penn Medicine is ranked in the Top 25% of Epic customers of 0.2 days to resolve errors.

SAVINGS
QUALITATIVE

TECHNOLOGY INTEGRATION PROGRAM CONSOLIDATES RESOURCES & INTEGRATES LANCASTER GENERAL HEALTH

BACKGROUND DESCRIPTION

The Technology Integration Program is an enterprise level initiative to attain common systems that are collaboratively installed and centrally managed. The program spans all applicable IS technology across Penn Medicine entities to gain economies of scale, improve services and availability, realize cost reductions and higher levels of redundancy, disaster preparedness, and recovery capabilities.

Penn Medicine's Information Services infrastructure was experiencing fast growth and dramatic change over the past several years. Replacement of legacy systems by PennChart began in 2016, followed by UPHS' expansion and mergers with Chester County Hospital and Lancaster General Health (LGH). With Princeton Health System on the horizon of joining Penn Medicine, the PennChart EPIC inpatient and ambulatory EHR was centralizing and growing in size exponentially to include HUP, Presbyterian, Pennsylvania Hospital and Chester County. Many on site departmental and ancillary systems continued to need to support individual hospitals through the transition and beyond. LGH went live on their own instance of EPIC several years earlier, and continued to maintain their own local operations with an additional disparate infrastructure and systems.

This rapid evolution created separate silos of contracts, assets, data centers, disaster recovery, and IT operations across the combined organization. Great progress has been made to unify applications, technology and operations using a single strategy, plan and roadmap to unify the remaining systems, consolidate data centers and networks, and eliminate redundancy.

As LGH joined Penn Medicine, we sought to consolidate shared or redundant assets, as well as physical data center locations, align hardware or software and converge networks. The Technology/LGH Integration Program was launched in late 2017. The following activities and benefits were realized.

TECHNOLOGY/LGH INTEGRATION

1. **Converged Data Centers** – Converged 12 separate locations, each with duplicative layers of hardware, software, storage and other technologies and applications at UPHS. We continue to use high availability data centers (production) systems and applications and converge on available underutilized internal space to lower costs and eliminate unnecessary sites.

- Leveraged internal Lancaster facilities to yield better efficiencies, redundancy and economies of scale;
- Relocation of the PSOM Walnut Street location in 2018, relocating all the main assets.

2. **Rationalized Technology Assets** – Achieved economies of scale through rationalization, combined server and storage resources to eliminate waste and strategically insource technology administration where appropriate.

3. **Realigned Network & Security** – Realigned existing optic assets, infrastructure, connectivity and architecture to lower costs, increase bandwidth and improve performance.

4. **Consolidated Contracts, Applications, Resources and Services** - Alignment, consolidation, convergence and rationalization of common functions such as resources, contracts, and service desk eliminated inefficiencies and waste.

TECHNOLOGY INTEGRATION PROGRAM CONSOLIDATES RESOURCES & INTEGRATES LANCASTER GENERAL HEALTH

BENEFITS REALIZED

STRATEGIC SAVINGS FROM KEY PROJECT DELIVERABLES (THROUGH MAY 2019)		
DATA CENTERS	$2,330,000	(one time savings)
ASSETS	$3,890,000	(multi-year savings)
NETWORK & SECURITY	$1,050,000	(multi-year savings)
CONTRACTS	$7,468,058	(multi-year savings)
APPLICATIONS	$2,652,000	(multi-year savings)
RESOURCES & SERVICE	$2,926,000	(one time savings)
TOTAL	**$20,316,058**	

- Results of the overall program far exceeded the goal, ($13,260,000) with a total of over $20 million in savings and cost avoidance, of which 75%, over $15 million, was accountable as savings that would be repeated annually, year over year.
- The data center expansion at Lancaster's Brownstown facility exemplified collaboration and strong partnerships between all teams and leaders involved, the project included:
  - Upgrading the power and cooling capacity to handle additional servers and systems;
  - Moving and decommissioning Lancaster systems;
  - Building a new network, data center and security infrastructure;
  - Relocating the PSoM operations and applications (approximately 800 servers);
    - Supporting new operations in a multi-purpose facility;
    - Zero user issues reported during Phase 2 completion in September 2018.

Bar chart:
- YEAR 1: $20,316,058
- YEARS 2: $30,793,587
- YEARS 4-5: $30,793,587
- TOTAL: $81,903,232
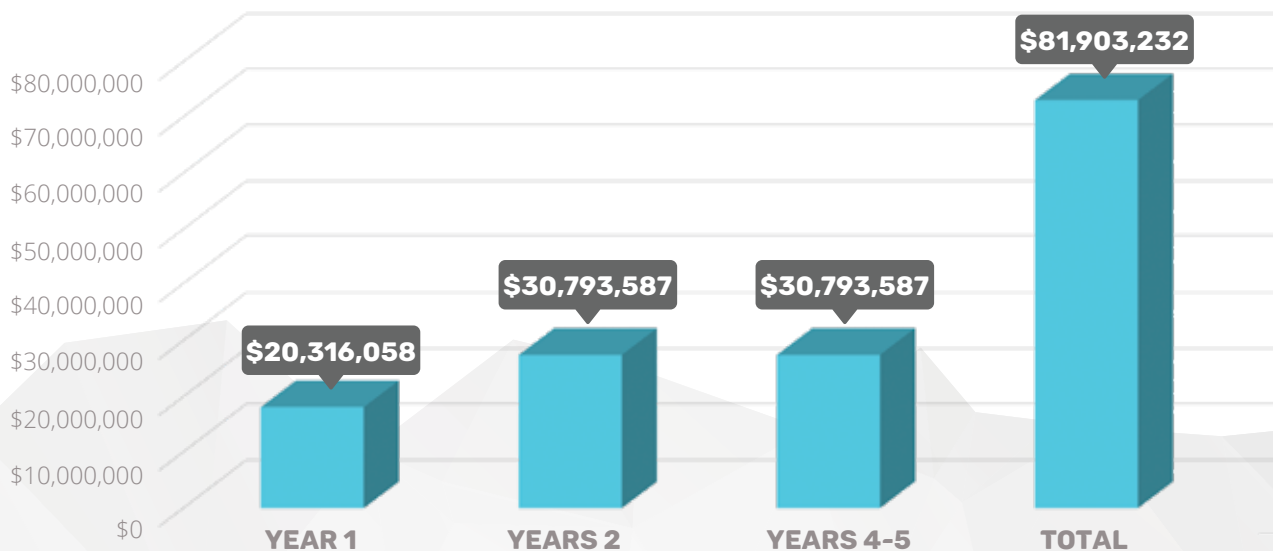
LEGACY SYSTEM SUNSET LENDS COST AVOIDANCE WITH REPLACEMENT SOLUTIONS

BACKGROUND DESCRIPTION

Each year, the Information Services team works closely with Penn Medicine operations leaders to implement new software systems that typically obsolete existing systems. A detailed plan is developed to extract key data from the replaced system and make this data available to the operations team in a HIPAA compliant solution, and where necessary, ensuring the data is stored in a SQL file making it available for research and analysis. Once a project is completed, the legacy system is "sunset", with appropriate legal notice to the vendor, thus avoiding unwanted software support or subscription fees.

BENEFITS REALIZED

- Eliminated vendor contracts that were obsolete or unnecessary;
- Renegotiated contracts with vendors resulting in cost savings or lower operational rates;
- Consolidated contracts to simplify ongoing contract management and maintenance;
- 1-year cost savings: $1,866,376;
- 5-year cost savings: $11,204,660.
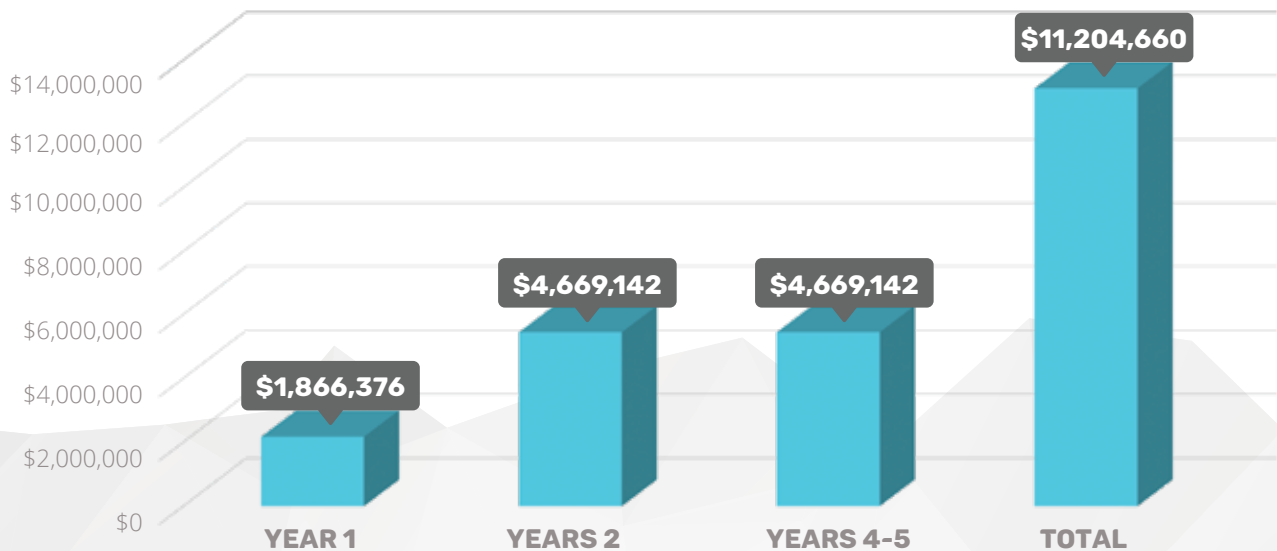
	YEAR 1	YEARS 2	YEARS 4-5	TOTAL
	$1,866,376	$4,669,142	$4,669,142	$11,204,660

PENN MEDICINE COMPLETES EMAIL INTEGRATION, REALIZES SUBSTANTIAL COST SAVINGS

BACKGROUND DESCRIPTION

Penn Medicine continued the enterprise email integration and consolidation, with platforms managed by several IS teams and housed in multiple data center locations serving UPHS (HUP, PPMC, PaH, CCH), Perelman School of Medicine (PSOM), Penn Medicine Princeton Health (PMPH), and Lancaster General Health (LGH). The email initiative immediately resulted in better oversight, management and workflow improvements, as well as cost reductions. There are inherent and redundant costs involved in operating separately managed platforms as well as several challenges seamlessly collaborating within the organization. As a result, there are significant savings realized and a tremendous business value by consolidating the four systems onto a single platform. Furthermore, there are savings and cost avoidance opportunities associated with moving to the Microsoft Office 365 Cloud service as a single Penn Medicine tenant.

This consolidation project, began its planning stages in April 2017 and completed all migrations in June of 2019. LGH, HCHS, PSOM, PHCS, PPMC, PAH and the IS migrations took place over the course of 21 months. This new enterprise email system lays the foundation for adoption of additional cloud-based collaboration tools, further breaking down geographical barriers and collaboration challenges. It also provides the organization with a new and unified Penn Medicine mail identity, reinforcing the "power of one" integration branding message used for our EHR within the organization. Plans for the decommission of legacy systems will continue and be complete by the end of calendar year 2019, resulting in additional realized cost savings.

