

Facilitating Health Information Exchange to Improve Health Outcomes for School-Aged Children: School Nurse Electronic Health Record Access

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Abstract

Background and Objectives School-aged children with chronic conditions require care coordination for health needs at school. Access to the student's accurate, real-time medical information is essential for school nurses to maximize their care of students. We aim to analyze school nurse access to medical records in a hospital-based electronic health record (EHR) and the effect on patient outcomes. We hypothesized that EHR access would decrease emergency department (ED) visits and inpatient hospitalizations.

Methods This retrospective secondary data analysis was conducted using EHR data 6 months pre- and post-school nurse access to students' hospital-based EHR. The main outcome measures were the ED visits and inpatient hospitalizations.

Results For the sample of 336 students in the study, there was a 34% decrease in ED visits from 190 visits before access to 126 ED visits after access ($p < 0.01$). Inpatient hospitalizations decreased by 44% from 176 before access to 99 after access ($p < 0.001$). The incident rate of ED visits decreased (IRR: 0.66; 95% CI: 0.53–0.83; $p = 0.00035$), and hospitalizations decreased (IRR: 0.56; 95% CI: 0.44–0.72; $p < 0.0001$) from pre to post access. These findings suggest school nurse access to medical records is a positive factor in improving school-aged patient outcomes.

Conclusion School nurse access to medical records through the hospital-based EHR may be a factor to improve patient outcomes by utilizing health information technology for more efficient and effective communication and care coordination for school-aged children with chronic medical conditions.

Keywords

- ▶ health information exchange
- ▶ electronic health records
- ▶ child
- ▶ outcome assessment, health care
- ▶ school nursing

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Background and Significance

Electronic health records (EHRs) have become the standard of communication and documentation for health care systems. In the United States, 86% of office-based physicians and 94% of hospitals used their EHR data to perform processes that inform clinical practice.^{1,2} For pediatricians, the use of a fully functional EHR with pediatric functionality had doubled from 8.2% in 2012 to 16.9% in 2016 ($p = 0.01$), yet full functionality has not yet been achieved.³ A fully functional EHR should include the ability to facilitate health information exchange (HIE) between health care providers and care team members for a school-aged child's care coordination, including school nurses.⁴ An integrative review found only a few articles on the use of EHRs for HIE with school nurses, consenting and information sharing guidelines complicated the HIE process.⁵

School nurse access to and communication of medical information is complicated by the intersection of two federal guidelines that protect student/patient health information. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) and the Family Educational Rights and Privacy Act of 1974 (FERPA) regulate medical information access and communication between schools and health care systems.⁶ For example, HIPAA allows health care providers to disclose the student's protected health information without parental consent for "treatment purposes," and under FERPA a school nurse can "clarify" an outside health care providers treatment instructions.⁷ This is not always clear to health care systems, and school nurses may be denied information without parental consent. On the other hand, FERPA does require a school nurse to obtain parental consent to share student personally identifiable information, including student medical information, with a health care provider.⁷ The specifics of what regulation applies, in what situation for sharing a student's health information can be confusing and hinder communication.^{4,8,9} Therefore, health care providers of school-aged children and school nurses need to be educated on both HIPAA and FERPA. There are helpful resources like *The Joint Guidance on the Application of FERPA and the HIPAA to Student Health Records*⁷ and *Data Sharing Guidance for School Nurses*.¹⁰

In addition, current HIE between pediatric health care providers and school nurses is antiquated, relying on outdated and inefficient communication using fax, phone, and traditional mail.^{5,10} School nurses are managing more students with complex health care needs that require communication between care coordination team members.¹¹⁻¹³ Chronic conditions are conditions expected to last more than one year, involve functional limitations or medical needs greater than usual for one's age,^{14,15} and may involve long-term physical, emotional, behavioral, and developmental disorders occurring on a mild to severely disabling continuum.^{16,17} Chronic health conditions commonly seen in school populations include asthma, seizure disorders, cancer, diabetes, cystic fibrosis, cerebral palsy, sickle cell anemia, severe allergies, and mental health conditions.¹⁸⁻²¹ These complex conditions require care coordination and

school nurse access to health care provider orders, health care plans, and up-to-date medical information. However, the current information systems used are not adequate for efficient HIE.

