Technical Note

Streamlined sign-out of capillary protein electrophoresis using middleware and an open-source macro application

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INTRODUCTION

Clinical laboratories are a key component of modern health care.¹ Modern laboratories are equipped with increasing number of sophisticated instruments, which provide precise and accurate diagnostic information and help physicians make correct clinical decisions.² For proper workflow in the laboratory, interfacing of clinical laboratory instruments with the laboratory information system (LIS) via “middleware” software is increasingly
common. Some instruments come with vendor supported middleware, but most of the time a third party middleware facilitates this interfacing.

Background
The core clinical laboratory at University of Iowa Hospitals and Clinics replaced gel electrophoresis and implemented capillary electrophoresis using a Sebia® Capillaries-2™ (Norcross, GA, USA) instrument for serum and urine protein electrophoresis. University of Iowa Hospitals and Clinics is a quaternary care academic medical center which includes a multiple myeloma treatment service. Our laboratory performed 3250 serum protein electrophoresis (SPE), 2548 serum immunofixation electrophoresis (SIFE), 528 urine protein electrophoresis, Twenty four hour (UPET), 188 urine protein electrophoresis, random specimen (UPE) and 886 urine immunofixation electrophoresis (UIFE) during 2012-2014. Our laboratory utilizes Data Innovations Instrument Manager (South Burlington, Vermont, USA) as a middleware to establish communication between most of our instrument and Cerner Laboratory Information System (Kansas City, MO, USA). This same middleware was used for data transfer between Sebia® Capillaries-2™ instrument and Cerner LIS. The interface after initial troubleshooting successfully allowed bi-directional transmission of numeric data, that is, the total protein value and its fractions. However, the text of the interpretive pathology report was not properly transferred. The incompatibility between instrument, middleware and LIS resulted in losing the text formatting during the transfer [Figure 1]. This resulted in manual re-entry of interpretive text and made the system prone to copy-paste errors.

MATERIALS AND METHODS
After exploring options for this trivial appearing problem, we evaluated AutoHotkey (http://www.autohotkey.com), a free, open-source macro-creation and automation software utility. Scripts were written in AutoHotkey to create macros that automated mouse and key strokes (script included in the supporting material). The scripts retrieve the specimen accession number, capture user input text, and insert the text interpretation in the correct patient record in the desired format [Figure 2].

AutoHotkey was also used to create abbreviations for various interpretation templates [Table 1]. These keystrokes which are sent in response to typed abbreviations are known as “hotstrings.” In addition, AutoHotkey automated repetitive nonintuitive keystrokes which were required for maneuvering through our LIS. Using AutoHotkey, we were able to save a substantial number of nonintuitive keystrokes involved in sign-out [Table 2].
RESULTS

The Autohotkey scripts executed well and accurately transferred narrative interpretation into the LIS in desired text formatting [Figure 1], thus reducing the manual effort of reentering the interpretation and also decreased the possibility for error in text data transfer. The scripts were basically executing copy-paste in an automated way. An important additional feature was that the script acquired both the accession number and the specimen type (e.g. SPE and SIFE for serums and UPE, UPET and UIFE for urines) from the Sebia instrument. Using the accession number and the specimen type, the script opened the patient’s record for this specimen in the LIS. This step ensured that the narrative was inserted into the correct patient record and type. Errors in patient and sample identification are minimized. The result was smooth and efficient transfer of data in the correct patient record.

CONCLUSIONS

Using the open-source AutoHotKey software, we successfully improved the transfer of text data between capillary electrophoresis software and the LIS. Open-source software allows the end user to review, modify, or share the source code, blueprint or design.
of the software for their own needs, customization, curiosity or troubleshooting under defined terms and conditions. Open-source software are often free or available at low cost. Although open-source software have been successfully used in many fields of medicine like imaging, electronic medical records, electronic health records, public health and bio surveillance, research, etc., but there is no published data on use of open-source software for interfacing clinical laboratory instruments with the LIS or middleware. Proper interfacing of complex laboratory instruments often requires sophisticated middleware software, but compatibility issues arise from time to time and hinder smooth functioning of an automated laboratory. Open-source software tools should not be overlooked as tools to improve interfacing of laboratory instruments.

REFERENCES

1. Kurec AS, Lifshitz MS. General concepts and administrative issues. In: Abraham NZ, Bluth MH, Bock JL, Hutchinson RE, Massey HD, Miller JL, et al., editors. Henry's Clinical Diagnosis and Management by Laboratory Methods. 22nd ed. Philadelphia, PA: Elsevier/Saunders; 2011. p.3-12.e1.

2. Killeen AA. The clinical laboratory in modern health care. In: Longo DL, Fauci AS, Kasper DL, Hauser SL, Lobsalco JJ, editors. Harrison's Principles of Internal Medicine. 18th ed., Ch. 53. New York City, NY: McGraw-Hill; 2011.

3. Pantanowitz L, Henricks WH, Beckwith BA. Medical laboratory informatics. Clin Lab Med 2007;27:823-43, vii.

4. Wagner KL. Middleware to 'littleware': Vendors catering to smaller labs. CAP Today 2011;3:14-18.

5. Swain M, Patel V. Health Information Exchange among Clinical Laboratories. ONC Data Brief 2014, No. 14, February, 2014.

6. Krasowski MD, Davis SR, Drees D, Morris C, Kulhavy J, Cron C, et al. Autoverification in a core clinical chemistry laboratory at an academic medical center. J Pathol Inform 2014;5:13.

7. Siegler EL, Adelman R. Copy and paste: A remediable hazard of electronic health records. Am J Med 2009;122:495-6.

8. Bowman S. Impact of electronic health record systems on information integrity: Quality and safety implications. Perspect Health Inf Manag 2013;10:1c.

9. autohotkey.com. AutoHotkey - A scripting language for desktop automation Free and Open Source software, licensed under the GNU GPLv2. Available from: http://www.autohotkey.com/. [Last updated on 2014 Aug 16; Last cited on 2014 Jun 13].

10. opensource.org. Open source initiative. Available from: http://www.opensource.org/licenses. [Last updated on 2014 Jun 09; Last cited on 2014 Jun 09].

11. Wikipedia contributors. List of open-source healthcare software. Wikipedia, the Free Encyclopedia. Available from: http://www.en.wikipedia.org/wiki/index.php?title=List_of_open-source_healthcare_software and oldid=611874172. [Last updated on 2014 Jun 06; Last cited 2014 Jun 13].