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Systematic reporting of medical kidney biopsies

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ABSTRACT

The medical kidney biopsy has an important added value in patient care in nephrology. In order to facilitate communication between the pathologist and the nephrologist and optimize patient care, both the content and form of the medical kidney biopsy report matter. With some exceptions, current guidelines in nephropathology focus on content rather than form and, not surprisingly, medical kidney biopsy reports mostly consist of unformatted and often lengthy free text. In contrast, in oncology, a more systematic reporting called synoptic reporting has become the dominant method. Synoptic formats enable complete, concise and clear reports that comply with agreed upon standards. In this review we discuss the possibilities of systematic reporting in nephropathology (including synoptic reporting). Furthermore, we explore applications of electronic formats with structured data and usage of international terminologies or coding systems. The benefits include the timely collection of high-quality data for benchmarking between centres as well as for epidemiologic and other research studies. Based on these developments, a scenario for future medical kidney biopsy reporting is drafted.

Keywords: guidelines, kidney disease, pathology, structured reporting, synoptic reporting, systematic reporting

INTRODUCTION

A kidney biopsy is often mandatory to establish an exact diagnosis of medical kidney diseases. Beyond establishing the diagnosis, the biopsy is also used to assess chronicity and activity in order to determine prognosis and choose the appropriate therapy. A repeated biopsy might be an adjunct to evaluate the applied therapy. Finally, kidney biopsies might be a tool in the assessment of genetic diseases.

When reporting medical kidney biopsies, pathologists generally adhere to a fixed layout and structure, covering all aspects of the biopsy in a sequential manner [1]. Because of the detailed and accurate description, reports can be very long. Despite the systematic approach, they contain a certain degree of variability reflecting the individual preferences of the reporting nephropathologist. From oncology, it is known that clinicians can have difficulty reading and extracting information from these pathology reports [2].

Over the last decades, pathology laboratories have implemented quality assurance practices for optimal workup of biopsies, including efforts to reduce unwanted variability and increase completeness and clarity in reporting [3–5]. The development of the synoptic format for reporting cancer specimens was a major step [2]. Adding electronic tools in reporting and using international terminologies have increased the potential for reuse of information for research, education, quality assurance and public health management [6, 7].

In this review we look at the status of medical kidney biopsy reporting. We relate to existing guidelines, but also to developments in oncology, where the synoptic report has become the preferred format for many pathologists, clinicians and registries.

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We then outline a future scenario of reporting on medical kidney biopsies and identify key measures to advance towards this.

MATERIALS AND METHODS

A PubMed search was carried out on 14 March 2021 with the following query 'Search: ((('biopsy standards'[All Fields]) OR ('biopsy methods'[All Fields]) OR ('biopsy needle methods'[All Fields])) AND ('humans'[All Fields])) AND (kidney). This search resulted in 1469 hits. In a first round, the 'summary' display option in PubMed was used and articles were excluded based on the following criteria: articles on subjects other than medical kidney diseases (e.g. kidney tumours and transplant biopsies), articles about single diseases or groups of diseases and articles on biopsy techniques and complications. Articles in languages other than English were also excluded. The first round of exclusion resulted in 31 remaining articles.

In a second round, the abstract and/or the full text of these 31 articles were reviewed. Articles that specifically covered pathology reporting of medical kidney biopsies were retained. Articles focusing solely on scoring systems or classification schemes were excluded. One article published in two journals was retained once [1]. Eight articles remained.

For this article, we did not include information from tertiary literature such as textbooks or handbooks. In this review, we focus on medical kidney biopsies, although some aspects equally hold true for transplant biopsies [where the Banff system might serve as a framework for (structured) reporting] [8].

CURRENT STATUS OF REPORTING MEDICAL KIDNEY BIOPSIES

General structure of a medical kidney biopsy report

The report of a medical kidney biopsy follows the general structure of a pathology report, as shown in Figure 1. The sections on immunopathology and electron microscopy are distinct elements of these reports. If carried out, reports also include results of ancillary studies.

