Antimicrobial Stewardship: Philosophy Versus Practice

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To promote the judicious use of antimicrobials and preserve their usefulness in the setting of growing resistance, a number of policy-making bodies and professional societies have advocated the development of antimicrobial stewardship programs. Although these programs have been implemented at many institutions in the United States, their impact has been difficult to measure. Current recommendations advocate the use of both outcome and process measures as metrics for antimicrobial stewardship. Although patient outcome metrics have the greatest impact on the quality of care, the literature shows that antimicrobial use and costs are the indicators measured most frequently by institutions to justify the effectiveness of antimicrobial stewardship programs. The measurement of more meaningful outcomes has been constrained by difficulties inherent to these measures, lack of funding and resources, and inadequate study designs. Antimicrobial stewardship can be made more credible by refocusing the antimicrobial review process to target specific disease states, reassessing the usefulness of current metrics, and integrating antimicrobial stewardship program initiatives into institutional quality and safety efforts.

Keywords. antimicrobial stewardship; health outcomes; patient safety; quality metrics; process measures.

In 2007, the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA) developed a comprehensive set of recommendations to optimize the use of antimicrobials that included establishment and support of antimicrobial stewardship programs (ASPs) in acute care institutions [1]. This recommendation was subsequently extended beyond acute care hospitals to all healthcare settings [2]. “Antimicrobial stewardship” refers to programs and interventions designed to improve antimicrobial prescribing—the right drug, dose, duration, and route of administration—to optimize clinical outcomes while minimizing unintended consequences of antimicrobial use such as toxicity, selection of pathogenic organisms, and emergence of resistance [1, 3].

The ultimate goal of ASPs is to improve patient care and healthcare outcomes [1]. Although many healthcare institutions in the United States have implemented ASPs, the impact of these programs has been difficult to gauge. Currently, there is no consensus on optimal metrics to demonstrate the effectiveness of an ASP; thus, assessment of the true effect of these programs has been challenging [4–6]. Metrics for ASPs can be divided into 4 main categories: patient outcomes, unintended consequences, antimicrobial utilization and costs, and process measures [6-8]. Outcome metrics are of greatest interest because they reflect all aspects of care, and optimization of outcomes is the ultimate objective of the intervention. Because of the challenges surrounding the measurement of outcomes, process measures have often been used to demonstrate the impact of ASPs [5]. Neither of these metrics alone is sufficient to describe the overall impact of stewardship efforts, and, to be most effective, assessments should include both patient-specific outcomes and related process measures to adequately assess the impact of any intervention. For example, studies that report only a
reduction in antimicrobial use infer that the ASP has improved outcomes. Inferential data may not suffice to gain continued support for ASP efforts. Conversely, assessing patient outcome data without some quantification of associated stewardship strategies is not useful.

In 2011, the IDSA Emerging Infections Network surveyed its membership to determine characteristics of ASPs and reported that clinicians and administrators differ in their assessments of outcomes of importance needed to support these programs [9]. An overwhelming majority (83%) of administrators underscored the importance of evidence of cost savings, whereas 63%–72% of physicians were more focused on patient outcomes, citing reductions in *Clostridium difficile* infection (CDI), adverse events, and resistance rates as the most important indicators to justify an ASP. In another survey, infectious disease (ID) physicians and pharmacists ranked appropriateness of antimicrobial use, infection-related mortality, and antimicrobial-associated length of stay (LOS) as the metrics of highest importance to demonstrate the impact of an ASP (see Bumpass et al, this supplement).

This article examines metrics used to assess the impact of ASPs, with a focus on those metrics recommended for ASPs vs those most commonly used in current practice; reviews barriers to measuring meaningful outcomes; and provides recommendations for implementing feasible practices for measuring the impact of these programs.

**PHILOSOPHY: CURRENT RECOMMENDATIONS FOR METRICS OF ANTIMICROBIAL STEWARDSHIP PROGRAMS**

A policy statement from SHEA, IDSA, and the Pediatric Infectious Diseases Society suggests the use of both process and outcome measures to monitor ASP interventions [2]. The statement recommends enactment of national legislation requiring participants in the Centers for Medicare and Medicaid Services (CMS) programs to implement ASPs, with processes to measure and monitor antimicrobial use at the institutional level for internal benchmarking. A research priority articulated in the statement is to develop and validate clear process and outcome measures to assess the impact of ASPs. These include resistance rates, rates of CDI, time to administration of appropriate therapy, adverse drug reactions or interactions related to antimicrobial therapy, drugs administered to patients with documented allergies, multidrug regimens with redundant antimicrobial spectra, regimens that are either inadequate or excessive, and durations of intensive care and overall hospitalization for patients treated with antimicrobials.