BENEFITS REALIZED

- The Penn Medicine enterprise/system runs on a common email platform, thus standardizing workflows and oversight;
- Enables implementation of other cloud collaboration solutions;
- Larger email-box sizes with unlimited archiving capabilities;
- Disaster recovery, data encryption, Data Loss Prevention (DLP) tools included;
- Improved Penn Medicine user collaboration with shared calendaring, file sharing, and communication tools;
- Fewer IS staff are needed to operate and maintain the system, especially as new users and new practices and hospitals are added;
- Projected four-year savings of $5,800,000, slightly higher than expected since project began;
- Cost avoidance approximately $3,100,000 associated with avoiding need to build and support on-premise Exchange 2016 environment.
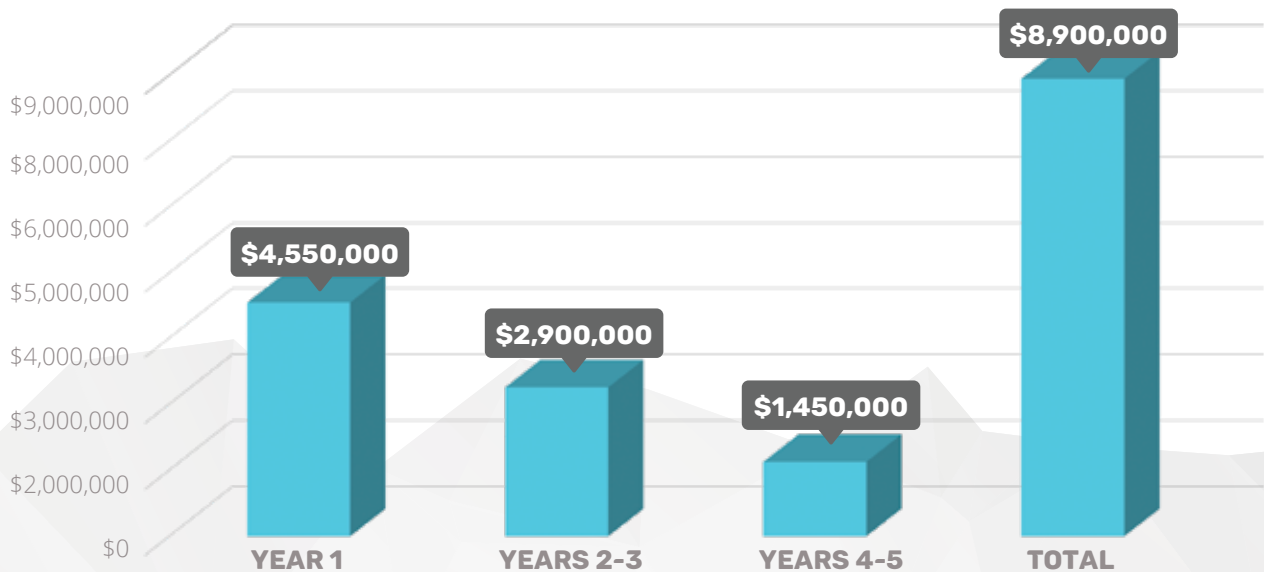
SAVINGS RECOGNIZED FROM CONTRACTING

BACKGROUND DESCRIPTION

The Information Services department is responsible for contracting with hundreds of vendors who provide UPHS with software systems, hardware technology and services. Vendors who provide software systems typically charge customers annual software support or annual subscriptions. Vendors who provide hardware technology charge customers for break-fix services and micro-code software support. IS executives and directors work closely with the IS Finance team to pro-actively renew vendor services when there is sufficient lead-time to seek alternatives should the incumbent vendor not meet Penn Medicine's business requirements. During the past two years, there were several contracts that resulted in noteworthy cost reductions or cost avoidance.

BENEFITS REALIZED

- Eliminated unnecessary vendor contracts;
- Renegotiated contracts with vendors, most often resulting in lower operational rates;
- Consolidated contracts, simplifying ongoing contract management;
- Maximized the return on investment for PennChart implementation and integration;
- Total cost savings 2018-2022: $3,623,000;
- Total cost avoidance 2018-2022: $2,646,000;
- Total benefits realized: $6,269,000.

	YEAR 1	YEARS 2	YEARS 4-5	TOTAL
	$1,367,800	$2,441,600	$2,459,600	$6,269,000
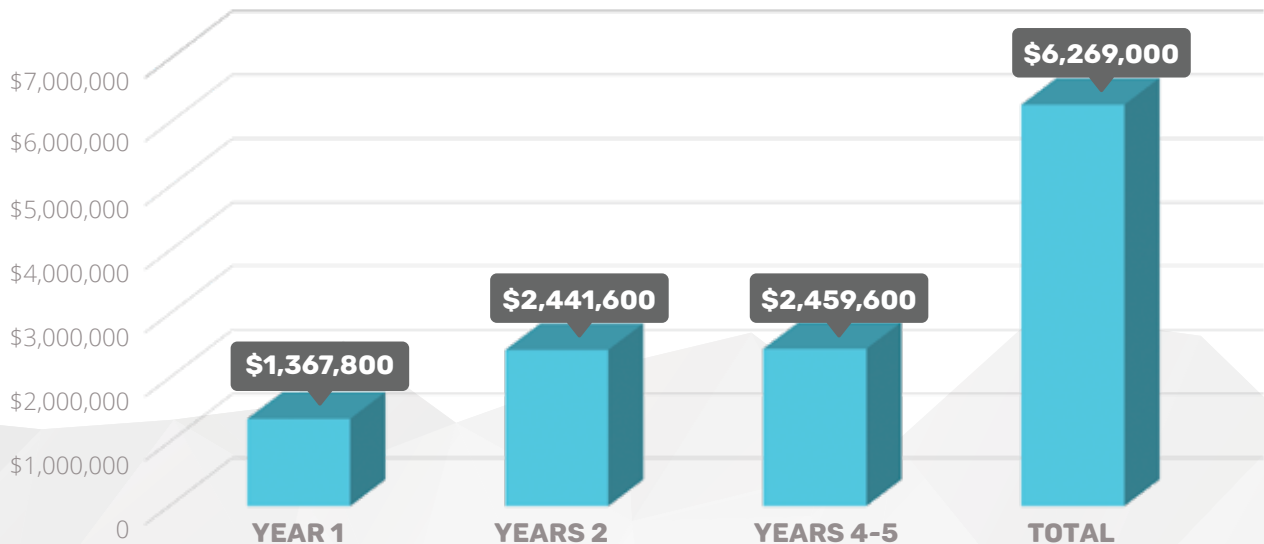
PENN MEDICINE PRINCETON HEALTH REALIZES SAVINGS & IMPROVES OPERATIONS FROM NEW INTEGRATED SYSTEMS

BACKGROUND DESCRIPTION

As Princeton Health merged with Penn Medicine on January 2, 2018, many IS related financial and operational benefits were tied to economies of scale and the use of common systems and technologies. The two largest projects contributing to improved operations and cost savings were the implementation of the PennChart (UPHS EHR solution) and transitioning all of Princeton's Enterprise Resource Planning (ERP) departments (HR, Finance, Supply Chain) to the UPHS ERP solution.

PRINCETON PENNCHART IMPLEMENTATION

From May 2017 to June 2018, Princeton embarked on the journey to adopt PennChart for all inpatient, outpatient and behavioral health departments. Once live, Princeton focused on converting 25 ambulatory clinics to PennChart between August and November 2018. This move to PennChart ensured standardization of clinical and revenue cycle workflows, while complying with NJ state and federal regulations.

PRINCETON ERP TRANSITION

Princeton and UPHS ERP departments worked together for 11 months to transition these important business functions on July 1st 2019 which resulted in improved department workflows, significant savings from UPHS' improved vendor discounts and standardized enterprise ERP operations, while contributing to resource efficiencies.

BENEFITS REALIZED

Princeton PennChart Implementation

- Integrated PennChart security and printer infrastructure;
- Converted 1,000,000 patient accounts, 3,000,000 results, 333,000 visits and 350,000 continuity of care documents;
- Procured and deployed 4,000 desktops/laptops, 300 printers and over 1,000 peripherals;
- Trained 4,000 users, completed 7,600 role-based training classes;
- Savings from vendor contract consolidations (e.g. lab, Rx).

Princeton ERP Integration

- Consolidated financial reporting;
- Centralized purchasing allowing Princeton to use UPHS lower purchasing costs;
- Centralized payroll and accounts payable, allowing for the reallocation of resources;
- Centralized HR functions allowing for a single source of truth used to provide consolidated reporting and common processes for managers, staff, and contractors;
- Streamlined IS support staff and roles, avoiding $6,250,000 over 5 years in costs.
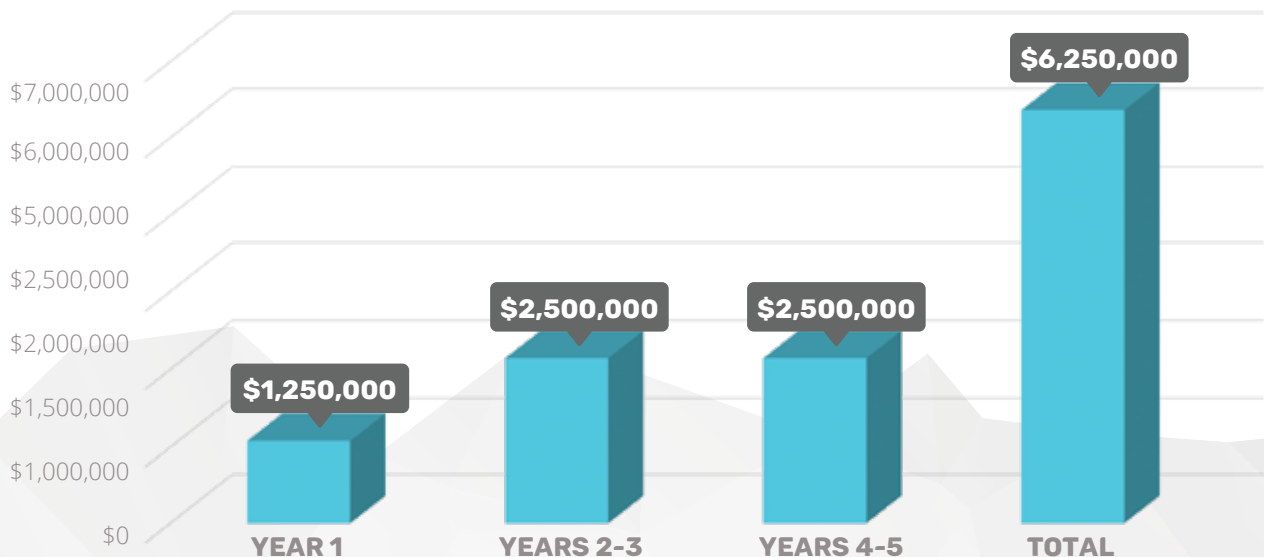
LINK EHR INSOURCING AT LGH

BACKGROUND DESCRIPTION

Lancaster General Health (LGH) had outsourced certain Epic application support services to LinkEHR, a wholly owned, for profit, LGH subsidiary based in Madison, WI. LinkEHR provided Epic support and consulting services to LGH and 4 other non-LGH health systems. LGH, working with UPHS leadership, was successful in selling the LinkEHR business to the Cumberland Consulting Group (CCG). Terms of the sale required LGH and CCG to work together to transition LGH's Epic application support services from CCG to LGH. Certain LinkEHR Epic support services were to be transitioned within 6 months' post-sale, with the remaining services being transitioned within 2 years' post-sale.

In an effort to share the workload between LGH and UPHS teams as we insourced the LinkEHR support services, the LGH Epic application team partnered with the UPHS PennChart (Epic) application team to identify organization and workflow synergies. The teams identified certain LGH Epic applications that could be supported more effectively by the PennChart application teams while ensuring high quality end user service. As not all Epic systems are configured in the same manner, the two application teams worked closely together to ensure that the affected PennChart application teams were educated on the LGH application workflows.

The sale of LinkEHR and the associated insourcing of LGH's Epic support services resulted in a substantial cost reduction for LGH while ensuring that LGH end users continued to receive excellent application support.

BENEFITS REALIZED

- The LinkEHR sale and insourcing project resulted in a $3,000,000 cost avoidance for LGH IS over a 4-year period.
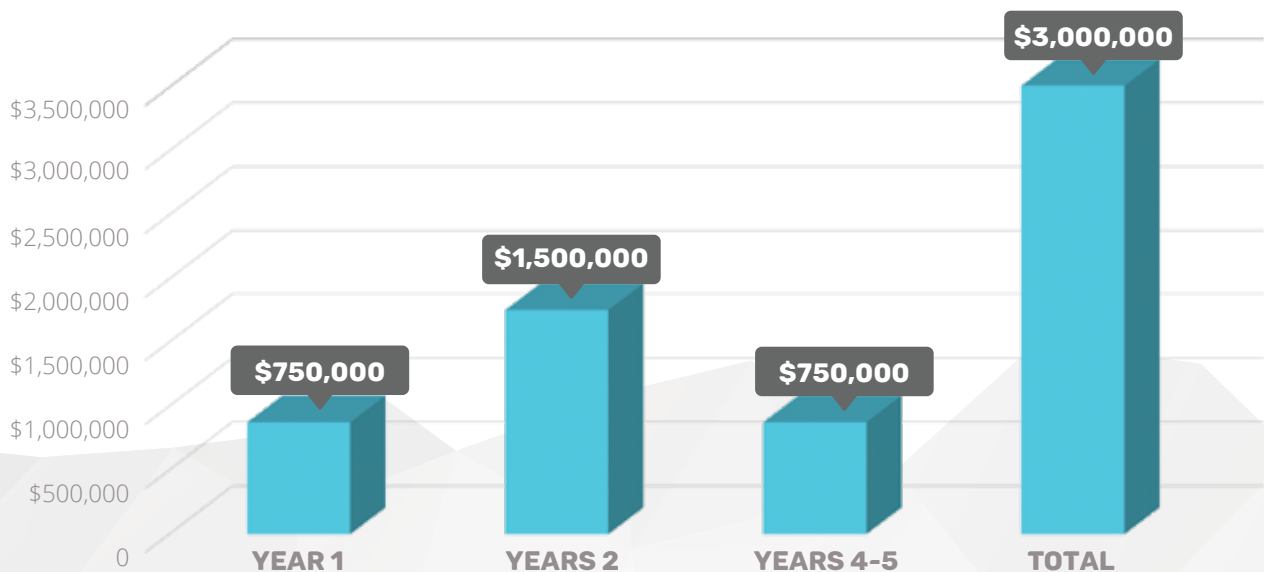
NEW INTERFACE ENGINE EFFICIENTLY LINKS DATA ACROSS PENN MEDICINE'S CLINICAL SYSTEMS

BACKGROUND DESCRIPTION

Penn Medicine's enterprise HL7 interface engine enables our clinical systems to exchange data with each other in real time, a capability that is necessary for our clinical operations to function smoothly. In 2017 work began to replace the old, end-of-life interface engine with a new, enterprise standard solution. This effort involved re-writing 353 HL7 interfaces, touching almost every clinical system in production at Penn Medicine. The project was completed ahead of schedule with no adverse operational impacts. These interfaces are now hosted on Penn Medicine's common enterprise integration engine infrastructure at the Brownstown and Duke St. data centers.