The American Academy of Pediatrics recommends pediatricians establish a working relationship and communication methods to exchange information with school nurses.²² The school nurse is frequently the only health care provider in a school overseeing emergencies and daily management of chronic health conditions; thus, they should be considered essential caregivers and part of the health care team for pediatric patients.²³ With heavy caseloads that span multiple schools, access to accurate, timely medical information is crucial for school nurses to provide effective and efficient care for improved patient outcomes. School nurse access to the student's EHR can provide that real time, up-to date information and possibly prevent ED visits and hospitalizations when optimal care coordination occurs with improved information access.

Research on patient outcomes related to this type of HIE between health care providers and school nurses is limited. Reeves et al²⁴ reported a significant decrease in hospital admissions for 33 children with asthma from 60.6% 12 months pre to 21.2% 12 months post messaging between school nurses and health care providers through the EHR. While the hospital admission results were encouraging, the sample size was small, and the study concentrated on only one chronic condition, asthma. We hypothesized that school nurse access to accurate, timely medical information in a hospital-based EHR might be a factor in decreasing ED visits and hospitalizations for students with multiple types of chronic conditions.

Objectives

To determine the effects of providing school nurses access to the medical information in a student's hospital-based EHR in a larger sample of students with multiple chronic conditions, we examined ED visits and inpatient admissions (hospitalizations) before and after school nurses were given EHR access. We included students with one or more of the four most common chronic conditions (type 1 diabetes, asthma, severe allergies, and seizures) seen in the school population. We hypothesized that school nurse access to accurate, timely medical information in a hospital-based EHR might be a factor in decreasing ED visits and hospitalizations for their students with chronic conditions.

Methods

Study Design

This study was a retrospective secondary data analysis utilizing a quasi-experimental matched pre/post design. The aim was to determine the possible impacts of school nurse access to medical records from an EHR on patient ED visits and hospitalizations for school-aged patients with type 1 diabetes, asthma, severe allergies, and seizures/epilepsy. This study was approved as exempt from human subjects

review as secondary data analysis by the Colorado Multiple Institutional Review Board (COMIRB).

Study Setting and Participants

The student sample ($n = 336$) came from a pool of 162 school nurses with EHR access to their medical records from three urban public school districts in the Denver metropolitan area. All the students in the sample were patients of the hospital's health care system and had a medical record in the hospital's EHR. Participants were identified by searching in the EHR for students with a School Connect consent in the EHR media tab and were identified by an Encounter labeled school consent (→Fig. 1). Inclusion criteria included: 3 to 19 years of age, diagnosed with one of four chronic conditions (type 1 diabetes, seizures, life-threatening allergies, and asthma), patients from a regional children's hospital in the western United States, had parental consent, and attended one of the public schools (pre-K to 12th grade) participating in the "Colorado Connect School Nurses Program." Data was abstracted from the EHR through the hospital's data warehouse for 6 months before and 6 months after the date the school nurse was granted access to the student's EHR. Chronic conditions were identified based on the following International Classification of Diseases 10 diagnostic codes: Allergies-T78*, Z87.892*, Z88*, or Z91*; Asthma-J45*; Type 1 Diabetes Mellitus-E10*; and Seizures or Epilepsy-G40* or R56*. The data was collected for two years of the "Colorado Connect School Nurses Program" from 2018 to 2020. Data were collected for two academic years to have a larger sample size as school districts were being onboarded on a rolling basis. The continual onboarding of school nurses and their varying times of initial access to the EHR means that specific dates are not reported here but were used for determining the pre and post access.

