

COMMENTARY

MacPLUS Federated Search: A New Era Tool for Evidence-Informed Clinical Decision Making

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INTRODUCTION

With two million biomedical research articles published annually, a clinician reading two articles daily would be 55 centuries behind each year.¹ More recently, it has been recognized that the evidence base for clinical effectiveness has become so vast that it is fundamentally unmanageable for individual providers.² Some research indicates that the ineffective employment of this evidence base via electronic information resources may lead physicians to change an initially correct answer to a wrong one.³⁻⁵ A decade ago, the Institute of Medicine's *To Err is Human* identified medical errors as the fifth leading cause of death, with more people dying from medical errors than from motor vehicle accidents, breast cancer or AIDS.⁶

In this commentary, we describe an innovative information retrieval service, MacPLUS Federated Search (MacPLUS FS), that has been built to address the twin dilemmas that practitioners face in their attempt to avoid medical errors: doing the right thing at the right time for patients and keeping up-to-date. The following discussion of the evolution and the evidence-based pedigree of the service, together with a specific search example, will illustrate how this new era tool is positioned to address the two challenges.

MACPLUS FEDERATED SEARCH: A (R)EVOLUTIONARY INFORMATION SERVICE

MacPLUS FS was conceptualized, developed and refined by McMaster University's Health Information Research Unit (HiRU). The two distinct enablers of MacPLUS FS are its organizational hierarchy of evidence, the 6S pyramid, and the Health Knowledge Refinery that supplies some of the highest quality content for the pyramid.

Key Points

- MacPLUS Federated Search (MacPLUS FS) provides one-stop access to best evidence available about the diagnosis, etiology, treatment, prognosis and prevention of clinical problems.
- MacPLUS FS displays evidence according to a hierarchy of clinical relevance to facilitate access to the best available evidence to support clinical decisions.
- The Health Knowledge Refinery, which feeds part of MacPLUS FS, enables users to stay up to date via customized alerts to newly published, quality-filtered, relevancy-rated, research evidence tailored to their clinical discipline, training level and evolving information needs and interests.
- Currently, the tool is available via Medportal and Clinical Connect for medical faculty and students at McMaster University.

The primary organizing principle behind MacPLUS FS is the 6S pyramid of evidence that places the most integrated and appraised evidence for clinical decisions at the top, while original studies are at the foundation (Figure 1).⁷⁻⁹ The pyramid encapsulates the evolution of information resources for evidence-based care over the past 15 years (the "old school" search would start from the bottom, whereas the "new school" search would consider the summaries level first). Each higher level of the pyramid above the base represents additional work that has gone into appraising and formulating the evidence at that level, including:

- identifying the most relevant *studies* for clinical care
- creating *syntheses* of all relevant studies on the same clinical question
- preparing *synopses* of the best studies and reviews
- integrating this accumulated evidence into *summaries* of how to manage clinical problems.⁷

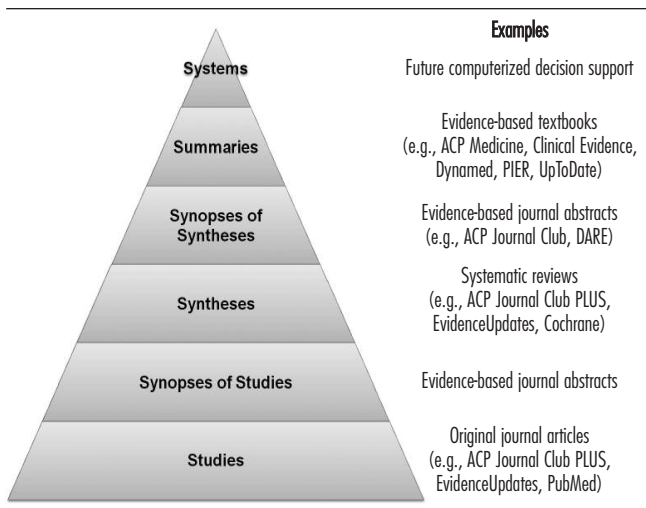


Figure 1. The 6S Pyramid, based on Reference 7, reproduced with permission of the American College of Physicians.