BENEFITS REALIZED

- Migrated to an enterprise standard HL7 interface engine software product, retiring an end of life product;
- Improved performance, reliability, and redundancy by moving to common enterprise hardware infrastructure, with enhanced disaster recovery capabilities;
- Consolidated software licensing, resulting in $200K annual cost savings;
- Consolidated hardware hosting, resulting in one-time cost savings of $104K and annual savings of $120K.
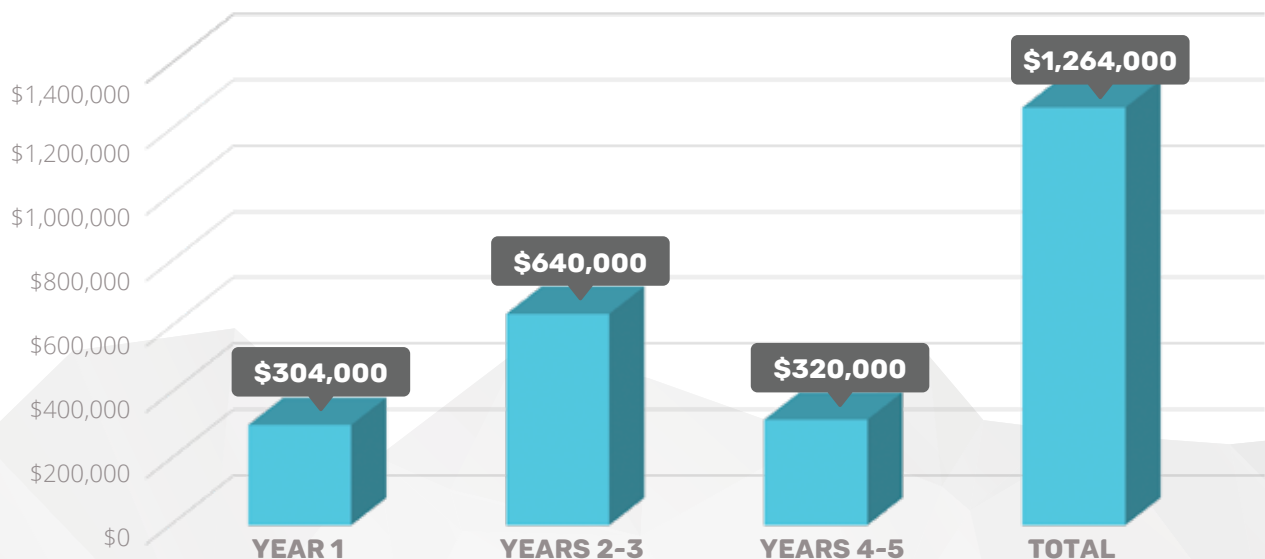
	YEAR 1	YEARS 2-3	YEARS 4-5	TOTAL
	$304,000	$640,000	$320,000	$1,264,000

OPTIMIZING THE ORGANIZATION THROUGH SERVICE DESK IMPROVEMENT AND INTRODUCING ISAAC

BACKGROUND DESCRIPTION

Users have submitted over 30,000 requests to the IS Service Desk each month in the last two years. With the sheer volume and breadth of the Service Desk responsibilities, Penn Medicine endeavored to make continued improvements to the existing operational functions, consolidate the Princeton Network Operations Center (NOC) and introduce the new Information Systems Advisory Center (Isaac).

Prior to adding the Isaac team to our technical support service model, ninety-six percent of incoming service requests were handled by the following units: IS Service Desk (62%), End User Support (EUS) (19%), Application teams (9%) and Governance Committees (6%). An estimated 1,000 contacts per month didn't have a clear key resolver group. IS management felt that these IS contacts needed a unique way of handling these inquiries.

The Isaac team was newly designed with experienced IS professionals who have a deep understanding of IS processes. They also know the IS "who's who", to address these difficult situations and answer user questions such as "Where can I find", "How can I" and "I was thinking but did not know". Isaac provides concierge service designed to be "go to" contact for users that are not sure where to go. The Isaac team visits various locations on a weekly basis in high traffic areas and attends key School of Medicine and health system events to educate and answer questions. Isaac newsletters are also electronically sent to entities highlighting recent technology use cases.

Penn Medicine also undertook an initiative to merge the Princeton NOC with the IS Service Desk. Prior to the PennChart implementation at Princeton Medical Center, IS support was handled by the Princeton NOC. The NOC was made up of fourteen (14) members who answered the phones and provided 24/7 desktop support. In July 2018, all Princeton IS support calls transitioned to the IS Service Desk. Seven members of the NOC stayed in Princeton to create a focused EUS team. The IS Service Desk added four (4) FTE's to take on the additional user contact workload.

BENEFITS REALIZED

Isaac
- Creates process efficiency using automation within the IS Service Desk;
- Dispatches reported cases in a more streamlined manner, improving the time to issue resolution.

Princeton NOC
- Centralization of key service desk support functions resulting in annual and five-year savings:
    - 1-year savings: $195,000
    - 5-year savings: $975,000
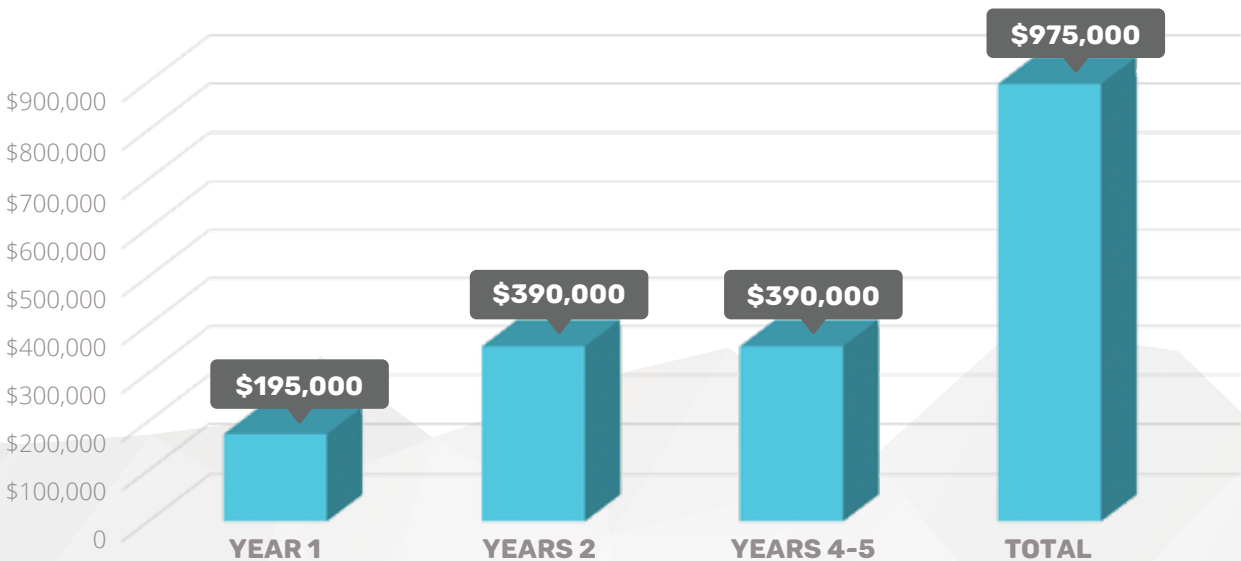
PENN MEDICINE INFORMATION SECURITY IMPLEMENTS FULL DISK ENCRYPTION SOFTWARE

BACKGROUND DESCRIPTION

Cybersecurity is a global top priority for leadership teams as healthcare organizations are at an increasingly heightened risk of data loss and misuse. Examples of how data loss can occur include misdirected emails, system compromise, and lost/stolen computer devices. Nationally, Health and Human Services (HHS) reported forty-three data breaches in 2018, involving over 700,000 patient records attributed to both loss and theft.

The Penn Medicine Information Security Office made a strategic decision to pursue complete full disk encryption of over 30,000 managed computer desktop workstations and laptops, many of which required manual intervention. Sponsored by the executive security governance committee, the effort took 18 months to complete between IS teams collaborating among the Project Management Office (PMO), End User Support (EUS), Platform Engineering (PE), and Information Security.

BENEFITS REALIZED

- Full disk encryption has been deployed to over 30,000 managed endpoints;
- Eliminated the high risk of potential data loss and exposure on lost and stolen Penn Medicine computer devices;
- According to a combination of internal and external research studies it was determined that the cost of full disk encryption is approximately $232 per user:
  - The cost per user includes technician time, hardware, software, increased load times of computers and more;
  - The same research studies valued the cost of a data breach to an organization; at $4,650 per user; demonstrating the value of full disk encryption outweighs cost by a factor of 4 to 20.

SAVINGS
QUALITATIVE

PENN MEDICINE COMPLETES ENTERPRISE INTEGRATION OF INFORMATION SECURITY INITIATIVE

BACKGROUND DESCRIPTION

The Information Security program's growth and maturity over the past 36 months has led to a significant increase in governance, awareness, technical and human capital investments, and risk reduction. A key initiative of the Information Security Strategic Plan was to ensure centralized program management, leading to consistent security controls, policy, standards, and responsibilities across all Penn Medicine entities and groups.

Program leaders from UPHS and Lancaster General Health (LGH) collaborated in FY18 and FY19 to develop a staffing integration plan for all information security practitioners. This included 15 staff members from the LGH IT Security group and Information Protection and Assurance group.

A focus on strategic alignment and well-coordinated efforts led to the Information Security Office successfully integrating the staffing models of both LGH entities with the downtown Philadelphia Penn Medicine Information Security team. The integration of staff and program direction increases the overall coverage of risk management, security engineering, security operations, and security business management for Penn Medicine. Furthermore, team integration promotes the strategic plan of Information Services and its core values of common systems, central management, and collaborative implementations.

BENEFITS REALIZED

- Increased staffing levels within the central Information Security program leads to overall risk reduction for the health system;
- Successfully converted 70% of security controls to a central model, goal is to be at 100% integration across team and security controls, team fully integrated 100% in 2018;
- A consistent and centralized approach to Information Security, has led to an increased user experience and clarity regarding security policy, process, and technology use and compliance;
- Program maturity and consolidation has sparked increased innovation due to added resource collaboration, leading to several national award achievements and nominations in 2018 and 2019, including:
  - CSO 50;
  - Security 500 Magazine;
  - SC Awards: 2019 Best Security Team (finalist);
  - SC Awards: 2019 CISO of the Year (finalist).

SAVINGS
QUALITATIVE

REAL-TIME PRIVACY MONITORING AUTOMATES SUPPORT TO PRIVACY OFFICE TO ENSURE DATA PROTECTION

BACKGROUND DESCRIPTION

The privacy of Penn Medicine's patient health information is of the utmost importance to support patient trust and engagement with their health care providers. As Penn Medicine continues to expand, a solution that supports proactive privacy monitoring was implemented while accommodating continued patient services growth. The Penn Medicine Privacy Office and Information Assurance team from IS started with a pilot, evaluation, and then selection of a solution.

Our privacy monitoring solution ensures that 100% of the medical record access logs are audited and scored prior to human review, allowing privacy office teams to prioritize work on cases that exceed the established thresholds and pose the most risk to the organization. The solution provides necessary resources to audit every access to every patient record. The privacy software automatically develops case summaries or observation statements based upon the user and patient interaction, including other users that accessed the patient record. These case summaries provide salient details about user access, access to the patient, and the intersection of both. Penn Medicine trains every user on privacy software to educate various stakeholders and user groups on the risk.

BENEFITS REALIZED

- Increased emphasis on privacy monitoring to mitigate risk to the Penn Medicine organization;
- Increased access to information, such as "case summaries" and valuable data points that provide privacy investigators with a significant "head start" in their investigations, to determine potential issues or supplement the investigation process;
- Promotion and awareness of privacy monitoring through education and training completed with user groups serves as a deterrent from committing unauthorized patient record access;
- Consistency in the identification of persons in violation of privacy policies and standardization in remedial action applied in cases of wrongdoing.