Description of EHR Access Program

The "Colorado Connect School Nurses Program" is a hospital-based program that provides view-only mode EHR access to school nurses via a web portal.²⁵ Epic systems published an article highlighting this innovative program.²⁶ The version of the hospital-based EHR used is based on EpicCare Link (Epic Systems, Verona, Wisconsin).²⁷ With Internet access, the school nurses can log into EpicCare Link and view the student's chart, including the longitudinal plan of care (LPOC), Encounters, current medications, school health care plans, medical orders, audiology reports, laboratory test results, immunizations, and notes related to clinic visits, ED visits, and hospitalizations. Behavioral health, minor consent notes, and protected notes are not accessible to the school nurse unless special consent has been obtained from the parent or adolescent. The school nurse EHR access did not include any functionality for bidirectional communication via Inbox messaging or documentation by the school nurse as it was view-only access. For this study, a multi-step EHR access process (→Fig. 1) started with approval by the school districts and regional children's hospital through a Health Information Sharing Agreement. School nurses were required to complete an online EHR training, sign a Security User Agreement, and attend an in-person training that included technical information and HIPAA and FERPA education. Educational and administrative forms and training videos were available via the program's external-facing website. Once training was completed, the school nurses received their username and password for login and were set up to receive EHR updates via Broadcast Messages in the EHR by email. School nurses then obtained consent from parents of individual students, which was then faxed to the hospital school health department. The school health department and information technology program administrators follow

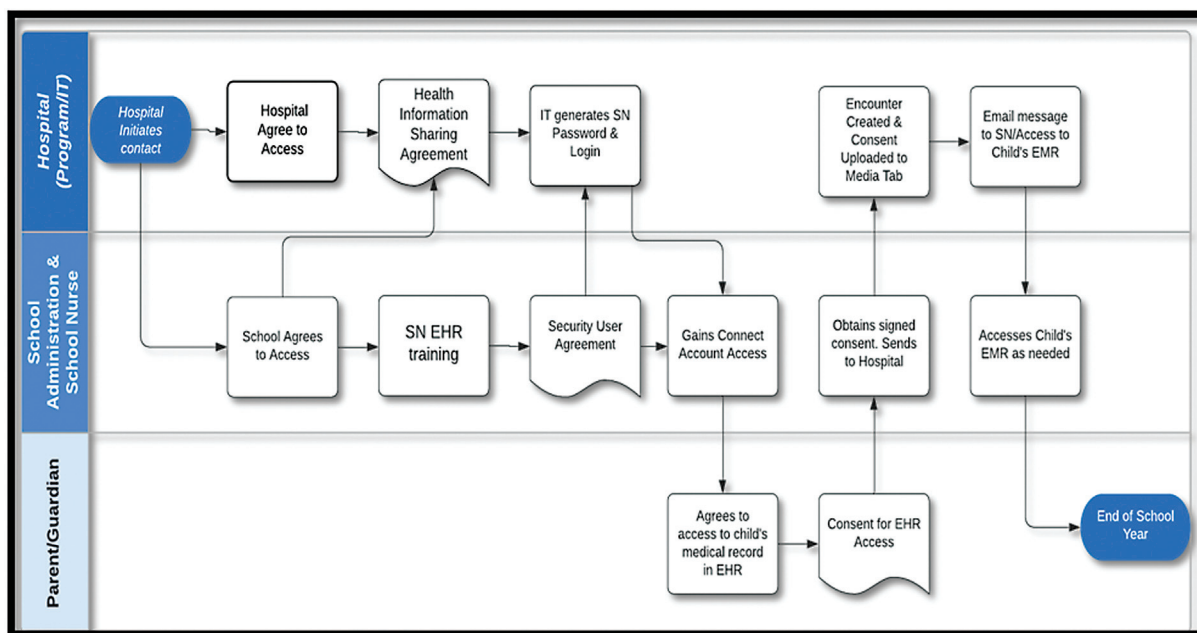


Fig. 1 Workflow for School Nurse EHR Access. The shapes in this swimlane diagram represent the beginning and end of the process (oval shape), square/rectangle for process step, and a document symbol (document shape).

program guidelines to enter the school and the school nurse as care team members into the EHR and grant school nurse access to that student's EHR.