To promote high-quality, patient-centered care, CMS is piloting 3 new surveyor worksheets for assessing compliance with 3 hospital Conditions for Participation, 1 of which is infection control [10]. A section on promotion of antimicrobial stewardship is included within the infection control worksheet. Among the elements to be assessed in this section are several strategies recommended by the IDSA/SHEA ASP guidelines: multidisciplinary processes to review antimicrobial utilization, local susceptibility patterns, and the antimicrobial formulary; systems to prompt clinicians to use appropriate antimicrobials; mechanisms prompting antimicrobial review after 72 hours of therapy; and mechanisms to identify patients eligible to switch from intravenous to oral antimicrobials. Compliance is assessed using both outcome and process measures. Similarly, the Centers for Disease Control and Prevention has also provided an initial antimicrobial measurement framework that recommends monitoring both outcomes (hospital-onset CDI, antimicrobial-related adverse drug reactions, and antimicrobial-resistant healthcare-associated pathogens) and processes (antimicrobial use and pharmacy costs) [11].

Noting the wide range of ASP-related outcomes described in the literature, in an effort to create a standardized approach for evaluating the impact of ASPs, an expert panel with members from Canada and the United States used a structured panel process to develop useful indicators of performance, with a focus on domains of antimicrobial consumption (ie, utilization), antimicrobial resistance, and patient outcomes [4]. The panel identified 5 metrics that could be used at healthcare facilities as internal quality indicators. These consisted of both process and outcome measures, including days of therapy per 1000 patient-days; number of patients with specific drug-resistant organisms; mortality related to the resistant organisms; conservative days of therapy among patients with community-associated pneumonia, skin or soft tissue infections, or other infections; and unplanned hospital readmission within 30 days. The first and second measures were also identified as useful for public reporting. Other than conservative days of therapy, which remains subjective, the other metrics have broad applicability and can be applied to all institutions with an ASP.

**PRACTICE: ASP METRICS AS REFLECTED IN THE LITERATURE**

**Patient Outcomes**

Data that document a positive impact of ASP interventions on clinical outcomes are limited (Table 1). In a Cochrane review of 89 studies on interventions to improve inpatient antimicrobial prescribing, only 11 (12%) evaluated mortality, 6 (7%) evaluated LOS, and 5 (6%) evaluated risk of readmission [12]. The meta-analysis of clinical outcomes showed that 4 interventions designed to increase effective prescribing for pneumonia resulted in a significant reduction in the mortality risk (risk ratio [RR], 0.89; 95% confidence interval [CI], .82–.97), whereas 11 interventions intended to decrease excessive prescribing did
not change mortality significantly (RR, 0.92; 95% CI, .81–1.06). Although the meta-analysis reported an overall increased risk of readmission of 1.26 (95% CI, 1.02–1.57), the enhanced risk stemmed from a single study that showed a significant increase in total readmissions (RR, 3.00; 95% CI, 1.18–7.64) but no significant increase in infection-related readmissions (RR, 1.33; 95% CI, 31–5.66) [13]. Other studies have shown a positive impact of antimicrobial management on mortality [14, 15], hospital LOS [14, 16–18], and readmission rates [19]; however, data also exist that show similar interventions fail to demonstrate similar outcomes [20–23].

**Unintended Consequences**

Limiting unintended effects of inappropriate antimicrobial use such as adverse effects, CDI, and emergence of resistance is an important goal of antimicrobial stewardship [6]. A review of stewardship efforts in the critical care setting showed that ASP interventions reduced antimicrobial use, led to fewer antimicrobial adverse events, and did not change nosocomial infection rates, LOS, or mortality [24].