SAVINGS
QUALITATIVE

REFRESH AND EXPANSION OF HIGH-PERFORMANCE COMPUTING

BACKGROUND DESCRIPTION

Penn Medicine Academic Computing Services (PMACS) completed a major refresh of the High-Performance Computing (HPC) environment in FY 18. The team replaced the aging storage and tape archive infrastructures of the HPC environment and expanded capacity to meet the accelerating growth in research data consumed to meet the current research analytics demands. The deployment of an enhanced high-speed parallel file system sped data transfers to complete the project without interruption to the computing demands of the research community. The HPC system was used by 700+ users, with 300 active per-month running 14,000,000 jobs in FY2018.

The project also sought to create future HPC analytical environments that incorporate cloud-based resources for research computing. The redesign was guided by the following:

- Reduce the on premise footprint, and pursue architectures aiding in efficient data movement between environments;
- Condense computing resources while maximizing their use;
- Improve efficiency of networks and enable rapid extension into cloud resources;
- Provide detailed resource usage to both management and research community consumers.

BENEFITS REALIZED

- Maintained HPC clusters production run state, enabling 14 million+ jobs during the project;
- Migrated over 1.8 petabytes of active research data contained in nearly 500 million files to new storage and over 1 petabyte of archived research data, another 400 million files;
- Physical on-premise HPC storage resources have reduced "footprint" of overall operational facilities and maintenance costs by $200,000, some offset by investment in improved technology;
- Current HPC application and operating system upgrades can now accept current and future programming and analytical packages and libraries for use in programming;
- Deployment of parallel file system across the new HPC allows for faster data throughput to and from the clusters yielding faster job turnaround and quicker results to investigators;
- HPC on-premise environment is now prepared for cloud/HPC integrations and can be a launch pad for hybrid analytics to cloud services;
- Network redesigns and infrastructure changes now provide capabilities for extended services to facilitate faster Next Generation Sequencer data ingestion, plus the ability to integrate additional ancillary services to the HPC clusters;
- Refreshed hardware has a new 5-yr lifecycle providing cluster stability, i.e. less downtime;
- Storage and archive can now provide growth capacity for near-term data growth and has a new modular approach to adding new storage.

SAVINGS
QUALITATIVE

DIGITAL HEALTHCARE

These projects are focused on implementation and enhancement of the electronic health record applications in which clinical documentation is captured and used to support patient care delivery. Mobile health and patient engagement tools are also represented.

YEAR 1	YEARS 2-3	YEARS 4-5	TOTAL
$10,354,601	$6,549,823	$4,856,412	$21,760,835

PENN MEDICINE'S TELEHEALTH PROGRAMS STREAMLINE WORKFLOW, SAVING TIME & COSTS WITH INTEGRATED PLATFORM

BACKGROUND DESCRIPTION

The pace of innovation in healthcare can sometimes be challenging for health systems to stay ahead or in control of from a technology standards perspective. Telehealth is a great example of an industry segment that has grown at record pace through the last decade; creating new use cases, laws/regulations, technology standards/requirements, and thousands of new market entrants in terms of technology hardware and software companies. As Penn Medicine has grown its own Telehealth program to now over thirty (30) clinical programs and over 100 active Penn Medicine providers, the need for a standardized and integrated platform became an enterprise priority.

Challenges related to integrations, workflow, and the technology itself were limiting the effectiveness of Penn Medicine providers and the IS team who were faced with a myriad of different telehealth technology platforms that could have been in use across thirty (30+) programs. While not every program used a separate vendor, had the Connected Health team and Penn Medicine IS not pursued standardization, additional vendors and variability would continue with time as more programs are added, eliminating a cost avoidance opportunity.

Feasibility of supporting the cost structure of multiple vendor implementations and maintenance contracts alone was burden enough to raise the issue among IS leadership. Penn Medicine IS began focusing more on supporting and maintaining telehealth in 2016/2017 as the health system moved to a single technology platform. The first priority was to ensure compliance elements of documentation and EHR integration to benefit provider workflow and patient care. A central governance team guided the telehealth strategy with active involvement by Penn Medicine IS. This was an integral step in unifying enterprise standards for telehealth operations, connectivity, integration, and compliance with state and federal requirements.

The transition to a single technology platform was achieved over a two (2) year timeframe. The results were immediate for all telehealth programs, notably for many was the ability to achieve improved visibility to clinical metrics.

Penn Medicine IS realized cost avoidance through no longer needing multiple outsourced IT vendors to support endpoints. And the overall connectivity across the system between providers, patients and Penn Medicine's thirty (30+) programs is improved through new unified communications software.

PENN MEDICINE'S TELEHEALTH PROGRAMS STREAMLINE WORKFLOW, SAVING TIME & COSTS WITH INTEGRATED PLATFORM

30+ TELEMEDICINE PROGRAMS ACROSS THE HEALTH SYSTEM IN A VARIETY OF SPECIALTIES & GROWING

1. Stroke
2. Sleep Medicine
3. Cardiac Genetics
4. Genetics Oncology
5. Hematology Oncology (BMT & Car-T)
6. GI Surgery
7. Oral Maxillofacial Surgery
8. Lung Transplant
9. Kidney Transplant
10. Veteran's Mental Health
11. Vascular Surgery
12. Emergency Room
13. Parkinson's
14. Adolescent & Young Adult
15. Surgical Oncology
16. GU Surgery
17. Neurosurgery
18. Lung Transplant
19. Radiation Oncology
20. Hepatology
21. OBGYN
22. Social Work
23. Medical ICU
24. Nutrition
25. Epilepsy
26. Pulmonary
27. Hematology Oncology (Mesothelioma)
28. Primary Care
29. Cardiology
30. Diagnostic Radiology
31. Cardiac Surgery
32. Dermatology

BENEFITS REALIZED

- Eliminated double documentation in outsourced vendor software and PennChart;
- Improved Wi-Fi as part of Penn Medicine IS standardizing telehealth hardware and software;
- ED Nurses now click one time connecting immediately to a Penn Medicine Neurologist;
- IS quickly handles all maintenance and support for the telehealth software and hardware;
- Cost avoidance of $13,500,000 in FY2020 – FY2022 realized through leveraging the enterprise EHR, reduced vendor implementation costs and ongoing maintenance costs.
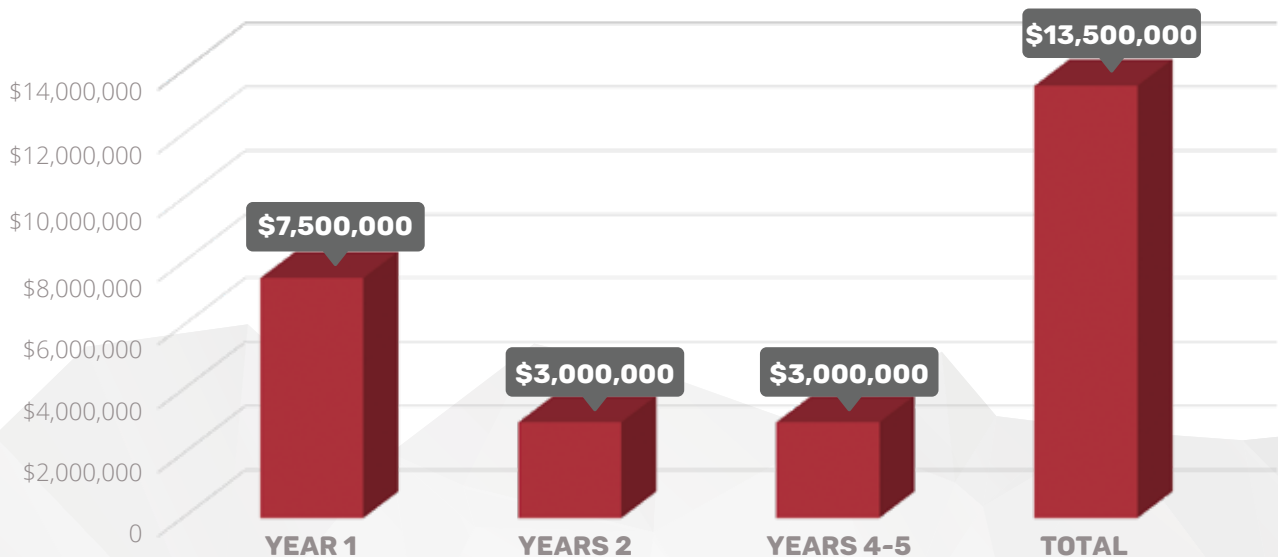
	YEAR 1	YEARS 2	YEARS 4–5	TOTAL
	$7,500,000	$3,000,000	$3,000,000	$13,500,000

IMPROVED CONVENIENCE FOR EMPLOYEES WITH PENN MEDICINE ON-DEMAND VIRTUAL ACCESS TO CARE

BACKGROUND DESCRIPTION

Access to timely appointments for urgent care needs are often challenging in primary care practices and ambulatory care settings. Penn Medicine employees face this challenge in large part because they are trying to access care in-between or after hours, outside their busy work schedules. Penn Medicine established, operationalized, and scaled an enterprise-wide virtual care practice to better meet the needs of employees. The practice, referred to as **Penn Medicine On-Demand**, supports approximately 58,000 covered lives and is staffed 24/7, for 365 days a year by nurse practitioners and telehealth coordinators who serve as our virtual front-desk staff. The practice is integrated and co-located within the **Penn Center for Connected Care (**https://www.pennmedicine.org/news/news-releases/2018/february/future-of-telemedicine**),** maximizing operational efficiency. The service is available to employees and adult dependents throughout Penn Medicine as a free benefit with no copay obligation. Bill Hanson, Chief Medical Information Officer and Vice President, stated that, "the program has been a huge success for our employees and shown to reduce unnecessary ED and urgent care visits, while allowing patients to get necessary health care from their home or workplace. We are expanding the service to additional non-Penn Medicine populations including employees of the University of Pennsylvania and their families."

Operational goals for Penn Medicine On-Demand included improving patient access and satisfaction, as well as communication and in-system use of Penn Medicine providers. Another aim was to reduce total cost of care by decreasing unnecessary utilization of brick and mortar health care.

Penn Medicine On-Demand is fully integrated with PennChart and uses audio-video telemedicine technology to complete virtual encounters. Clinical protocols have been maintained and automated for common clinical conditions by providers, ensuring superior clinical outcomes. Tele-providers assess, diagnose, and prescribe electronically, and in the end, route all patient encounters to the established primary care provider (PCP) teams. Patients have the option for asynchronous communication with the virtual care team through their patient portal. Using myPennMedicine, patients have the option to self-schedule and self-check-in future virtual care appointments.

The project also resulted in an improved patient intake process to seamlessly support virtual care delivery using a simplified process for registering, scheduling, and connecting to facilitate. Through active marking and self-scheduling functionality, Penn Medicine On-Demand has increased the weekly call volume and optimized care delivery to ensure that high-quality virtual care is provided seamlessly from PennChart, our electronic health record.

IMPROVED CONVENIENCE FOR EMPLOYEES WITH PENN MEDICINE ON-DEMAND VIRTUAL ACCESS TO CARE

BENEFITS REALIZED

- Completion of 7,200 virtual patient encounters;
- Favorable mean Press Ganey survey scores during the first year of program operations:
    - 97.8% convenience of office hours;
    - 94.2% ease of scheduling appointments;
    - 93.7% ease of use audio-video functions;
    - 96.1% likelihood of using audio-video functions again;
    - 97.5% coordination of care across time and;
    - 97.1% overall likelihood of recommending the practice;
- Driver of subsequent in-system utilization of a Penn Medicine practice at follow-up for those who used Penn Medicine On-Demand for an initial low-acuity visit;
- Reduction in total cost of care by an estimated $1,635,445 represented as cost avoidance due to decreasing unnecessary utilization of brick and mortar facilities;
- Penn Medicine employees did not have an associated co-pay with their virtual consult, a major positive for employee morale; Increase in employee % establishing a PCP following an on-demand visit in first year operations.
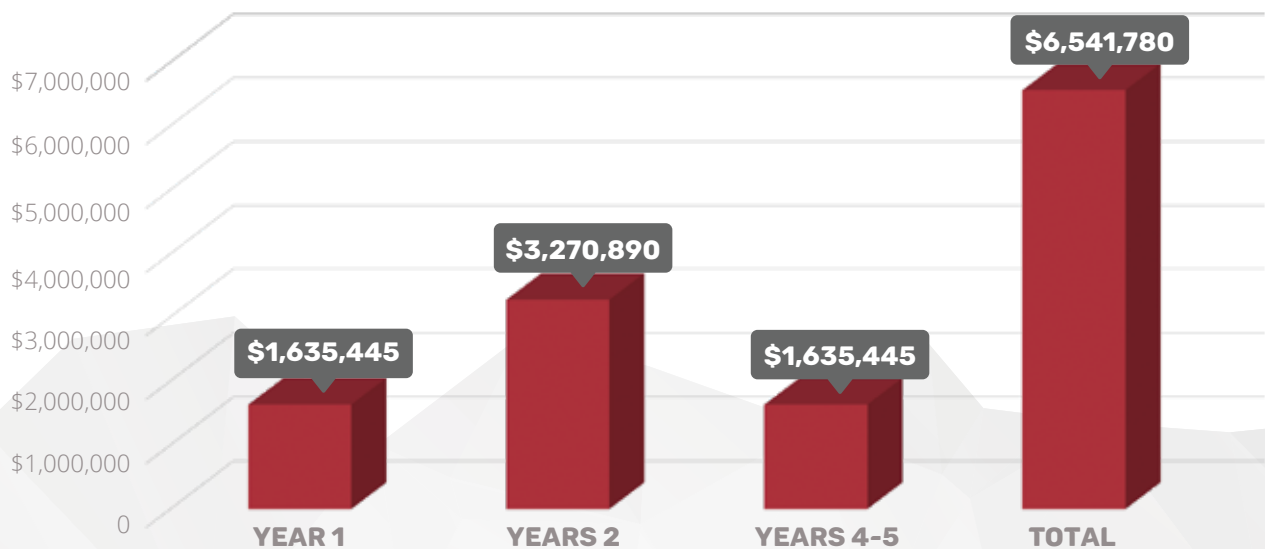
PENNCHART INTEGRATES FURTHER WITH IMPLEMENTATIONS AND EXPANSIONS

BACKGROUND DESCRIPTION

Penn Medicine pursued further expansion of the PennChart Electronic Health Record (EHR) in 2018 and 2019. Initiatives included enhancing the existing infrastructure within specialty clinics, connecting with community affiliates and adopting clinical science programs which allowed for further collaboration, integration and partnership between Penn Medicine and its various programs and services.

