POCT 数据挖掘/分析概述

——POCT 数据整合的重要性

【前言】数据挖掘是一种对数据进行整合、分类和处理，以提取有用信息的技术。数据整合是数据挖掘的前提步骤*(Data mining is a technique for combining, sorting and manipulating data to extract useful information. Integration of data is a prerequisite step to data mining)*。它通过将所有实验室结果收集到某个公用数据库或建立各种数据库与其他数据源之间的通信来实现*(This can be accomplished by collecting all laboratory results in a common database or establishing communication between the various databases and other sources of data)*。对于核心实验室，仪器接口可将数据传输到实验室系统(LIS)和医院信息系统(HIS)。然而，对于 POCT 而言，由于存在着多种设备、不同的供应商和多个不同的检测地点，其数据整合难度较大*(For core laboratories, instrument interfaces communicate data to laboratory and hospital information systems, but for POCT there are multiple devices, vendors and numerous testing locations)*。使用数据管理或者中间件计算机系统让多种设备或单一接口通道的数据获取及 LIS 或 HIS 信息汇入成为可能，方便了实验室和 POCT 数据的整合与中心化*(Use of a data management system or middleware computer that can collect data from multiple devices and channel the data through a single interface to the laboratory or hospital information system facilitates the combining and centralization of laboratory and POCT data)*。NCCLS POCT-1A 标准的开发简化了多种设备与数据系统连接和收集数据的能力*(The development of the NCCLS POCT-1A standard has simplified our ability to connect and collect data from multiple types of devices and vendors)*。整合让 POCT 数据的操作、索引与集成成为可能，并有利于将数据与其他数据库（如核心实验室结果、患者电子病历、药房信息、放射检测结果和门诊病历）的整合*(Integration makes possible the manipulation, sorting and mathematical combination of POCT data, as well as combining this data with other databases such as core laboratory results, the patient's electronic medical record, pharmacy, radiology and outpatient records)*.

“数据挖掘”是从众多、大量的数据中提取有用信息，相关技术现已广泛应用于数据收集、数据管理、数据整合和可访问性等问题挑战*(The technique of extracting useful information from vast amounts of data is termed “data mining”. Technological solutions are now available to meet the challenges of data collection, data management, data integration and accessibility.)*。在将来，在实时通信支持下，数据挖掘及其更快的分析结果将有效提高床旁患者的护理*(While data mining can convert data into information, in the future real-time communication could allow faster data analysis to improve patient care at the bedside.)*

与其他实验室数据形式类似，POCT 结果包含了改善患者护理的潜在信息（*如时间戳和患者数据*）*(Point-of-care testing (POCT) results, like other forms of laboratory data, hold potential hidden information that can be utilized to improve patient care)*。同时，也与其他实验室检测数据一样，POCT 具有信息揭示和改善

患者护理的潜在能力。不过，目前 POCT 结果往往保存在一个个单独的数据库中，很难轻易获取到*(Point-of-care testing (POCT) results, like other forms of laboratory data, hold potential for revealing hidden information that can be utilized to improve patient care. Unfortunately, POCT results are not readily available in a single database.)*。而且，POCT 常常在多个地方，以手动的方式实施，其直观、解释性的试纸结果也不易与专有设备进行连接。因此，POCT 数据往往分散在多个不同地点、难以相互通信的不同数据库中*(POCT is performed in multiple locations, often by manual, visually interpreted dipsticks and proprietary devices that do not readily interconnect, so POCT data is scattered in different places and in different databases that often do not communicate with each other.)*

例如，某机构可能直观地读取尿液试纸、验孕及 HgbA1c、pH 和潜血等检测结果，然后以手动方式将结果记录转录到 LIS 系统中（***注：可能再转到患者的电子病历 EPR 中***）。而血糖仪和血气仪之类的结果，则可直接报告给 HIS 系统*(An institution, for instance, might visually read urine dipsticks, pregnancy tests, HgbA1c, pH and occult blood tests, the results of which are manually transcribed into a hospital information system, while devices like glucose meters and blood gas instruments report directly into a laboratory information system.)*。门诊 POCT 结果往往也存放在医师办公室，与 LIS 或 HIS 系统也是分开的*(Outpatient POCT may be kept in the physician's office, separate from either the hospital or laboratory information systems.)*

因此，要进行所有这些数据的分析、分类和挖掘，必须将这些检测结果统一汇入某个公共数据库中，或者，让不同的计算机系统相互通信，实现数据整合*(To analyze, sort and mine laboratory data, all of the test results must be brought together in a common database, or the various computer systems must communicate with each other to allow the combining of data from different systems.)*