Currently, the summary-level resources are being customized to various specialties; the process entails soliciting expert physician raters' nominations of evidence-based, reliably updated resources. Before inclusion into MacPLUS FS, these resources are evaluated for 11 evidence-based features such as "in-line references" for treatment and diagnostic recommendations, policies indicating rating of evidence and grading of recommendations, date stamping and schedules for updating chapters, new evidence updates, user alerts, and federated search of content. None of the integrated summary publications individually is perfect or has a full coverage of medical problems, but searched together through a federated search, they can be quickly assessed for these crucial constituents of reliable information:

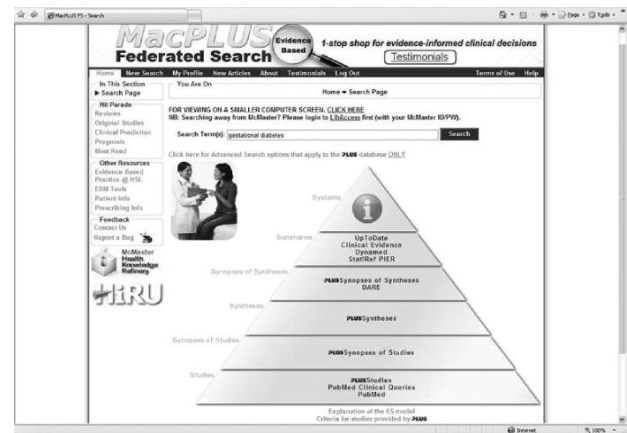
- **Pertinence:** Which resource provides the most relevant information to address a specific question?
- **Consistency:** Does the answer found agree with information from other sources?
- **Recency:** Which resource provides the most recently updated answer?

MacPLUS FS makes it possible to avoid dependence on single sources of information such as the widely used UpToDate or Google, and thus facilitates more accurate clinical decision-making.

CLINICAL SCENARIO

A 36-year-old Caucasian woman with gestational diabetes and elevated blood sugars despite exercise and dietary measures asks, "Is there an alternative to insulin?"

MacPLUS FS Results at Glance



While it is best to consider all of the hits displayed on the pyramid (beginning at the top), in the interest of space, let us consider the search results from the select summaries and synopses level publications for this scenario. The following information is time sensitive and was accurate when the search was conducted in January 2010.

UpToDate (Summaries level)

- **Medical Therapy:** If normoglycemia cannot be maintained by medical nutritional therapy, then anti-hyperglycemic agents should be initiated. There are two options in pregnant patients who require medical therapy aimed at controlling blood glucose: insulin (and some insulin analogs), which is the only recommended approach in the United States; and oral anti-hyperglycemic agents, which are used in some other countries.
- Currently, the ADA and the American College of Obstetricians and Gynecologists do not endorse the use of oral anti-hyperglycemic agents during pregnancy and such therapy has not been approved by the United States Food and Drug Administration for treatment of GDM [references are from 2001 and 2004].

DYNAMED (Summaries level)

- Dietary advice plus insulin may reduce risk of maternal and perinatal morbidity, but may increase labor induction in women with mild gestational diabetes (level 2 evidence).
- Glyburide, metformin or insulin are associated with similar maternal and neonatal outcomes (level 2 evidence).

Stat/Ref (ACP) PIER (Summaries level)

- In a randomized study of 404 women with gestational diabetes, there was no difference in glucose levels, fetal macrosomia or congenital anomalies in women taking glyburide compared with those using insulin (Langer O et al. N Engl J Med. 2000; 343: 1134-48).

ACP Journal Club (Synopses level)

- Evidence from randomized trials does not show consistent differences in maternal or neonatal outcomes between oral diabetes agents and insulin for treatment of gestational diabetes. Nicholson W et al. Obstet Gynecol. 2009;113:193-205.

So what?

Clearly, no one resource consistently delivers the best current evidence from a comprehensive clinical perspective. While UpToDate authoritatively issues no endorsement for oral anti-hyperglycemic agents (OHAs), it does present evidence comparing insulin and OHAs. Perspectives from multiple other sources are a click away using the MacPLUS Federated Search and reveal additional evidence that can be useful when the practitioner responds to this patient's needs and preferences for oral diabetes agents. This example illustrates the advantages of the federated search.