In the previously mentioned Cochrane review, 21 of 89 studies (24%) evaluated microbial outcomes [12]. Interventions to change antimicrobial prescribing were associated with a decrease in CDI (5 studies), resistant gram-negative bacteria (9 studies), methicillin-resistant *Staphylococcus aureus* (MRSA) (7 studies), and vancomycin-resistant enterococci (3 studies) [12]. Several of the studies, however, did not have reliable data about the impact of the intervention on prescribing practices. One study reported a reduction in rates of CDI, MRSA, and extended-spectrum β-lactamase–producing coliforms after routine use of ceftriaxone and ciprofloxacin was banned [25]; other studies have also shown a reduction in CDI after restricting the use of high-risk antimicrobials [23, 25–30]. Several studies of stewardship activities have shown decreased rates of resistance [15, 18, 22, 31–38], although capturing changes in rates of resistance can be problematic, especially in US hospitals, many of which lack the infrastructure to capture these data [39]. In addition, an unanticipated negative effect, the association of restriction policies with decreased susceptibility to unrestricted antimicrobials—the “squeezing the balloon” phenomenon—has also been reported [24, 40].

**Antimicrobial Utilization and Costs**

Antimicrobial utilization and costs are commonly used to assess ASPs for many reasons, including the ease of capturing this type of data. Although not the primary aim of stewardship,
antimicrobial cost is a measure of great interest to administrators, and therefore, measures of cost and antimicrobial use are often used to justify ASPs [17, 21, 28, 29, 37, 38, 41–56]. A survey of ASPs in 82 acute care hospitals in Florida reported that the most common outcomes measured by 56 facilities with established programs were drug purchasing costs (70%), antimicrobial resistance rates (66%), and rates of CDI (66%), whereas only 43%, 38%, and 34% of facilities evaluated patient outcomes, LOS, and adverse drug reactions, respectively [57]. Although clinicians rate patient-centered outcomes as the most important determinants of stewardship success, the metrics collected most often by institutions are antimicrobial utilization and costs [9] (see Bumpass et al, this supplement).

The literature on ASP effectiveness reflects the focus on successful reduction of antimicrobial use and costs, as evidenced by a comprehensive list of published literature relating to all aspects of antimicrobial stewardship published from 1993 to 2014 (available at www.cubist.com/superbugs/antibiotic-stewardship). Further, a special-topic issue of Infection Control and Hospital Epidemiology on antimicrobial stewardship included 15 articles that evaluated cost, utilization, or clinical outcomes. Of these, 8 articles focused solely on antimicrobial costs and/or utilization [37, 41, 44, 46, 50, 56, 58, 59]. Overall, antimicrobial utilization/costs was the only or the primary outcome in 80% (12/15) of the manuscripts published in this special issue, demonstrating the preponderant emphasis on these particular metrics.

Of 10 articles in a specially themed issue of Pharmacotherapy on antimicrobial stewardship, 2 reported original research, with 1 article describing appropriate antimicrobial therapy as a primary measure [60] and the other reporting both antimicrobial use and patient outcomes [61]. An article reporting on a comprehensive literature search for significant studies that evaluated the effect of ASPs identified 44 studies. The majority of these studies (35/44 [80%]) reported process measures as the primary or only endpoints [5].

**Process Measures**

Understanding how stewardship interventions are driving antimicrobial use is an important component of evaluating any ASP. Process measures quantify the actions of stewardship programs, and this is essential to determine which actions may or may not be associated with a given outcome [62]. Furthermore, quantifying the activities of the ASP documents that invested resources are being used as anticipated and allows benchmarking with other facilities, both important considerations for program longevity. Process measures, other than utilization, that have been reported in the literature to evaluate antimicrobial stewardship include changes in the decision to prescribe an antimicrobial; choice of agent, dosage, route, or dosing interval; duration of treatment; compliance with guidelines; acceptance rate of ASP recommendations; percentage of patients receiving appropriate antimicrobial therapy; time to appropriate therapy; and proportion of prescribers who record the indication for antimicrobial prescribing [6, 8, 12]. These measures assess whether the ASP has accomplished a task, changed prescriber behavior, or changed a process, but do not provide information on how effective the interventions are in improving patient outcomes or safety.