然而，旧有、数量众多的 POCT 设备来自不同设备商，其设备型号不同，加之检测地点的差异，数据整合具有挑战性*(For POCT, combining data is*

challenging because of the sheer number of different manufacturers, models of devices and distance between testing locations.)。传统上，POCT 设备与计算机系统需借助专有的电缆、连接器及通信协议（*注:或来自设备商的提供的连接器，如 Siemens、Radiometer、Roche 或 Conworx 等公司*）才能实现数据从设备到远端信息系统的传输*(Historically, POCT devices and computer systems have required proprietary cabling, connectors and communication protocols to transfer data from devices to more permanent information systems.)*. 这意味着将某台设备中的数据与其他不同厂商（即便是同一厂商不同型号）的数据进行整合，使用同一种通讯协议和计算机系统是不可能的*(This meant that data from one device could not be combined with data from a different manufacturer, and even different models of devices from the same manufacturer might not utilize the same cabling and computer systems.)*。这迫使检测机构不得不购买不同的计算机系统，并在可能情况下为不同的 POCT 设备重新布线*(This required institutions to buy different computer systems and possibly rewire their facilities when implementing different POCT devices.)*。

不过，这些情况也逐步有所改观。一些新的 POCT 设备已经开始具有计算机化的数据管理功能，可将日期、时间、患者标识、操作员标识、设备序列号、试剂和对照批号、有效期、对照结果及标本注释等相关数据与检测结果存储在设备上*(Newer POCT devices have computerized data management features that store pertinent data on the device in conjunction with the test result; like date, time, patient identification, operator identification, device serial number, reagent and control lots, expiration dates, control results and specimen comments.)*。而且，相关设备商也开发了相应的计算机系统和软件，可将 POCT 设备中的数据自动下载到某个数据库，并将电子数据上传至 LIS 或 HIS 系统，从而实现计费和永久记录*(Manufacturers have developed computer systems and software that allow the automatic downloading of POCT device data into a database and transferring of the data electronically to LIS or HIS for billing and permanent documentation.)*

通信标准化与“中间件”*(COMMUNICATION STANDARDIZATION AND "MIDDLEWARE")*

设备通信和中间件的标准化简化了一个地方的 POCT 数据收集*(Several recent developments in the standardization of device communication and middleware have eased the task of collecting POCT data in one place.)*。2000 年初，一个 POCT 设备商协会开发了 POCT 设备通用通信协议（POCT-1A），该协议已转到临床与实验室标准协会（以前的 NCCLS）进行推广和标准维护*(Early in 2000, a consortium of POCT vendors developed a universal communication protocol for POCT devices (POCT-1A) that was transferred to the Clinical and Laboratory Standards Institute (formerly NCCLS) for promotion and standards maintenance)*。POCT-1A 标准第一次定义了 POCT 数据从设备到计算机系统的数据通用协议，让不同制造商设备中的数据汇集至同一数据库变为可能*(The POCT-1A standard defined for the first time a common protocol for communicating POCT data from devices to computer systems, so that data from different manufacturers could be collected in the same database.)*

中间件是一种计算机技术（包括硬件和软件），它既可帮助来源不同的数据集成，也可提供包括数据挖掘算法在内的数据操作*(Middleware is the computer technology (hardware and software) that can help integrate data from different sources as well as provide manipulations of data, including data-mining algorithms.)*。中间件是 POCT 计算机的“数据管理器”，允许消费者自定义查看，具有数据处理方式的灵活性*(Middleware is a type of “data manager”, as POCT computers are termed, but middleware has the flexibility to allow the consumer to customize the way they view and handle the data.)*。较早的数据管理系统要求将数据导出到分离式程序中供客户进行数据管理，或者要求设备商创建数据报告，并开发相应的算法程序以便进行数据集成、统计计算，甚至数据与统计图显示*(Older*

data management systems required export of data to separate programs for customers to manage data, or required the manufacturer to create a data report and to develop the equations to combine data, calculate statistics, and even display plots of data and statistics.)。使用中间件，消费者可根据自己的需求变化进行相应的数据操作*(With middleware, consumers can create their own data manipulations as needs change.)*。

随着发展，“中间件”一词最近有了更广泛的定义，它不仅包括对 POCT 数据处理的数据管理计算机，还包括与其他计算机、仪器及数据库进行通信以集成和整合多种不同来源数据的系统*(The term “middleware” has recently taken a wider definition to encompass not just data management computers that handle POCT data, but systems that can communicate with other computers, instruments and databases to integrate and combine data from many different sources.)*。