Measures

The primary outcomes were the number of emergency department (ED) visits and hospitalizations. ED visits and hospitalizations are measurements typically used in assessing patient outcomes for care coordination activities.²⁸ The categories of ED visits were identified as 'Emergency' or 'Urgent Care.' Hospitalization categories of patients were identified as "Renal Dialysis," "Bedded Outpatient," "Surgery Admit," "Ambulatory Surgery," "Observation," "Extended Recovery," and "Inpatient." The Renal dialysis category was used only in those requiring hospitalization.

Demographics and Covariates

The following demographics were also extracted for the patient population: age (in years), sex (male and female), race (White, Black, and Other), and ethnicity (Hispanic or Latino or not). The study participants' chronic conditions extracted were allergies, asthma, type 1 diabetes, and seizures or epilepsy (diagnosis codes listed earlier).

Analysis

Descriptive analysis was conducted on demographic variables. ED visits and hospitalizations were not normally distributed by the Shapiro-Wilks test ($W=0.52$, $p < 0.0001$; $W=0.52$, $p < 0.0001$). Therefore, unadjusted matched Wilcoxon Rank Sum tests were conducted to compare outcomes between each subject's pre and post-access time periods. A multivariate mixed Poisson regression was conducted to estimate the impact of EHR access for school nurses on outcomes, adjusting for covariates: age, sex, race, ethnicity, asthma, allergies, type 1 diabetes, seizures, or epilepsy. This model accounted for the matched design. Incident rate ratios (IRRs) were calculated for each covariate. IRR describes the added or subtracted incidence of an outcome for one category concerning a reference category.²⁹

Power analysis was calculated based on the ED visit outcome from a similar study.²⁴ Assuming an expected difference of 0.25, a standard deviation of 0.60, an α level of 0.05, 50 subjects would provide 85.6% power to detect a difference.

Results

Study Population Characteristics

The study sample consisted of 336 students. Students had at least one of the four diagnoses, with the largest percentage of students with life-threatening allergies (40%), followed by asthma (32%), seizures (31%), and type 1 diabetes (4%). The median age was 9.6 years (± 4.3). Students were mainly Hispanic or Latino (54%) and White (47%). The complete demographic results are shown in **Table 1**.

Emergency Department Visits and Hospitalizations

There was a 34% ($n=64$) reduction in ED visits from 190 visits before school nurse access to the EHR to 126 ED visits

Table 1 Demographic variables ($N=336$)

Variables	N (%) Means (SD)
Race	
White	159 (47%)
Black	53 (16%)
Other	124 (37%)
Ethnicity	
Hispanic or Latino	183 (54%)
Not Hispanic or Latino	153 (46%)
Age	9.6 (4.3)
Asthma	109 (32%)
Allergies	134 (40%)
T1DM	14 (4%)
Epilepsy/Seizures	105 (31%)

Abbreviations: T1DM, type 1 diabetes mellitus.

after access ($p=0.01$). Hospitalizations decreased by 44% ($n=77$) from 176 before to 99 hospitalizations after access ($p < 0.001$). See **Table 2** for complete bivariate results for outcomes, pre and post-school nurse EHR access.