**BARRIERS TO MEASUREMENT OF OUTCOMES ASSOCIATED WITH ANTIMICROBIAL STEWARDSHIP PROGRAMS**

**Inherent Difficulties With Certain Measures**

The impact of appropriate antimicrobial use on improving clinical outcomes seems obvious; however, these outcomes are more difficult to measure, and a causal relationship is challenging to prove [5–7]. For example, outcomes such as clinical response and resistance rates are dependent on multiple aspects of care and not just a single change in process. Furthermore, the current emphasis on use of interventions in bundles complicates the assessment of the contribution of individual strategies [6]. Because most antimicrobial stewardship studies are single-center studies and often unfunded, obtaining an adequately powered sample size to detect clinically meaningful and statistically significant differences in clinical outcomes such as mortality and LOS is difficult. The subjective nature of several measures, such as appropriate use (see DePestel et al, this supplement) or clinical cure, does not lend itself to electronic data capture, making quantification difficult.

Changes in resistance patterns after implementing ASPs take time to develop and detect; there are inherent difficulties in assessing this outcome over time [63]. A decline in antimicrobial use may not be reflected by a similar change in the hospital-wide antibiogram [64–67]. It has been demonstrated that resistance can be decreased if measured in those individuals with decreased exposure to antimicrobials [68–70]; therefore, it is generally preferred to evaluate resistance on a patient, not institutional or unit, level. A drawback of using resistance rates as a metric is that in addition to antimicrobial use, resistance rates are affected by other interventions, such as infection control practices. Interfacility patient transfer can also impact resistance, especially if a patient is being transferred from a facility without robust ASPs or infection control programs; thus, controlling for confounding factors can be difficult [63]. Some experts caution against using resistance rates as a primary stewardship measure or metric [71]. Confounding factors also make the assessment of a number of other outcomes, such as LOS and mortality, challenging.

**Funding and Time Constraints**

Lack of funding for programs, personnel, or information technology (IT) remains a primary barrier to effective ASPs [9, 72]. Although the number of ID physicians who are compensated
for antimicrobial stewardship activities has increased over the past decade, >50% of ID physicians still remain uncompensated for their participation [9]. Antimicrobial stewardship programs potentially compete for financial resources with other mandated quality- and cost-containment measures [73], and institutions generally give priority to projects that are directly tied to incentives or requirements [74]. Many current ASPs depend on the participation of members who derive financial support from other activities [73]. This may promote the collection of readily available utilization and cost data, and limit the ability of clinicians to advocate for collection of additional data such as those pertaining to patient outcomes.

IT tools such as clinical decision support systems can be invaluable to ASP activities for documenting and monitoring interventions, but are expensive to acquire, require integration into the institution’s existing IT infrastructure, and necessitate extensive investment of time to be customized to an ASP’s requirements [73]. Additionally, these tools are often cost justified based on decreases in antimicrobial spending, leaving little to no resources for gleaning benefit in patient outcomes. Without adequate personnel, funding, time, and IT support, data collection and analysis, whether manual or electronic, is not feasible.

**Inadequate Study Design**

In general, the quality of research in the ASP field is poor. In the Kaki et al review of antimicrobial stewardship interventions in critical care, 75% of the 24 studies that met inclusion criteria were uncontrolled before–after studies [24]. For the Cochrane review, the 89 studies that met review criteria represented only 20% of the published literature, with the remainder dominated by uncontrolled or inadequately designed studies [12].

The use of inappropriate or inadequate study designs does not allow for an objective evaluation of causal association between stewardship intervention and outcome, and limits the evidence base. This is due in part to many of these reports stemming from quality assurance and improvement data that use different methodologies from true investigations designed to assess the impact of a singular intervention. Current published research studies are challenged by selection bias, insufficient power, varying duration of interventions, confounding variables, lack of compliance measurement, and nongeneralizability [2]. Designing a randomized controlled trial for antimicrobial stewardship is complicated, especially for strategies such as prospective audit and feedback, because location cannot be concealed.

Selection of outcomes and statistical methods are often suboptimal. Randomized controlled trials have shown the efficacy of stewardship activities in improving prescribing behavior in hospitals [75, 76], in an outpatient setting [77], and in long-term-care facilities [78], but these are measures of process and not true patient outcomes. Many studies of ASP interventions use a nonrandomized quasi-experimental design without controlling for confounding factors and or use inappropriate statistical methods, for example, comparing means rather than performing time series regression analysis (see McGregor and Furuno, this supplement) [79–81].