在 POCT-1A 之前，每个设备商都有自己专有“数据管理器”，POCT-1A 标准促进了通用系统的开发。在该系统中，不同设备的数据可连接并传输到一个公共数据库*(Before POCT-1A, each vendor had their own proprietary “data managers”, but the POCT-1A standard promotes the development of universal systems where different devices can connect and communicate their data to a single database.)*。中间件使用者无需等待就可编写和实现数据管理算法，也无需支付额外费用，即可让计算机供应商在后续升级中快速开发相应的算法程序*(Data management algorithms can be written and implemented by consumers of the middleware system without waiting for the computer vendor to develop the equations in a future upgrade at additional cost.)*。因此，中间件比传统 HIS 或 LIS 系统更易实现数据操作，更具效益成本*(Data manipulation is thus easier to implement and more cost effective through a middleware computer than through the traditional laboratory or hospital information systems.)*

AACC 甚至创建了数学算法中间件库，以协助那些正经历数据挖掘算法、反射测试和自动验证的机构*(The AACC has even created a middleware library of mathematical algorithms to assist institutions that are experimenting with*

data-mining equations, reflex testing and auto-verification)。对于 POCT 而言，中间件是下一代制造基础的数据管理器，它提供了更灵活的数据管理，更广泛、更轻松的设备连接能力*(For POCT, middleware computers are the next generation of manufacturer-based data managers that offer greater flexibility of data management and the ability to more readily connect a wider menu of devices.)*

整合让数据访问与操作简化*(INTEGRATION PROVIDES SIMPLIFICATION)*

数据整合到公共数据库或中间件具有多种优势，这些优势是迈向数据挖掘的基本步骤。公共数据库的使用简化了人们（员工）与数据之间的交互过程*(Integration of data into a single database or middleware computer has several advantages that are fundamental steps towards data mining. The use of a single database simplifies the interaction of staff with the data.)*

通过通用特性界面的数据访问与操作，人们（员工）只需学习一个公用系统，而无需去学习每个设备的不同编程特性，就可以标准的方式访问所有数据*(There is one interface with common features for staff to access and manipulate data. Staff do not need to learn different programming features for each vendor's device, but can learn one, shared system to access all data in a standard fashion.)*。与相互隔离的数据库通讯相比较，使用单公共据库可让数据操作更加高效和快捷。而且，公共数据库的使用也有利于数据管理流程和最终报告生成的标准化*(Use of a single database allows data manipulations more efficiently and faster than communicating sets of data between separate databases. Use of a single system also standardizes the data management processes and final reports that can be generated.)*

网络门户 *WEB PORTAL*

互联网已进一步提高了我们从远程收集 POCT 数据的能力。互联网连接正变

得越来越普遍，它让 POCT 数据从远程到公共、中心数据库的传输变得简单、容易，不再需要额外花费、布线或者进行专有设备与计算机的连接*(The Internet has further improved our ability to collect POCT data from remote locations. Internet connections are becoming universal and its use makes it easy to transfer POCT data from remote sites to a single, central database without the expense and labor of additional wiring or proprietary device and computer connections.)*。此外，大多进行互联网连接的计算机都具有可用的、标准化 Web 浏览器。因此，借助这些 Web 浏览器的安全保证，Web 数据门户让数据的访问和查看变得更加轻松，去除了额外的软件、计算机与相关培训费用，及软件不兼容所带来的相关问题 *(Additionally, most computers with Internet connections have standard web-browser software already available. The use of web portals, to access and view data over secure web browsers, allows easier access to data without the expense of additional software, computers, training and problems with software incompatibility.)*.

例如，在我们的健康管理系统中，任何医生均可从任何一台计算机，通过浏览器访问一（登录）网页，使用密码登录到（数据库）安全站点，从而访问（相关）患者的电子病历和药物订购信息，以及查看放射检验或实验室检查结果*(In our health system, physicians can access their patient's electronic medical record, order medications and view radiology or lab results from any computer by accessing a web page on their browser and signing into the secure site with a password.)*。类似地，我们将整个西马萨诸塞州的 POCT 数据通过互联网传输至我们实验室中的一台公共服务器中，以 Web 浏览器的方式供具有访问权限的任何人操作、索引和查看 *(We similarly transfer POCT data from devices throughout Western Massachusetts over the Internet to a single server in our laboratory for manipulation, sorting and viewing data by anyone who has access to our site over their web browser.)*

更好的预防错误*(ERROR PREVENTION BETTER THAN CURE)*

将来，POCT 数据的管理应用肯定会更加复杂与多样化。POCT 现有的局限性其中包括结果即时性与设备数据获取的延迟性*(In the future, the application of POCT data management will certainly be more varied and sophisticated. One of the current limitations of POCT is the immediacy of the result and the delay in acquiring the data from devices.)*。