The regression model results are presented in **Table 3**. Adjusted post-access IRR was 0.66 (CI 0.53–0.83; p -value = 0.00035) for ED visits and 0.56 (95% CI 0.44–0.72; p -value ≤ 0.0001) for hospitalizations compared with IRRs for pre-access. Students with asthma had significantly higher rates of ED visits (IRR 2.04, CI 1.40–3.08, $p=0.0007$) and hospitalizations (IRR 1.61, CI 1.07–2.42, $p=0.02$) compared with students without asthma. Students with allergies had significantly higher hospitalizations (IRR 1.75, CI 1.17–2.64, $p=0.007$). For demographic variables, the only significant finding was for White, Hispanic, or Latino students and hospitalizations (IRR 1.73, CI 1.12–2.66; $p=0.012$) and age for ED visits (IRR 0.95, CI 0.90–0.99, $p=0.026$). See **Fig. 2A** and **B** for Forest Plots of IRRs for ED visits and hospitalizations, indicating the point estimates (IRR) and confidence intervals (95% CI).

Table 2 Bivariate results for outcomes (pre-access versus post-access, $N=336$)

	Pre-access N Mean (SD) Median (IQR)	Post-access N Mean (SD) Median (IQR)	p-Value ^a
ED visits	190 0.56 (1.1) 0 (1)	126 0.38 (0.8) 0 (0)	0.01
Hospitalizations	176 0.52 (1.0) 0 (1)	99 0.29 (0.7) 0 (0)	<0.001

^ap-Value calculated by matched Wilcoxon tests.

Table 3 Regression results for patient outcomes and variables

Variables	ED visits IRR (95% CI; <i>p</i> -value)	Hospitalizations IRR (95% CI; <i>p</i> -value)
Post-Access (Ref: Pre-Access)	0.66 (0.53–0.83; <i>p</i> = 0.00035)	0.56 (0.44 - 0.72; <i>p</i> ≤ 0.0001)
Race: White (Ref: Black)	1.18 (0.65–2.14; <i>p</i> = 0.57)	1.45 (0.81–2.61; <i>p</i> = 0.21)
Race: Other (Ref: Black)	1.0 (0.52–1.92; <i>p</i> = 0.99)	1.36 (0.73–2.64; <i>p</i> = 0.32)
Ethnicity: Not Hispanic or Latino (Ref: Hispanic or Latino)	1.30 (0.52–1.92; <i>p</i> = 0.23)	1.73* (1.12–2.66; <i>p</i> = 0.012)
Age	0.95 [†] (0.90–0.99; <i>p</i> = 0.026)	0.97 (0.93–1.02; <i>p</i> = 0.22)
Asthma: Yes (Ref: No)	2.04 [†] (1.40–3.08; <i>p</i> = 0.0007)	1.61* (1.07–2.42; <i>p</i> = 0.02)
Allergies: Yes (Ref: No)	1.35 (0.89–2.05; <i>p</i> = 0.15)	1.75* (1.17–2.64; <i>p</i> = 0.007)
T1DM: Yes (Ref: No)	0.61 (0.20–1.89; <i>p</i> = 0.39)	0.81 (0.27–2.40; <i>p</i> = 0.70)
Epilepsy/Seizures: Yes (Ref: No)	1.09 (0.72–1.66; <i>p</i> = 0.66)	1.17 (0.78–1.75; <i>p</i> = 0.46)

Abbreviations: IRR, incidence rate ratio; Ref, reference that variable is being compared with; Var, variable; T1DM, type 1 diabetes mellitus. Significant results are indicated by *.