PENN CHART CARDIOLOGY IMPLEMENTATION

Penn Medicine used several legacy Cardiology systems for documentation, reporting, and image capture while results returned to PennChart. Challenges with the legacy systems included that they were independent and used HL7 interfaces to maintain alignment. Use of the separate systems created a barrier to having a fully integrated Cardiovascular Information System (CVIS), where information could be shared and seen across the enterprise, including the 4 hospitals and 15 clinics using the system regularly.

The implementation of PennChart Cardiology, which went live in November 2018, provided an integrated CVIS for heart and vascular procedures and testing that leverages patient information throughout the health system. PennChart Cardiology produces state of the art structured reports meeting the needs of cardiovascular providers, referring providers and patients. PennChart Cardiology workflows support collaborative team-based care that avoid duplicate documentation and allow for real time data collection for registries, certification and quality improvement.

BENEFITS REALIZED

- Cost Savings and Revenue Generation measures:
  - Sun Setting of legacy system in EP nets a savings of $66,500 annually;
  - Multiple CPACS systems were consolidated in preparation for PennChart Cardiology implementation which resulted in $966,289 in savings;
- Use of a seamless medical record for standardized documentation and workflow across all Cardiology care settings;
- Provider reports closing more quickly than with prior system, allowing for bills to drop sooner;
- Allows for integration with third party systems, vendors and equipment/devices, increasing the quality and integrity of data and associated care provided;
- Re-engineered workflows are more effective and efficient, reducing duplication of effort and increasing provider and care team time;
- Supports using evidence-based data meeting accreditation, regulatory and registry requirements;
- Provides high quality structured reporting with ease of use for users;
- Generates discrete data elements to support data mining, analytics, reporting and registries.

HALL MERCER MIGRATES FROM LEGACY SYSTEM TO PENNCHART

Hall-Mercer Community Mental Health Center is a part of Philadelphia's Behavioral Health system and operates within Pennsylvania Hospital. It is one of 11 community mental health centers in Philadelphia. Hall-Mercer is a critical asset to the community, as it supplies Behavioral Health services for the homeless population in the Philadelphia region, as well as traditional clinical care for those of limited means. The practice supports multiple behavioral health service lines, treatments, and care teams.

Hall-Mercer desired to migrate from their legacy EHR platform to PennChart, and standardize within the Penn Medicine system. PennChart went live at Hall-Mercer after nine months of project planning in February of 2019 for 143 users. The planning process was integral executing a tailored EHR application to meet the unique needs of the community mental health center.

BENEFITS REALIZED

- Total realized savings of $93,400 for FY19;
- Integrated billing systems, with a standardized support team, reduced variation in workflow and expedited issue resolution processes;
- Cohesive electronic health record, allowing Behavior Health provider community with access to the records, without logging into a separate system.

PENNCHART INTEGRATES FURTHER WITH IMPLEMENTATIONS AND EXPANSIONS

PENN MEDICINE ENABLES INTER-SPECIALTY COMMUNICATION AND CLINICAL STANDARDIZATION THROUGH PENNCHART

The new Spine Center at Pennsylvania Hospital is the result of co-locating providers from Neurosurgery, Orthopedics, Pain Management, and Physical Medicine & Rehabilitation specialty clinics to offer a multidisciplinary approach to treating spine patients. The new facility was refurbished, relocated and furnished with the latest medical technologies for treating patients and opened in March 2019.

Prior to the new Spine Center opening, Penn Medicine IS consolidated the use of their various EHRs and implemented PennChart as a comprehensive solution for all specialties. The activities involved in the PennChart implementation involved purchasing new hardware and standardizing clinical order sets.

As a result of the co-location of multiple specialties and the launch of a new call center focused on appointment scheduling, access and utilization of the Spine Center has increased. Using a new intake questionnaire and physician order set, the staff were able to work through the new process efficiently.

BENEFITS REALIZED
- Combined administrative functions to provide an efficient approach to augment process for staff scheduling in-system referral appointments for spine care for all 4 clinics;
- Created a new process by using a PennChart access questionnaire to properly ensure patients were receiving the correct appointment;
- Streamlined the physician order, from 4 disparate orders into 1, to simplify the process for scheduling a patient and pinpointing the correct clinic for the correct appointment;
- Greatly improved patient access to spine care.

BECKER ENT JOINS PENNCHART INTEGRATION

Becker ENT is a private practice providing Otorhinolaryngology services in New Jersey. The practices include eleven (11) providers and five (5) audiologists at eight (8) office locations; facilitating approximately 45,000 patient encounters per year. Becker ENT was a member of the Penn Medicine Department of Otorhinolaryngology's Physician Specialty Network. As part of the network, they saw an opportunity to create further integration and standardization by becoming a leased practice within the Penn Medicine Medical Group and by implementing the PennChart application. Becker can now function with standard hardware and infrastructure for performing core functions within the clinic, including patient scheduling, clinical documentation, billing, clear roles/accountability for staff and targeted education for all user groups.

BENEFITS REALIZED
- Current state workflow assessment completed during the build phase led to new ideal state workflows; agreed to by stakeholder groups and built in PennChart for EHR workflows, order sets, billing, patient access, roles/training assessment, chart abstraction, appointment conversion;
- A centralized billing model offers a streamlined approach to billing across all payer groups;
- Used Penn Medicine hardware to access and input information in a standard manner;
- ENT clinical services now offered in the Princeton region reinforce the relationship in the Princeton service area. ENT clinical services will be expanded to the Yardley area in September to help improve access in Bucks County.

# PENNCHART INTEGRATES FURTHER WITH IMPLEMENTATIONS AND EXPANSIONS

THE PENN SCHOOL OF NURSING TRANSITIONS TO PENNCHART EHR PLATFORM

The School of Nursing leadership sought to use PennChart as the school's EHR. The goal was to create a training environment that better mimics the "real world" healthcare environment, while improving clinical skills and teaching critical decision-making skills in the academic setting. The School of Nursing previously used another EHR system to train nursing students on technology used to support patient care. Using the previous system had limitations regarding the clinical workflows and overall use and functionality compared to PennChart. It also didn't allow for full clinical workflow integration into Penn Medicine's clinical setting.

Penn Medicine is one of a small number of hospitals that has installed the Epic EHR solution in an academic setting, overcoming several complex technology challenges related to integration and curriculum requirements. The new EHR technology mirrors the PennChart environment including patient workflows, medication additions and barcode scanning. The School of Nursing was also able to create and load exams directly into the PennChart environment for testing the nursing students according to their curriculum and academic requirements. The School of Nursing training environment went live with a pilot in August 2018 and live with all courses in January 2019 supporting over 600 nursing students.

BENEFITS REALIZED

- Approximately 25% of Penn nursing students each semester intern or work at a UPHS facility. The hours saved on training nursing students to chart using PennChart at the start of their internships and roles has been significantly reduced, allowing them to start providing patient care sooner;
- Penn nursing students experience a near-LIVE clinical environment, making their transition to interns and other nursing roles much easier and quality of nursing education more valuable;
- Standardizes and educates nursing students on clinical practices and critical decision making required to practice high quality patient care;
- Better simulates how to chart a patient encounter, learn to place orders, chart medications, labs and procedures, enter notes for patients;
- Easier transition to medication administration in clinical practice for the student nurse;
- Designed to teach the WHY and the HOW of clinical workflows and documentation practices.
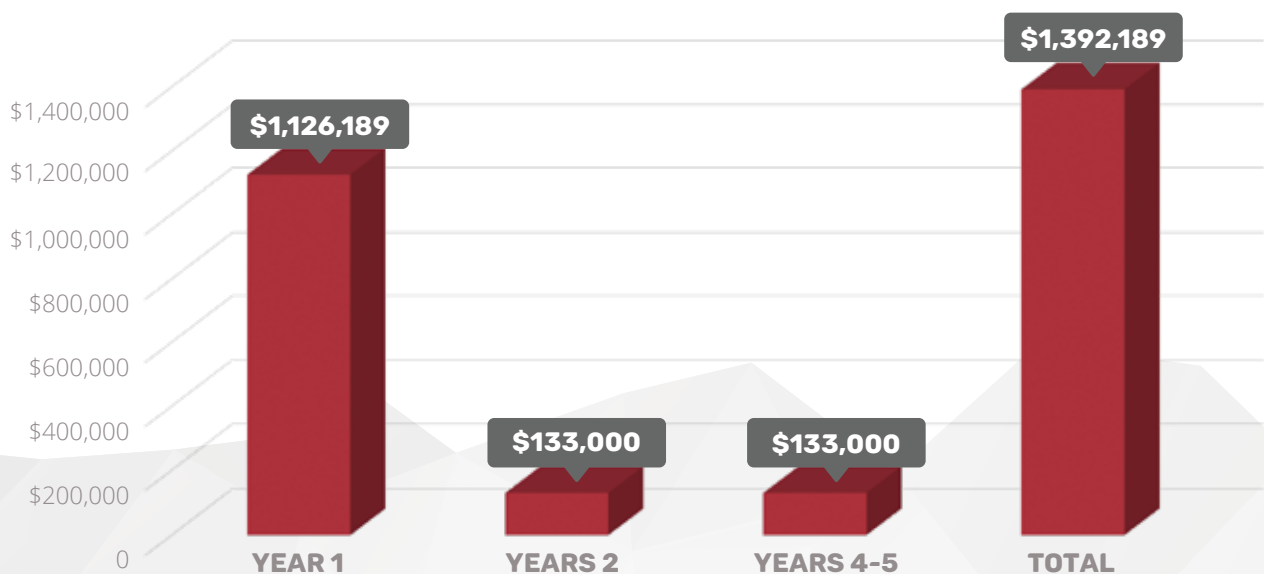
REALIZING THE VALUE OF OUR PENNCHART INTEGRATED EHR THROUGH EXPANSIONS, UPGRADES, AND ENHANCEMENTS

BACKGROUND DESCRIPTION

The investment a health system makes in its electronic health record (EHR) can translate to significant value to an organization. At Penn Medicine, the IS team never rests in their drive to leverage PennChart for maximum value and return on investment through implementing a variety of initiatives and application features in pursuit of excellence. In 2018 and 2019, Penn Medicine performed PennChart upgrades and implemented new system features to further drive clinical quality and process efficiency.

In February 2018, and April 2019 enterprise-wide upgrades to PennChart versions 2017 and 2018 were completed. The upgrades provided Penn Medicine's 40,000 users new functionality and enhancements to ensure use of the latest and most advanced software. Several key enhancements facilitated the integration and standardization of patient data between the ambulatory, inpatient and homecare settings. Each upgrade was a large effort, with around 9,000 notes reviewed between the two releases, 2,300 build items, and 700 enhancements. Application teams and supporting user groups worked together to coordinate education efforts and provide go live support. The upgraded versions of PennChart were well received by users, serving as a catalyst of benefits realized across Penn Medicine.

Additional specific initiatives highlighted our health system's commitment to quality of care and innovation, and returned a variety of benefits, often creating new industry standards and best practices.

PENNCHART WAY TO HEALTH OBGYN INTEGRATION

Way to Health is a remote patient monitoring program. This initiative sought to reduce maternal morbidity and mortality in OBGYN patients that present with high blood pressure and pre-eclampsia. Previously, the program workflow was done manually, which was time consuming and error prone. By using PennChart, all blood pressure data became captured, automatically integrated and available in a usable format such as flowsheets and graphs to Cardiology and OB/GYN caregivers to help facilitate patient care for this program.