PLUS LEVELS OF THE PYRAMID: THE HEALTH KNOWLEDGE REFINERY

Recognizing the need to winnow the torrent of medical information into a manageable stream of high-quality evidence in a timely fashion, HiRU created its Health Knowledge Refinery (HKR) in 1991. Since then, the HKR has evolved and has been distilling newly published research evidence, developing better ways to identify and disseminate high-quality, clinically-relevant research to health care practitioners. Its existing products include EvidenceUpdates (<http://plus.mcmaster.ca/EvidenceUpdates/>), ACP Journal Club PLUS (<https://plus.mcmaster.ca/acpjc>), Evidence-Based Medicine, Clinical Evidence updates, ACP PIER Updates and several others.

In the HKR's two-step critical appraisal process, about 60,000 articles per year from more than 120 journals are pre-appraised for their scientific merit, clinical relevance and newsworthiness. First, articles are filtered for their methodological soundness by the trained HiRU team (inter-rater reliability [κ] of >90% beyond chance).¹⁰ This process predicts citation counts at $p < 0.001$.¹¹ Second, articles selected in the first step are rated by more than 4,000 expert physicians who participate in the McMaster Online Rating of Evidence (MORE) system on a seven-point rating scale for their relevance and newsworthiness (usefulness) to clinical practice (more details at <http://hiru.mcmaster.ca/more/RatingFormSample.htm> and http://hiru.mcmaster.ca/hiru/HIRU_McMaster_PLUS_projects.aspx).

The MORE system has recently been recognized as a beneficial way of "intelligent harvesting" of high-quality evidence and separating the wheat from the chaff,¹² thus aiding clinicians in their evidence-informed decision making. HiRU's Refinery provides information for many evidence-based resources around the world, and MacPLUS FS provides faculty and students at McMaster with an opportunity to get the information directly from the source.

MacPLUS FS: CURRENT BEST EVIDENCE AND CLINICAL DECISIONS

MacPLUS FS is built to address this question: what is the current best information to support evidence-based care for this patient? No matter how comprehensive and rewarding a search may be, however, it is important to emphasize a truism of evidence-based medicine: "Evidence doesn't make decisions, people (patients and practitioners) do."¹³ Evidence from research has strengths and weaknesses, and even the strongest signal from research needs to be interpreted in light of the patient's own circumstances and their wishes.^{3-5,14}

MacPLUS FS: STAYING CURRENT = MAINTAINING CLINICAL COMPETENCIES

In addition to assisting practicing clinicians and learners with an easy way to find best evidence at the right time,

MacPLUS FS alerts its users to important new evidence that is pertinent to their own patient care. The service identifies the most important articles for 61 clinical disciplines, of which the most highly rated 20 to 30 articles per year per discipline (on average) are strong enough to warrant a change in clinical practice. By signing up for email alerts customized to one's training level, specialty, interests and preferences about the frequencies for receiving email alerts, users have the opportunity to stay current with a modest investment of time. In fact, research shows that physicians' competencies tend to decline with age.¹⁵ Efficient and effective employment of current best information technologies may help to overcome this. For practical ideas on how to effectively manage the virtual avalanche of information and proactively "harvest" medical literature, the readers are referred the work of Citrome and colleagues.¹²

MacPLUS FS: WHERE CAN I GET IT?

Currently, MacPLUS FS can be accessed via three routes:

1. Medportal (at <https://medportal.ca>): MacPLUS FS can be found in the McMaster University undergraduate and postgraduate homepages, under Educational Resources.
2. Clinical Connect (the electronic medical record of Hamilton Health Sciences, currently expanding to include the entire Local Health Integration Network): MacPLUS on the Clinical Connect top task bar.
3. Direct: For those who have already registered via Medportal and/or Clinical Connect at <http://plus.mcmaster.ca/macplusfs/>

In registering with MacPLUS FS, users can help to determine its value for finding best evidence efficiently for clinical care. The evaluation, which may comprise online monitoring of frequency and patterns of use and satisfaction questionnaires, has been approved by the McMaster University Research Ethics Board. The evaluation is observational, anonymous and voluntary. The information from this evaluation will be used to determine whether to proceed with a randomized trial or to simply deploy the resource to other schools.

MacPLUS FS provides new opportunities for those who want to harness strong evidence from the vast clinical research and stay up to date.†

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Author Biographies

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