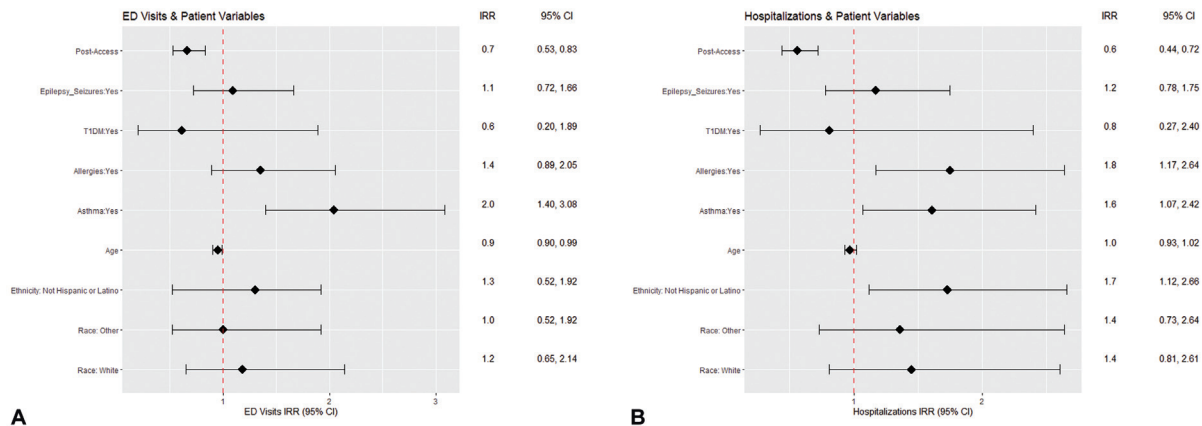


Fig. 2 Forest plots of IRRs for ED visits and hospitalizations, indicating the point estimates (IRR) and confidence intervals (95% CI) represented by whiskers. The red dotted vertical line plots the reference point (1), with the statistical significance of each variable’s individual point and whiskers compared with that reference line. (A) Forest Plot of incidence rate ratios: ED visits. (B) Forest plot incidence rate ratios: hospitalizations.

Discussion

This study found an overall decrease in ED visits and hospitalizations from pre to post-access for this sample of students with chronic conditions. The decrease in hospitalizations was similar to Reeves,²⁴ in hospitalization rates for their sample of students with asthma. However, this study also found a significant decrease in ED visits post access, contrary to Reeves,²⁴ whose results showed a slight insignificant increase in ED visits post access. Factors such as sample size, population diseases, and time frames may have contributed to the differences in the results between our studies.

The high incidence rates of ED visits and hospitalizations for students with asthma and allergies after adjusting for EHR access in this study align with research that the highest percentage of hospitalizations for children is for asthma, more than epilepsy and type 1 diabetes.^{11,30} Medical encounters such as ED visits and hospitalizations for children are consistently cited as causing high costs to families and communities related to lost school days, parents’ loss of wages, and health care access and expenditures.^{31–33} Previ-

ous intervention data focused on students with chronic conditions like asthma have demonstrated reduced morbidity, absenteeism, and exacerbations with various electronic messaging and transmission of health care plans.^{6,34–36}

In this study, school nurse access to the EHR allowed them to obtain school health forms independently, view updated medical information, and access school-related orders without contacting or causing time burdens on clinicians and clinics. Studies have looked at the documentation burden of EHR use for pediatricians estimating that pediatricians spend approximately 3.4 hours a day on care documentation.^{3,37} However, it is unknown how much of that burden and time is related to communication and documentation for school health-related forms. When the school nurse can access school forms in the EHR independently, it can help decrease the time and lessen the burden of EHR use for the pediatricians and health care staff. Overall, EHRs are not used to their full functionality for potential cost savings and fall short of adequately supporting care coordination needs.^{38–40} The results of this study highlight steps toward more robust use of the EHR.

The school nurse's visibility can be increased with their contact information in the EHR, but bidirectional communication could provide even more EHR functionality. When the school nurse submits the parental consent, the school is added as a "provider," and the school nurse's contact information is added to the care team section of the LPOC. Traditionally, school nurse visibility can be limited with their high caseloads and numbers of schools; communication of medical information is commonly cited as a barrier by parents, school nurses, and health care providers.^{34,41–46} Bidirectional documentation and messaging functionality in the EHR for the school nurse could be an added factor in breaking down the barriers in communication. However, even with some bidirectional messaging in the Reeves study,²⁴ the laborious consent process and lack of interoperability between the EHR and a school-based information system were limitations to seamless communication. Other barriers may arise from parents' mistrust in sharing of medical information²⁴ and pediatricians have voiced concerns about inappropriate disclosures of medical information through EHR use in general.³