当前，POCT 设备（还）需操作员手动将数据下载至计算机，数据收集不连续，存在间断性。POCT 检测结果产生于患者床旁，相关的医学诊疗通常在结果传输之前就已开展。一旦实现了 POCT 设备实时无线通信，数据管理新水平即可打开大门*(Currently, POCT devices require an operator to manually download the data to a computer, so data collection is intermittent and not continuous. POCT results are generated at the patient's bedside and medical treatment often instituted before the test results are communicated. Once real-time wireless communication becomes available, the door will open to a new level of data management possibilities.)*。实时通信允许在数据下载、处理前进行实时的错误（反馈）检查。当操作员输入患者标识时，即可据患者的有效记录进行相应的查验*(Real-time communication of POCT devices allows the detection of errors as they occur, rather than retrospectively after data have been downloaded and processed. As operators enter a patient identification, that number is checked and verified against an active patient record.)*。如今，某些型号的血气分析仪具备此手段*(Some models of blood gas analyzers already use this method today.)*。这些设备甚至可基于实时错误检测（反馈）来判断和进一步控制后续的（设备）检测功能访问（权限）。与检测后的错误更正（操作）相反，这可（有效）防止错误的发生*(Real-time error detection could even be used by the device to control access to testing features. This would prevent errors from occurring as opposed to correcting the errors after the test is completed.)*

POCT 实时患者信息整合能力可在患者护理之前进行相关问题的预警。例

如，尽管现有的血糖仪可获得患者限值范围内的血细胞比容检测，但很少有临床医生在检测前查验患者的（已检测）实际血细胞比容*(The ability to combine patient information in real-time allows the prediction and warning of problems before patient care is affected. Current glucose meters are limited to a range of patient hematocrit; however, few clinicians verify the patient's actual hematocrit before commencing testing.)*。在血糖仪中，若操作员输入患者身份后即可验证患者的（实际所检测的）血细胞比容（超出相应的比容范围，设备返回警告），那么避免基于错误结果的（进一步）检测和治疗是可能的*(If glucose meters were capable of verifying the patient's hematocrit after the operator has entered the patient's identification, a warning could be returned on the device if the patient's hematocrit is out of range, before the test is conducted and treatment is based on an incorrect result.)*。

POCT 设备与药房数据库信息交换也可按这种方法进行药物（作用）相抵预警。而且，药物和剂量的（相关）信息（也）有助于进一步的检测结果解释*(Communication of POCT devices with a pharmacy database could also return a warning of potential drug interferences with the method. Drug and dosage information would further be important to the interpretation of the test result.)*。例如，患者当前所服用香豆素或肝素的信息能对 POCT 凝血酶原或部分凝血活酶结果进行标记，并给出患者（服用药物）剂量的合适参考范围*(For instance, the information that a patient is currently taking coumadin or heparin could flag the POCT prothrombin or activated partial thromboplastin result, and attach the reference range appropriate for the patient's dose.)*。这些信息与实验室检测（结果中）的药物相关趋势信息进行结合，可进一步计算和预测出患者（对药物的）治疗反应及（合适）药物剂量*(Drug information linked to laboratory trends could further be utilized to calculate an individual patient's response to therapy and predict future dosage.)*

可以想象一下，餐前血糖检查时，我们是不是可以获知患者的（历史）胰岛素使用剂量和相应的葡萄糖响应情况？血糖仪不仅可检测患者当前的葡萄糖水

平，还可根据患者原有的胰岛素响应信息和当前的胰岛素检测结果，估算所需的胰岛素剂量*(Imagine if a patient's past insulin dose and glucose response were available at the time a pre-meal glucose were being performed, and the glucose meter were not only able to give the patient's current glucose level but also estimate the patient's required insulin dose based on their past response.)*

计算自动化(CALCULATION AUTOMATION)

利用整合数据可计算患者护理相关的参数。例如，将患者的年龄、性别、体重或种族等信息与血清肌酐水平结合起来，通过计算肾小球滤过率，可评估肾功能*(Combinations of data could be utilized to provide calculated parameters for patient care. Examples include the calculated glomerular filtration rate as an estimate of renal function provided the patient's age, sex and weight or race are available to combine with the patient's serum creatinine level.)*。将患者血液中有可用气体与血红蛋白、吸入氧气比例、体表面积及其他生理参数等结合起来，可获知重症监护患者的血流动力学和氧合参数*(Hemodynamic and oxygenation parameters could be calculated for use by the critical care intensivist provided that the patient's blood gases are available and can be combined with the hemoglobin, fraction of inspired oxygen, body surface area and other physiologic parameters.)*

尽管目前医师可手动估算这些参数，但如能将这些数据与 POCT 结果一起实时、整合显示，那么患者（的诊疗）护理将更加流畅，出现错误的机会也会减少*(Physicians currently calculate these estimates manually, but if the data can be combined in real-time and displayed with the POCT result, patient care would be streamlined and there would be less chance of a calculation error.)*