BENEFITS REALIZED

- Adherence to ACOG (American College of Obstetricians and Gynecologists) guidelines increased from 0% to 82% due to automated workflow, which was previously manual;
- Pre-eclampsia-based readmissions dropped from 5% to 1%;
- As of June 2019, the program has been used for almost 3,200 patients;
    - Approximately 38% of those were escalated at HUP and 26% at PAH, giving patients the highest quality care in their time of most need, a life-threatening matter;
- Blood pressures are continuously monitored. Patients receive calls for intervention if needed; increased focus on population health management and readmission prevention;
- Penn Ob/GYN Associates routinely check the flowsheet when patients call the office and use the integrated information to triage phone calls/complaints and assess needs for medication, evaluations in triage or office. Cardiology reviews patient flowsheet data at 4-6-week follow-up;
- Increased data and reporting capabilities, taking two minutes per day to push the data;
- High provider and care team satisfaction as a result of integration.

REALIZING THE VALUE OF OUR PENNCHART INTEGRATED EHR THROUGH EXPANSIONS, UPGRADES, AND ENHANCEMENTS

PENNCHART PATIENT LEAVE OF ABSENCE FEATURE

The Leave of absence (LOA) feature allows a patient to be placed on leave of absence while retaining two bedded admissions and have their hospital admission, respective procedures, and medication orders put on hold. LOA is mostly used when a patient leaves the GSPP LTACH at Rittenhouse to be checked out in either the PAH or HUP ED. Once they return to the original facility, all of their care can resume uninterrupted, reserving their bed and saving related data.

BENEFITS REALIZED

- Patients can travel between Penn Medicine facilities without having to do a full discharge and readmission.
- Improved patient safety reduces opportunity for errors when re-entering orders and notes;
- Reduction in manual billing efforts to merge multiple encounters;
- Improved communication and collaboration across Penn Medicine locations;
- Reduction in clinical team documentation time of two hours saved with each transaction at UPHS' Rittenhouse Rehabilitation Facility at an average of $113.66 per LOA occurrence;
- Total clinical team time savings at Rittenhouse is 510 hours since July 2018 implementation.

	YEAR 1	YEARS 2	YEARS 4-5	TOTAL
	$57,967	$115,933	$57,967	$231,866
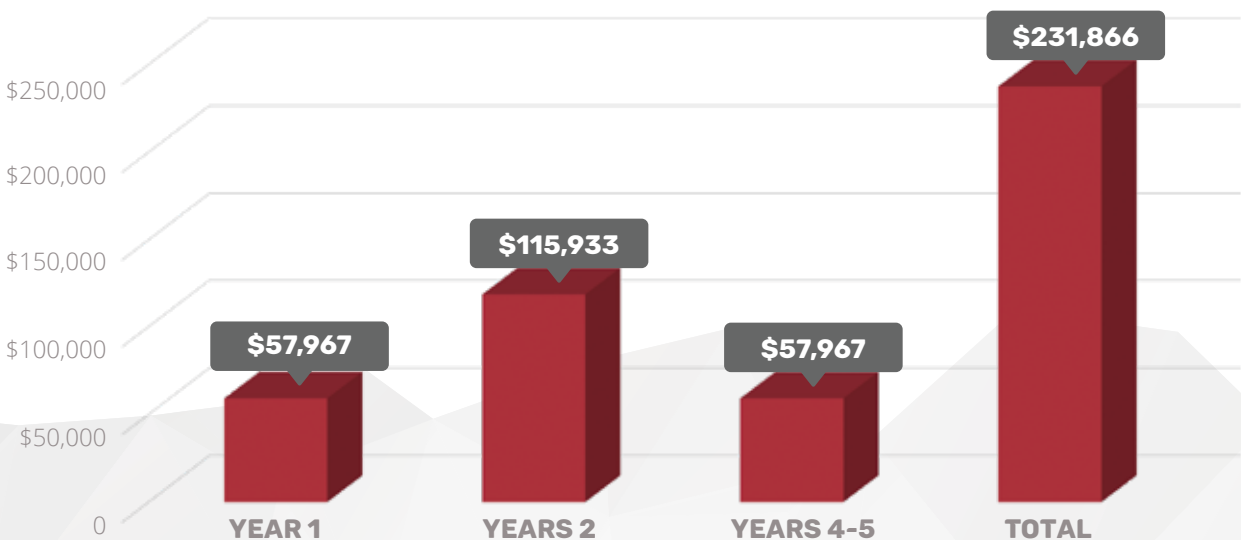
OUR COMMITMENT AND INVESTMENT IN CREATING POSITIVE PATIENT EXPERIENCES

BACKGROUND DESCRIPTION

Creating innovation in healthcare aims to solve problems, while also improving the experience of patients and families using health care services. Penn Medicine, with a strong history of technological innovation, identified opportunities within the system's OR, clinics and hospital service departments to improve approaches to common processes like communicating updates and clinic check-in. These initiatives were implemented in 2018 and 2019 to improve patient satisfaction, increase process efficiency and drive savings and revenue opportunities.

TEXTING FAMILY MEMBERS FROM THE OR

Sending and receiving information through text message is a simple, convenient and reliable means of communication used at a global scale. Penn Medicine implemented technology allowing texting from the OR to the family. As a patient in the operating room progresses through their procedure and the OR team is documenting their progress, PennChart automatically sends important status updates at various points during the procedure. Text messages are sent at predefined times within the OR workflow from locations such as the prep room, OR and post-operative units. The feature also creates the ability to send text messages on an ad-hoc basis if desired.

Patient families are given the opportunity to opt-in to receive messages when checking the patient in for a procedure. The feature gives families peace of mind by allowing more freedom to leave the OR waiting area for meals and breaks without being concerned about missing an important update. To date, over 24,000 each month texts are now generated from OR's throughout the health system, with about 5-7 texts per patient being sent on average.

BENEFITS REALIZED

- Improved communication contributed to more accurate information, efficient timing for provider schedules, transparency and patient satisfaction;
- Penn Medicine has compared data on patient satisfaction related to texting and PPMC and PMUC have each exceeded benchmarks;
  - PPMC "Information about delays" currently exceeds the benchmark (89.4, with a benchmark of 87.1) and have improved from FY18 (84.7);
  - PMUC "information about delays" exceeded benchmark 87.1 with 93.9 FY18, 94.4 FY19Q1;
- Increased efficiency with OR due to elimination of time consuming manual updates to families.

PENN MEDICINE SIMULATION CENTER GOES HIGH DEFINITION WITH UPGRADED EQUIPMENT AND ENHANCED FEATURES

The Penn Medicine Simulation Center provides a space for residents, fellows, faculty, medical students and nurses to conduct a wide range of skills based training and simulated patient encounters in a realistic hospital setting. The Simulation Center is used by Penn Medicine, Perelman School of Medicine and external groups throughout the region for conducting training, assessment and change management process improvement activities.

The Simulation Center's audio and video recording capabilities were aging and needed to be replaced. Penn Medicine Information Services worked with media services and the Simulation Center, to go-live in September 2018 with upgrades and equipment that provide high definition (HD) video and audio. Additionally, the multi-skills lab, one of the primary conference meeting spaces, was upgraded and added to the recording platform, expanding the ability of groups to also record the classroom-based components of their sessions.

BENEFITS REALIZED

- Savings of $20,000 by using existing computers, lectern and monitors in the upgrade;
- Reduced maintenance and support costs of outdated system results in $5,000 savings annually;
- Additional $10,000 expected revenue per year driven by the use of the upgraded system and enhanced features by internal and external clients;
- Increased productivity due to adding HD video and recording capabilities to the multi-skills room;
  - This created an additional space to conduct simulation scenarios, causing the Simulation Center's utilization to increase with more courses now accommodated simultaneously.

OUR COMMITMENT AND INVESTMENT IN CREATING POSITIVE PATIENT EXPERIENCES

SCHEDULING APPOINTMENTS ONLINE ADDS CONVENIENCE FOR PATIENTS

Since open scheduling launched, patients have been able to make an appointment online without needing to call the practice. From July 2018 through May 2019, 7,154 appointments were scheduled online using New to Penn Patient Self-Scheduling. This scheduling option is available for prospective patients to schedule appointments in Orthopaedics and at Penn's Urgent Care facility in South Philadelphia.

BENEFITS REALIZED

Patients can use the Find a Doctor tool (https://www.pennmedicine.org/providers) on https://www.Pennmedicine.org to easily find an appropriate Orthopaedics specialist or urgent care facility and schedule a visit online.

SHARING DOCTOR'S PROGRESS NOTES WITH PATIENTS IN MYPENNMEDICINE

At Penn Medicine, we are committed to providing patients and their care providers with access to all necessary data, and ensuring open communication regarding their care. To help us achieve our goals, a new enhancement was put into place for progress note sharing to default to "Share with patient" when the progress note is created. National studies show patients who have access to their progress notes–especially the most vulnerable patient populations, those with complex health conditions, and individuals who serve as care partners report key benefits.

BENEFITS REALIZED

- Patients have better understanding of their health and medical conditions;
- Patients have improved recall of their care plan;
- More collaborative decision-making and stronger relationships between patients and their care team;
- More consistent patient adherence to taking their prescribed medications.

MYPENNMEDICINE PATIENT PRE-CHECK-IN

Penn Medicine partnered with a team of IS experts to implement a new myPennMedicine portal feature that provides patients the ability to "Pre-Check-In" as many as (four) 4 days before their appointment. myPennMedicine's new Pre-Check-In feature lets patients confirm or update contact information and preferred pharmacies, verify or request updates to current medications, allergies and current health issues, complete electronic questionnaires and sign certain necessary paperwork on their computer or mobile device ahead of their appointment. This new option, available for most outpatient appointments at over 250 practices Penn Medicine, can save patients time at check-in. The upfront collection of patient data allows it to be available to the practice and ensures changes to their clinical information is captured and available for their provider to review directly in the electronic health record.

BENEFITS REALIZED

- 60% of patients eligible for the portal are using as of May 2019;
- Over 100,657 patients have completed pre-check-in steps in myPennMedicine, saving time for patients, providers, and practices;
- Future enhancements for Pre-Check-in include collecting insurance information and paying co-pays conveniently on-line.

OUR COMMITMENT AND INVESTMENT IN CREATING POSITIVE PATIENT EXPERIENCES

MYPENNMEDICINE OFFERS PROXY ACCESS TO HELP PATIENTS MANAGE THEIR CARE

myPennMedicine began offering proxy access in May 2018 to authorized individuals wishing to access and manage the online medical records of a loved one's healthcare. By completing a proxy agreement for the patient whose account they want to manage, this access adds convenience to improving the management of the patient's experience. Proxy accounts are available for adults, children and adolescent patients.

BENEFITS REALIZED

- Total of 5,542 proxy-subject relationships out of 1,861 active proxy accounts;
- Ability to view test results and clinical information, schedule appointments, send messages, and complete other tasks on behalf of the patient for whom they are serving as a full proxy;
- Ability to view allergies and immunizations information on behalf of the patient for whom they are serving as a limited proxy.
- Since moving to shared open progress notes in September 2018, patients who are granted proxy access can review progress notes, helping them to better understand and support the patient's care plan.

PENNCHART FINANCIAL TOOLS EMPOWER PATIENTS AND PROVIDERS WITH CONVENIENCE AND TRANSPARENCY

BACKGROUND DESCRIPTION

Insurance and payment for health care services can be both complex and frustrating to patients struggling to understand what they owe and how it's calculated. Penn Medicine recognized the need for more transparency around billing and patient convenience. We implemented Patient Estimator and myPennMedicine Bill Pay. These two helpful PennChart finance features are proving to be a significant satisfier for a growing number of patients who value enhanced communication and convenience.

The Patient Estimator tool provides a calculation for the portion of the bill that is the responsibility of the patient driven by an estimate of the amount their insurance will cover and their benefits. PennChart Financial Counseling staff review and finalize the estimate before patient services are rendered.

MyPennMedicine Bill Pay is a functionality that allows patients to view and pay their statement balances online through the myPennMedicine patient portal. Patients active on the portal receive a notification by email when a new statement is available in myPennMedicine. Patients have the ability to review their statement and pay a portion of their balance or pay their balance in full for current or existing accounts. An additional feature allows patients to message billing customer support directly through the myPennMedicine patient portal for any billing inquiries.

BENEFITS REALIZED

PATIENT ESTIMATES

- Use of templates to simplify creating common or complex estimates;
    - Templates include the expected procedures and context information for estimates, so all users can create estimates quickly, even users who aren't as familiar with the codes;
- Availability of historical reimbursement information in PennChart enables staff to provide patients with the estimate an insurance company expects to pay;
- Storing benefits in PennChart allows estimates to automatically calculate the patient portion;
- Real Time Eligibility (RTE) communicates with a payor or clearinghouse to automatically retrieve and file a patient's benefits, capitalizing on auto-filing approaches, the fastest and most accurate way to record a patient's benefits.