**APPLICATION TO CLINICAL PRACTICE**

The Holy Grail: Metrics to Embrace

The focus of ASPs should be on quality-of-care improvements and disease-based management rather than solely on antimicrobial utilization and cost savings. To demonstrate their value to hospital administration for continued support and for greater physician buy-in of recommendations, ASPs must measure patient outcomes, unintended consequences, antimicrobial utilization and cost of care, and process measures (Table 2).

Antimicrobial stewardship needs to address overall antimicrobial use and appropriateness of use, and should not just target a limited number of high-cost agents. Antimicrobial reviews should go beyond simple drug acquisition costs to include assessments of appropriate use applying national or international guidelines as a metric when institution-specific criteria are not available. These tasks may seem daunting, but can be accomplished by cycling different agents through the review and evaluation process, or by performing periodic point-prevalence audits or reviews. Additionally, ASPs need to identify new and innovative means to leverage IT systems to improve efficiency and identify opportunities for comprehensive improvements in antimicrobial utilization.

Rather than establishing a broad restrictive policy, antimicrobial stewardship efforts should be directed at facilitating timely use of the right drug, de-escalation, and reduction in treatment duration [82]. The use of disease-based management rather than antimicrobial management can allow for a more evidence-based approach to interventions for appropriate use. Instead of focusing antimicrobial stewardship efforts primarily on the most complicated cases, efforts to promote appropriate prescribing would be more fruitful if also directed at more common conditions such as respiratory tract, urinary tract, and skin or skin structure infections and bacteremia, as these infections are more frequent in acute care facilities and are often managed without involvement from ID consultants. For conditions such as respiratory tract infections, stewardship efforts should be directed at ensuring that antimicrobial treatment adheres to established recommendations; a useful metric would be the number of patients being treated longer than the standard treatment duration for that condition. More well-designed studies need to be conducted to standardize treatment approaches for various infections. When the presence of an infection is unclear and treatment is empiric, the ASP could set criteria for duration of therapy. In such cases, there should be provision for an antimicrobial “time-out” after 48 or 72 hours of empiric treatment to...
evaluate the need for ongoing treatment and the potential for de-escalation, and for establishing a duration of therapy [83]. With regard to costs, measuring only cost savings from reduced antimicrobial use does not reflect the total cost of care. Costs for implementing and maintaining the ASP, costs associated with drug-related adverse effects, and those associated with suboptimal or delayed treatment have to be factored in when evaluating the overall costs or savings associated with cost-effectiveness of ASP interventions [84]. Cost savings need to be correlated with improved quality of care [85]. Justifying the expense of an ASP on the basis of reduced antimicrobial purchases and cost encourages its perception as a cost-cutting rather than quality improvement initiative.

**A TIME FOR CHANGE**

**Metrics to Abandon**

For reasons described in the preceding section, we advocate abandoning drug costs as a metric of process or outcome for an ASP. Antimicrobial acquisition costs do not reflect any of the primary goals of antimicrobial stewardship. Estimating the overall cost of care would provide a better measure of the savings accrued or costs avoided. Efforts should shift to measuring the value of care, with value defined as health outcomes achieved per dollar spent and cost referring to the total costs of care for the patient’s medical condition, not the cost of individual services [86]. It may be beneficial for ASP personnel to partner with the institution’s finance department to help with determination of overall cost of care.

As a primary strategy, routine individual drug audits or reviews should be replaced by evidence-based disease state reviews. A case may be made for targeting certain agents, for example, if there is considerable variability in use from year to year or if use of an agent is associated with a surge in resistance or adverse events. Otherwise, we consider review of use by disease state to be the preferable option.

Another metric that could be abandoned is the number of stewardship interventions performed or antimicrobials tracked.
as these metrics provide no information on actual outcomes. What matters from a quality or safety perspective is the outcome of the protocol or therapy that was implemented as a result of the intervention. A couple of analogies can serve to illustrate this point. A fall-prevention strategy used in hospitals consisted of placing a sticker in the charts of at-risk patients; the metric tracked was not the number of stickers placed in patient charts but rather the number of falls that occurred [87]. Similarly, standard isolation precautions are used in infection control, and the metric that is tracked is not the number of patients placed in isolation, but the actual infection rates. Correspondingly, with ASPs, the goal is to optimize antimicrobial therapy, not the number of times the pharmacist had to intervene. If monitoring interventions is necessary, possibly as a means of tracking time spent on antimicrobial stewardship activities, data gathering should be facilitated by a robust IT infrastructure to limit “busywork” of ASP members. Each program should include appropriate audits of compliance, but not as a metric to demonstrate the impact or success of the program.