Limitations

This research was conducted in a large urban setting with a school health department and robust information technology resources in a children's hospital. The results, therefore, may not be generalizable to other settings. In this study, any ED visits or hospitalizations in other organizations would not have been accounted for; however, the care network involves multiple health care utilization sites. School nurse competency in utilizing technology associated with the EHR, initiative to obtain parental consent, frequency of EHR use, or interventions related to EHR access was not evaluated and could potentially affect the study's results as confounding factors. Seasonal differences in the pre and post-data were not reported because the rolling basis of consent dates and data collection 6 months pre- and post-consent meant a variety of peak and non-peak months were included in the study. Some final data collection ended in May of 2020 when the COVID-19 pandemic could have affected the use of ED and hospitalizations for students. We did a sensitivity analysis incorporating observations not impacted by the pandemic and found similar patterns. Further, this study did not account for the variation in the schools. There were many school clusters with few students in those clusters. However, this study included a larger sample with more diverse chronic conditions than the previous Reeves study.²⁴ In the future, research could include a larger sample across multiple organizations over several years, other health outcomes like hemoglobin A1c levels for children with type 1 diabetes, and socio-economic data such as zip codes.

Conclusion

This study suggests that school nurse access to medical information and school health care plans in a hospital-based EHR may be a factor in improving health outcomes for students with chronic conditions. HIE that allows for real-time accurate medical information is essential for optimal

patient outcomes. Further research should explore the feasibility of large-scale, national efforts for bidirectional HIE and interoperability for all care team members in pediatric care coordination. There is a critical need to facilitate communication among children, families, schools, and clinicians that ensure confidentiality but support integrated care.^{6,47} HIE through EHRs with organizations outside of health care systems is essential for improved data capture and use of social data as the importance of social determinates of health is realized in health care.⁴⁸

Clinical Relevance Statement

School nurse access to hospital-based EHRs is a feasible and effective method to improve patient outcomes for school-aged children with chronic conditions. Health care practitioners such as pediatricians, nurses, and school nurses can work together with clinical informaticians to create HIEs for improved communication in care coordination. The future of HIEs includes health care information access for a variety of external partners in the journey toward better patient care.

Multiple Choice Questions

1. When considering health information exchange between school nurses and health care providers, what Federal guidelines should be considered?
 - a. Health Insurance Portability and Accountability Act of 1996 (HIPAA).
 - b. Family Educational Rights and Privacy Act (FERPA).
 - c. Both HIPAA and FERPA.
 - d. None of the above.

Correct Answer: The correct answer is option c. Both HIPAA and FERPA Federal guidelines need to be considered for sharing of information between school nurses and health care providers. It is important to follow the guidance of resources like the *Joint Guidance on the Application of the Family Educational Rights and Privacy Act (FERPA) and the Health Insurance Portability and Accountability Act of 1996 (HIPAA) to Student records*. Student health records are considered part of the academic record and thus need to be treated under FERPA for information flow from the school to the health care provider. The specifics of what regulation applies, in what situation, for sharing a student's health information, can be confusing and hinder communication when coordinating care in the school environment.

2. What clinical practice measures were positively affected with school nurse access to medical information through hospital-based EHRs in this study?
 - a. Faster referral process.
 - b. Real-time access to more accurate and up to date information.
 - c. Increased appointment scheduling process.
 - d. Direct communication between provider and school nurse through Inbox messaging.

Correct Answer: The correct answer is option b. In this study, the school nurses could independently access school forms and view important medical information through the EHR. The functionality of the EHR access was limited to view only and did not include bidirectional messaging with health care providers at the hospitals or clinics. There was no functionality to make appointments or submit referrals. Other studies have documented feasibility of bidirectional messaging between school nurses and hospital and health care systems.

Protection of Human and Animal Subjects

The Multiple Institutional Review Board of the University of Colorado (COMIRB) approved the study (protocol # 18-0264).

Conflict of Interest

None declared.

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