BILL PAY

- Total amount collected and number of payments since go-live:
    - 8,800 total transactions and $1,211,000 worth of services used allows faster collections;
- Ensures PCI DSS (Payment Card Industry Data Security Standards) compliance for accepting online credit card payments and handling credit card data;
- Saves patients time by being able to make payments within myPennMedicine patient portal;
- Patients can view all account statements in one centralized location;
- Patients can message billing staff through myPennMedicine, reducing phone calls;
- myPennMedicine payments are processed and posted automatically;
- Statement notifications sent via email message allow for quicker communication to patients that new billing information is available.

SAVINGS
QUALITATIVE

PENN MEDICINE'S NOVEL USE OF REAL-TIME DATA DASHBOARDS IN THE ICU IMPROVES VENTILATOR WEANING

BACKGROUND DESCRIPTION

Many critically ill patients require a mechanical breathing ventilator to survive. Although ventilators are life-saving, they are associated with risks and complications to the patient. In addition, the longer patients remain on mechanical ventilation the longer they need to stay in the Intensive Care Unit (ICU). This drives up ICU and hospital costs, representing 10-15% of total hospital cost, and reduces bed access for other patients requiring ICU care from both within the hospital and from referring institutions. Thus, shortening the time patients need to spend on mechanical ventilation has great value to the patient, ICU, hospital, and overall health care system.

Penn Medicine solved this problem by harnessing information stored in the EHR to provide clinicians real-time access to meaningful ventilation and sedation data. We created a novel computerized program that (1) promotes bedside providers to wean down more rapidly both ventilator and sedative supports, (2) enables automated, continuous (24/7) patient screening for eligibility to come off the ventilator and sedative medications, and (3) provides real-time actionable data to the ICU team and local quality managers to enable staff feedback about sedation and ventilation compliance protocols.

An electronic dashboard and alert system called the Awakening and Breathing Coordination (ABC) application was built to leverage our PennChart EMR with a meaningful display of real-time sedation and ventilation protocol data and automated screening results. ABC, the core component of the full 'ABCDEF' ICU bundle of care, which ICU's strive to use to improve patient outcomes, is a concept supported by evidence from a Penn Medicine ABC clinical trial, showing that coordinating sedation and ventilation protocols improves patient outcomes. The new data streams allow live-status of patients to reflect on the dashboard at any time based on current vitals, ventilator settings, and other clinical parameters.

The impact of immediate feedback, and patient response to clinical interventions was key to improving adherence and communication of protocols among the cross-disciplinary team. Provider nudges occur in real-time as data and results are analyzed, promoting more rapid liberation of patients from sedation and ventilator support. The notification system was able to alert respiratory and nursing staff when interventions were required. The ABC application sends simultaneous text alerts to the mobile devices carried by bedside staff (RN, RT) 24/7. The respiratory therapist is alerted when patients meet criteria to undergo a trial off the ventilator, and if that same patient is over sedated the nurse and provider are alerted with advice to stop the sedation. The ABC application represents a transformative innovation that is indispensable for the ICU.

BENEFITS REALIZED

- Facilitation of more rapid ventilator and sedation liberation with a significant reduction in the duration of mechanical ventilation;
- Following the intervention:
  - Patients were 28% more likely to be extubated successfully and 31% more likely to be discharged from the ICU at any point in time;
- There was a 2.2-day reduction in the median duration of mechanical ventilation and a 2.6-day reduction in the median ICU length of stay, compared to the expected durations;
- Resulted in a trend toward a significant reduction in hospital length of stay.

SAVINGS
QUALITATIVE

PENN MEDICINE 1ST IN PA USING INCIDENT MANAGEMENT TOOL FOR EMERGENCY RESPONSE BED TRACKING

BACKGROUND DESCRIPTION

The Pennsylvania Department of Health (PADOH) uses the Knowledge Center Healthcare Incident Management System® (HIMS) state wide in order to support hospital emergency managers in prevention, response, and recovery phases of their mission. The HIMS software tracks and manages incidents, resources, and critical infrastructure on a statewide level; communicating a common operating picture of incident/event information with each member hospital. Beginning in summer 2018, Penn Medicine sought to provide real-time bed availability information from PennChart to HIMS, allowing local emergency management teams to understand capacity at each local facility and tailor needed emergency response based on data.

The HIMS Bed Tracking Agent interfaces with PennChart, allowing each Penn Medicine facility to configure data delivery and periodically poll the hospital's bed availability data from within the EHR and inform Bed Availability to HIMS. Bed availability information maintained by HIMS can be used by the Federal Hospital Available Beds for Emergencies and Disasters (HAvBED) reporting program, eliminating the need for duplicate data entry in both state and federal programs. The project was funded through several healthcare coalitions across Pennsylvania, with the Southeast Coalition contributing $150,000.

BENEFITS REALIZED

- Contributing to an interoperable IT system allows essential information regarding bed availability during state, special and planned events such as mass casualty events and facility evacuations;
- Providing up to date bed capacity in near real time to emergency response partners, including the Hospital Association of Pennsylvania, PADOH, and others as requested;
- Being first of three Pennsylvania health systems to be active (July 2019) on the statewide project;
- Real-time assessment for surge capacity data and analysis capability, during both normal surge (flu season) and extraordinary surge (mass casualty);
- Compliance with grant requirements set forth by US Health and Human Services and the Office of the Assistant Secretary for Preparedness and Response;
- Being first health system and state in the country to automate bed capacity tracking communication beyond its own enterprise.

SAVINGS
QUALITATIVE

MAKING DATA MEANINGFUL

These projects are focused on effective capture and use of data from the clinical and financial systems to support improved care delivery, financial management and quality improvement.

PENNCHART CONTRIBUTES TO IMPROVED HEALTH SYSTEM READMISSION RATES

BACKGROUND DESCRIPTION

UPHS is the first health system in the United States to partner with a commercial insurer, wherein UPHS provides a 30-day readmission guarantee on all inpatient services and surgeries for members of this specific commercial insurer. As part of the program, UPHS developed new initiatives to improve care quality and reduce patient costs.

UPHS and the insurer agreed to this partnership, with UPHS taking on substantial financial risk, in large part because UPHS had implemented an enterprise-wide electronic health record (PennChart). Risk of readmission varied greatly among patients depending on their illnesses and general health status, making it difficult to target interventions. UPHS leveraged PennChart to identify patients at high risk of readmission and stratified them based on a readmission score. PennChart was enhanced to highlight high risk readmission patients to clinicians in EDs, outpatient clinics and home care; to provide clinicians with information that reduces post-discharge hurdles; and to help clinicians through an electronic "discharge plan of care" containing real-time post-discharge care information that is available at the point-of-care across the entire health system.

BENEFITS REALIZED

Results after one year of this initiative were impressive. UPHS attained a staggering 30% reduction in readmissions for patients covered by this program. When considering readmission rates for all patients, UPHS attained a remarkable 8% reduction, the largest annual reduction in the history of the health system. On average, within the US, hospital interventions typically reduce readmissions by ~1% annually.

INSURER PARTNER READMISSION PROGRAM	ALL PATIENTS
30%	**8%**
REDUCTION IN READMISSIONS	REDUCTION IN READMISSIONS LARGEST 1 YEAR REDUCTION EVER

SAVINGS
QUALITATIVE

PROJECT NAME

PENN DATA STORE II - CATALYST FOR PENN MEDICINE'S DO-IT-YOURSELF DATA ANALYTICS

BACKGROUND DESCRIPTION

Penn Medicine implemented a cloud-based enterprise analytics data lake platform in 2019, referred to as the Penn Data Store II (PDS2). PDS2 is an enhanced self-service analytics initiative to address the increasing complexity and velocity of Penn Medicine data needs. Software development for the new platform started in September 2018, with phased software releases beginning in May 2019. Phase one go live efforts integrated clinical, financial, research, and other data, allowing users to work in a common environment to speed their own discovery, insight, and action through data. In transitioning from on premise data center hosting to a cloud-based architecture, Penn Medicine increased operational agility, allowing the flexibility to scale up or down quickly depending on demand.

A key advantage of the data lake approach is the speed in which data, both structured and unstructured, can be brought in from internal and external data sources. This allows the data to be available much more quickly compared to traditional data warehouses. To improve user and data analyst experience, data is modeled into curated data stores, providing self-service access to disparate data via the method and tool of the user's choice. The various access points for users (source data, data lake, curated data store, data marts, reports and dashboards) enable Penn Medicine to support the needs of a wide customer base, from providers to data scientists. Another outcome of this initiative is the availability and transparency of system-wide metrics that are developed and governed by enterprise data domain committees (ambulatory, hospital, clinical/quality, finance, marketing/patient experience, research, enterprise data management).

BENEFITS REALIZED

- Increased discovery and self-service access to data in raw and curated forms;
- Ability to move data from on premise server storage infrastructure to a cloud-based platform;
- Improved speed to data for quicker decision-making;
- Validated data are transparent and uniform across the organization;
- Standardized definitions of key health system data metrics;
- Data from Penn Medicine entities across the enterprise are available for analysis.

SAVINGS
QUALITATIVE

PENN MEDICINE'S INTEGRATED SYSTEMS APPROACH TO MANAGE OPIOIDS AND CONTROLLED SUBSTANCES

BACKGROUND DESCRIPTION

Penn Medicine's Opioid Task Force, supported by Penn Medicine's Information Services (IS) team implemented national best-practice strategies to fight the opioid epidemic, which leads to an average of 115 overdose deaths daily in the US. Efforts included creating evidence-based care pathways on PennChart (our EHR) that address prescribing opioids to relieve pain for specific procedures. The emphasis is on prescribing the lowest number of tablets for the shortest period of time.

PennChart now provides a best practice alert when prescribers enter in new orders for opioid prescriptions that exceed guideline-recommend amounts of an initial 5-day supply. The alert presents two choices: 1) select from a menu of alternative orders with dosing amounts that are for a 5-day supply or less or 2) acknowledge the initial order exceeds guideline recommended supply of tablets. If a physician tries to prescribe for a longer time period, an alert asks if he or she wants to exceed the national guideline. Other embedded guidelines include using regional anesthesia in surgery when possible, which has been shown to reduce the need to give opioids after surgery, using more non-opioid pain medications, and getting patients mobile earlier after surgery. This initiative extends best practices system-wide and reduces variation in care, leading to improved patient outcomes.

IS also integrated Pennsylvania's prescription drug monitoring program (PDMP) into PennChart. Before prescribing opioids, physicians are required by law to check PDMP to access a patient's prescription history within the state. With a single click in PennChart, the system conducts the query for the physician and puts the information on their chart. Patient data is also integrated from the adjacent state of New Jersey to further address the problem of "physician shopping."

Additionally, IS created a dashboard to measure how well several opioid-related metrics are being met. These include documentation that the patient has seen a physician within three months of an opioid prescription and that a urine drug-screen has been obtained. The dashboard also provides information on the number of Penn Medicine patients receiving opioids, average length of prescriptions, and total number of prescribed opioid tablets. The metrics can be measured system-wide, by department and division, and for individual physicians.

IS also enabled physicians to prescribe controlled substances electronically from PennChart, directly to the pharmacy, making it easier for the patient and reducing risk of fraud and supporting compliance with applicable state and Federal law. The implementation was completed in June 2018 and has resulted in provider order-entry workflow efficiencies, greater auditing and reporting capabilities and more effective controls for prescriptions involving controlled substances. The solution was implemented in partnership with PennChart, Surescripts, Penn Medicine retail pharmacy locations and eligible participating external retail pharmacies. From Penn Medicine, over 2500 providers were authorized to prescribe controlled substances electronically to date. Eighty-two percent of all controlled substance prescriptions are now being sent electronically. An average of 4000 electronic prescriptions for controlled substances are sent monthly at a 99.7% rate of successful exchange with pharmacy partners.

PENN MEDICINE'S INTEGRATED SYSTEMS APPROACH TO MANAGE OPIOIDS AND CONTROLLED SUBSTANCES

BENEFITS REALIZED OPIOIDS:

- The proportion of all opioid orders for acute indications throughout Penn Medicine meeting the automatic default maximum of five days increased by nearly 50 percent;
- The number of prescribed opioid tablets system-wide has decreased by 16.5 percent – the equivalent of nearly two million tablets;
- More than 50 percent of all controlled substances are now prescribed electronically at Penn Medicine, reducing the risk of fraud and abuse and expected to reduce expenses tied to conventional prescriptions;
- Decreased the proportion of prescriptions written for 20 tablets from 22.8 percent to 16.1 percent, and prescriptions for 11-19 tablets from 33.5 percent to 20.1 percent;
- Eliminated redundant clinical work by standardizing care and adopting best practices, thus reducing unnecessary expenses and complications which arise from process variation.

BENEFITS REALIZED E-PRESCRIBING:

- Streamlined provider order entry workflow and reduce paper process burdens on staff;
- Reduced incidence of manual process error by removing human intervention in the process;
- Improved patient safety and elevated quality of care resulting from greater auditing and more effective controls;
- Decreased patient wait-time for prescription refills;
- Integrated prescription details with PennChart;
- Improved regulatory reporting capability for controlled substance prescriptions;
- Reduced potential for fraud and abuse with system automation and removal of human intervention.