**Reporting Structure for ASPs**

Antimicrobial stewardship program activities can be further facilitated if stewardship is viewed not as a stand-alone function, but rather as part of an institution’s quality- and safety-enhancing infrastructure. Unwarranted variations in medical practice and poor adherence to standards of care across many disciplines compromise the quality of care and the ability to control costs [88, 89]. Most antimicrobial prescriptions are written by non-ID physicians in general medicine or emergency departments and for surgical prophylaxis [90]. More than a third of antimicrobial prescriptions are not compliant with evidence-based guidelines [83, 91], highlighting the variability in antimicrobial prescribing. Limiting inappropriate antimicrobial use should therefore be considered a quality initiative, similar to efforts in other fields [92, 93]. By showing improvements in quality and safety, ASPs can make a stronger case for continued funding.

Historically, most ASPs have been funded by the pharmacy department, thus perpetuating the emphasis on directly impacting the pharmacy budget. However, if ASPs are to improve patient outcomes and reduce adverse events, they should more appropriately be funded as part of Patient Safety and Quality departments, similar to that of Infection Control, which historically reported to the nursing department but is now increasingly a part of a hospital’s Quality and Safety department. Because of the value placed on safety initiatives, if an ASP can track quality measures, including safety metrics, it can demonstrate ongoing value, unlike reductions in drug cost, which may plateau over time. Also, a hospital’s Quality and Safety department oversees compliance with regulatory criteria, such as The Joint Commission measures for pneumonia [94] or the Surgical Care Improvement Project measures [95], and pay-for-performance criteria, including CMS Hospital Value-Based Purchasing [96]. As regulatory bodies and CMS, both of which align with ASPs, move toward establishing criteria for antimicrobial stewardship, initiatives to address and report on these measures will also likely fall in the Quality domain, making it imperative for antimicrobial stewardship to evolve into a process for improving quality and safety. Moving stewardship into the Quality department would facilitate the move toward using more meaningful outcome measures and eliminate the “silo mentality” in terms of the perceived need to impact the pharmacy budget. With >50% of hospitalized patients receiving antimicrobials, the involvement of Quality and Safety in stewardship is vital [83].

**Exemption From Stewardship Activities**

No specialty should be exempted from antimicrobial stewardship interventions, including ID specialists. Because of the need for close collaboration between the ASP and the ID division and the role that ID division members often play in assisting with the conduct of the program, ID physicians are frequently exempted from certain antimicrobial stewardship strategies (eg, formulary restriction with authorization). Although the ID division members may be exempted from certain stewardship strategies to allow for efficient workflow, there must be a strong ID champion for the stewardship program who is willing to provide feedback to the ID division about their practices.

**CONCLUSIONS**

With diminishing healthcare resources at both the institutional and national levels, administrators and governments will require justification for continued support of ASPs, and increasing emphasis will be placed on identifying interventions that yield the greatest benefit. Current ASP guidelines outline the requirements and strategies for implementing ASPs but do not provide detailed input regarding the optimal metrics to gauge the success of ASPs. Several quality metrics have been proposed, and the use of both process and outcome measures is likely to provide the needed evidence base to support ASP activities. Currently, in many institutions, the focus is on antimicrobial costs and utilization, with patient outcomes reported less frequently. This must change, as the focus of an ASP should be on improving the quality of care for patients and minimizing antimicrobial resistance in society. The lack of strong scientific evidence for most antimicrobial stewardship interventions has led to considerable disagreement about their effectiveness, but certain practices may facilitate use of more meaningful measures. The efficacy of ASPs can be improved by reevaluating the antimicrobial review process, focusing on disease state management, and using metrics that are aligned with quality and
safety initiatives. As regulatory and pay-for-performance initiatives grow in hospital settings and in view of potential legislative or regulatory requirements for ASPs, a greater focus on patient-centered outcomes can help to advance antimicrobial stewardship efforts and recognition.

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References