SAVINGS
QUALITATIVE

CLOUD TECHNOLOGY BREAKTHROUGH FOR BRAINIAK APPLICATION REAL TIME ATTENTION STUDY OF DEPRESSION

BACKGROUND DESCRIPTION

Penn Medicine introduced a virtual cloud computing server in the new public cloud environment in July 2018 to support the significant computing needs of the BrainIAK application. The project allowed Penn Medicine IS to support the Real Time Attention Study- a novel approach being taken to treat depression that uses feedback data to improve patient treatment. This project was also one of the first cloud computing implementations facilitated by Penn Medicine IS, establishing best practices for ongoing implementations in cloud computing to economize cost and time savings in support of larger enterprise projects requiring many servers.

The Real Time Attention study is a joint initiative between Penn Medicine Center for Neuromodulation in Depression and Stress and Anne Mennen, a doctoral researcher for the Princeton Neuroscience Institute. The study looks at the possibility of reducing depression in subjects by training their attention away from negative images and toward neutral or positive images, guided by feedback from real-time MRI processing via software developed by Princeton and Intel researchers.

BENEFITS REALIZED

- Saved time, enabling set up time for new servers to be completed in minutes instead of weeks;
- Reduced number of technical SMEs needed for server provisioning process by 50-75%;
- Decreased infrastructure and operations costs by 50% compared to hosting the same infrastructure in on-premises data centers; virtual servers can be built just in time and decommissioned as soon as they are no longer needed;
- Eliminated uncertainty regarding costs for shared servers and applications, charging each clinical and business unit appropriately for cloud resources they consume;
- Proved cloud platform could be used to quickly set up hardware and software required for the study, enabling other scientists to more easily replicate and expand upon this research;
- Explored a potential treatment for depression, which affects 300 million people globally;
- Furthered development of Penn Medicine's cloud platform and strategy, readying us for the next cloud-based projects;
- Received **Fierce innovation award** (**https://www.pennmedicine.org/news/news-releases/2018/december/cloud-based-brain-activity-mapping-system-receives-fierce-innovation-award**) for solving telecommunications challenges.

SAVINGS
QUALITATIVE

MAKING THE CONNECTION

These projects are focused on using technology to enhance the communication and sharing of information between providers and patients across the continuum of care.

PROJECT NAME

PENN MEDICINE PCP'S LEVERAGE ENCOUNTER NOTIFICATION SITE TO ACHIEVE VALUE BASED CARE INITIATIVES

BACKGROUND DESCRIPTION

Supporting population health and value-based payment initiatives is a strategic initiative at Penn Medicine and Penn Medicine's Primary Care physician (PCP) offices play a critical role. As patients have a visit at the Emergency Department or the inpatient setting, it is critical for Penn Medicine's Primary Care providers to follow-up with their patients regardless of whether it was a Penn Medicine facility or not. A service provided by the local HIE (Healthcare Information Exchange), HSX (HealthShare Exchange), enables Penn Medicine to receive this information from area hospitals for the 250,000+ patients cared for by Penn Medicine Primary Care providers.

What was previously a challenging and very manual process is now centralized and standardized for thirty-nine (39) Primary Care practices. The solution is a process created by the Penn Medicine IS team to import HSX data and post it on a secure intranet site where each of the practices can pull their pre-formatted patient data, saving many hours of work every day. The solution, now in place for over nine months, targets patients at the highest risk and allows the Primary Care service line to take a proactive approach to care coordination and necessary follow-up on all patients admitted. Additional phases of the project will include methodology for risk stratification in collaboration with the data science center.

BENEFITS REALIZED

- Creation of a centralized and standardized reporting method for fifty-one (51) distinct users, supporting 38,012 emergency visits and 23,516 inpatient discharges to date;
- Increased emphasis on value-based care initiatives and proactive intervention and mitigation for high-risk populations;
- Supported ability to meet at-risk contract requirements to avoid penalties and receive incentive payments for care coordination;
- Increased security and privacy of reporting and analytics processes with use of active directory;
- Customized report views, creating flexibility for data analytics at enterprise and practice levels.

SAVINGS
QUALITATIVE

NEW PHYSICIANLINK - A REGIONAL FIRST, OFFERS RADIOLOGY IMAGE VIEWING FOR EXTERNAL/REFERRING PROVIDERS

BACKGROUND DESCRIPTION

Penn Medicine is among the first in the region to launch an image viewing function for referring providers within our physician portal called PhysicianLink in August 2018. The new feature now enables referring physicians outside of the Penn Medicine system to view radiology images through a link in the EHR's chart review. Historically, physicians outside the institution who referred patients to Penn Medicine for diagnostic radiology studies, could only review the text results of those studies. Now, along with the diagnostic result, a link appears that permits the external provider to launch a PACS image directly using the same clinical imaging viewer as the health system.

The PhysicianLink imaging integration is a huge satisfier for external providers and patients. Penn Medicine is part of an elite group of Epic sites offering this advanced form of data sharing and the first in the region.

> "PhysicianLink enables our referring providers to access important clinical information for their patients. Practicing clinicians gain context by viewing actual images to support clinical decision making - rather than simply reading the interpretations. Patients appreciate that their referring provider has a deep dive view of their data."
>
> **Karen Pinsky, MD, CMIO**
> Chester County Hospital

Having the actual images brings tremendous value to office based practitioners who are part of a patient's care team and patients who now have an additional opportunity to look at the images alongside of their provider.

Penn Medicine's PhysicianLink Radiology Image viewing is another breakthrough in technology development that gives providers and patients alike a technical edge in providing patient care.

BENEFITS REALIZED

- Immediate access to images after the exam is performed with no wait time for a DVD to be produced and delivered;
- Clinical decisions can be informed by timely image availability, without having to rely solely on the diagnostic report, resulting in improved patient care;
- Ease of use induces providers to refer their patients to Penn Medicine for diagnostic imaging.

SAVINGS
QUALITATIVE

IS ACTIVITIES YIELD SUBSTANTIAL ON-GOING SAVINGS AND COST AVOIDANCE

This is the third edition of the Information Services Benefits Realization Analysis. This edition features twenty-seven (27) high profile IS projects that were completed in 2018 and 2019. The savings and future cost avoidance derived from many of these projects is on-going.

This chart summarizes the cumulative savings and future cost avoidance associated with the IS projects featured in the last ten years. It is evident that past IS activities continue to contribute to substantial savings and future cost avoidance to Penn Medicine. The contributions noted in this chart are reflective of the teamwork and collaboration between administration, clinical leadership, operations and Information Services.
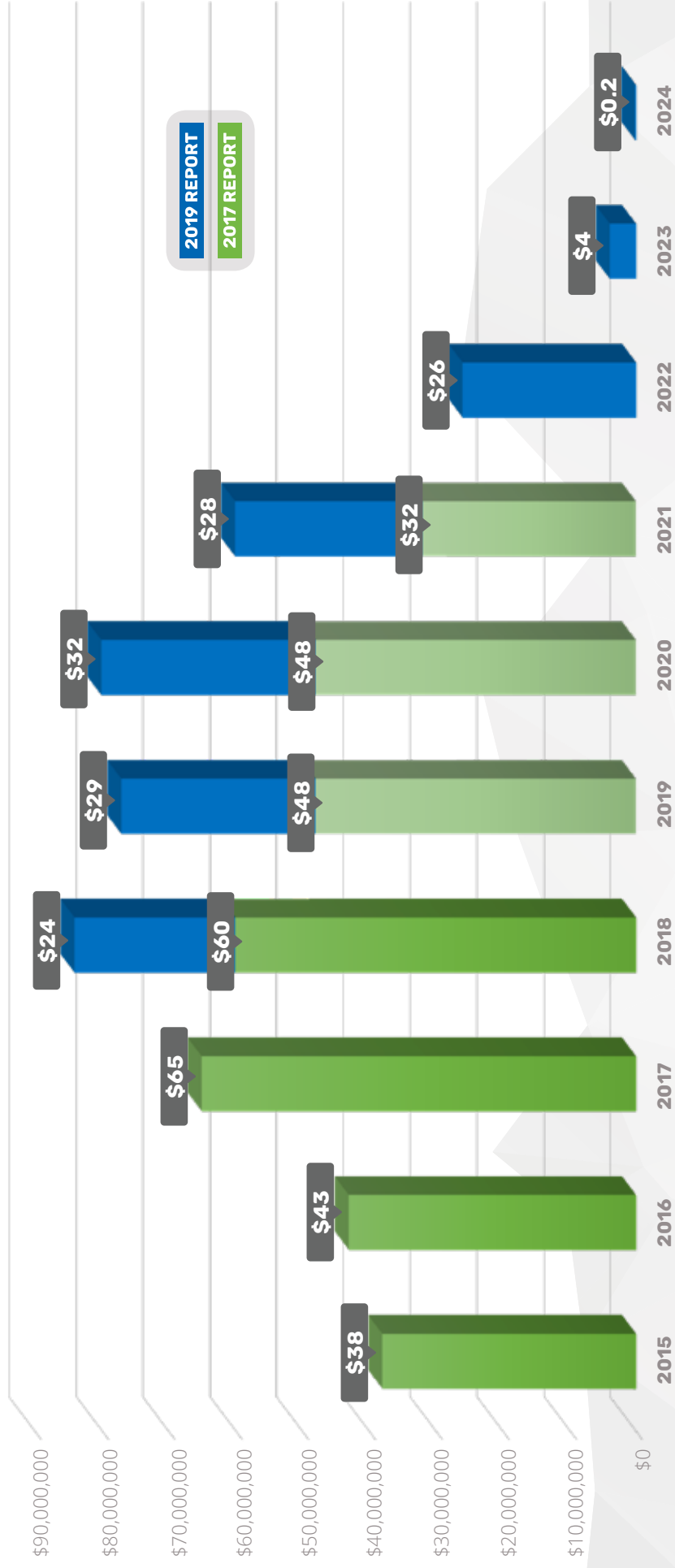
GLOSSARY

ABC: Awakening and Breathing Coordination

ABCDEF ICU Bundle: Assess (Prevent and Manage Pain), Both SAT and SBT, Choice of Analgesia and Sedation, Delirium Assess Prevent and Manage, Early Mobility and Exercise, Family Engagement and Empowerment, Intensive Care Unit

ACOG: American College of Obstetricians and Gynecologists

CCH: Chester County Hospital (Penn Medicine Hospital)

CCA: Clinical Care Associates

CFB: Candidate for Billing

CIO: Chief Information Officer

CMIO: Chief Medical Information Officer

CPUP: Clinical Practices of University of Pennsylvania

CVIS: Cardiovascular Information System

DAC: Data Access Center

DLP: Data Loss Prevention

ED: Emergency Department

EHR: Electronic Health Record

EIO: Entity Information Officer; This is the IS Executive at each entity, including HUP, PAH, PPMC, HCHS, CCH, LGH, PMC, and CPUP/CCA

EHR: Electronic Health Record

ERP: Enterprise Resource Planning

EPIC/ EpicCare: The enterprise ambulatory EMR system

e-Prescribing: The workflow of ordering a non-controlled medication in order entry and electronically transmitting it to a (retail) pharmacy using a certified e-prescribing vendor.

EUS: End User Support, the desktop and network support, technicians who work at each entity facility

GSPP LTACH: Good Shepherd Penn Partners Long Term Acute Care Hospital

HAvBED: Hospital Available Beds for Emergencies & Disasters

HCHS: Penn Home Care and Hospice Services

HD: High Definition

HHS: Health and Human Services

HIE: Health Information Exchange

HIMS: Healthcare Incident Management System

HIPAA: Health Insurance Portability & Accountability Act of 1996

HL7: HL7 is a framework (and related standards) for the exchange, integration, sharing, and retrieval of electronic health information

HPC: High Performance Computing

HSX: HealthShare Exchange

HUP: Hospital of the University of Pennsylvania

ICU: Intensive Care Unit

LOA: Leave of Absence

LGH: Lancaster General Health

MPM: myPennMedicine

NOC: Network Operations Center

OR: Operating Room

PACS: Picture Archiving and Communication System

PAH: Pennsylvania Hospital

PADOH: Pennsylvania Department of Health

PCAM: Perelman Center for Advanced Medicine

PCI DSS: Payment Card Industry Data Security Standards

PDS: Penn Data Store (Clinical Data Warehouse)

PDS2: Penn Data Store II

PE: Platform Engineering

PennChart: Penn Medicine's Electronic Health Record

PHCS: Princeton Healthcare System (now Penn Medicine Princeton Health or PMPH)

PMACS: Penn Medicine Academic Computing Services

PMAR: Penn Medicine at Rittenhouse

PMO: Project Management Office

PMPH: Penn Medicine Princeton Health

PMUC: Penn Medicine University City

PPMC: Penn Presbyterian Medical Center

PSOM: The Perelman School of Medicine

RTE: Real Time Eligibility

Sunset: Retirement of technology system

UPHS: University of Pennsylvania Health System