There are different modalities for the communication of information in a pathology report (Table 1 for definitions). Traditionally, a free-text format is used [1].

Guideline papers

The PubMed search retrieved eight papers about reporting of medical kidney biopsies (Table 2) [1, 10–16]. These papers were analysed for recommendations on reporting for the various sections of the pathology report (Figure 1).

Clinical information. Nearly every paper underlines the importance of adequate clinical information. Clinical information provides the framework within which morphologic findings are interpreted. Without sufficient clinical information, the risk of not reaching an aetiologic diagnosis increases. Therefore many pathology laboratories use a specific requisition form for medical kidney biopsies. Relevant clinical information typically drawn from this requisition form should be reported in a dedicated [15] section of the final pathology report [1, 15]. This can be done as a short summary of the clinical history.

Microscopy. Medical kidney biopsy reports include a meticulous light microscopy description of tissue slides stained routinely with a set of histological stains. A description of immunopathological findings, either by immunohistochemistry or immunofluorescence, and a description of electron microscopic findings are fixed parts of the report.

The microscopy description contains several quantitative or semiquantitative elements that are always recurring by default, such as the number of glomeruli, grade of tubular atrophy and degree of arteriosclerosis in light microscopy. Immunopathology findings will always include a rather standardized description of the routinely tested immunoglobulins, complement factors and light chains. Any electron microscopy description will mention the condition of the foot processes, the thickness of the basement membrane and the presence or absence of deposits. Grading systems are recommended for semiquantitative assessment, e.g. for tubular atrophy [1, 15], arteriosclerosis [1, 15] and

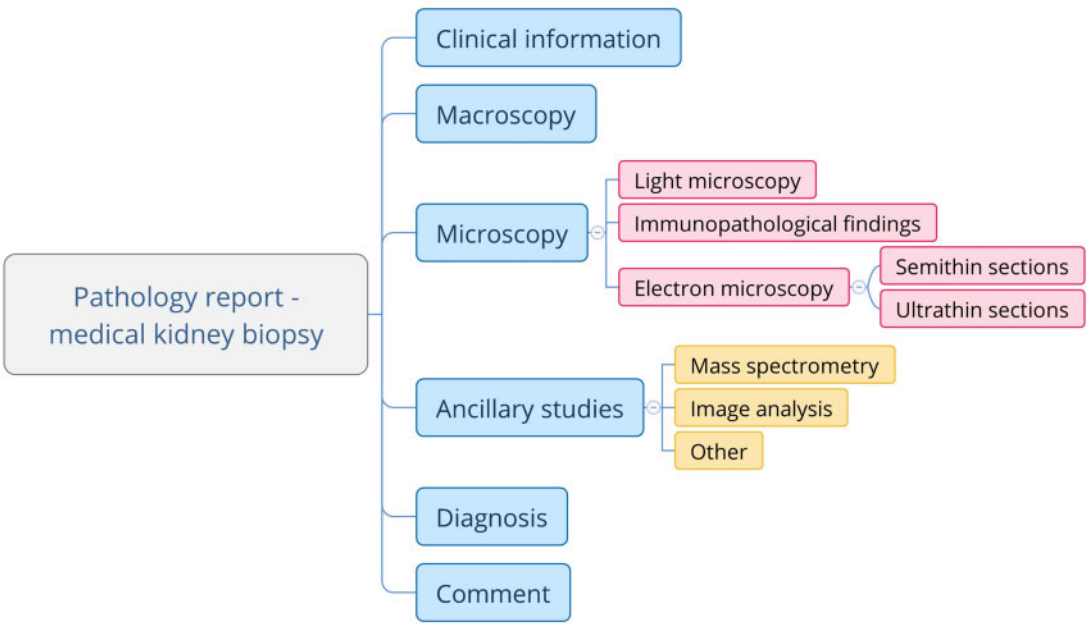

FIGURE 1: Elements of a pathology report for a medical kidney biopsy.

Table 1. Definition of terms often used in connection with pathology reporting

Term	Definition
Structured reporting	A report based on a universal information structure. The report may contain elements of structured data, structured text or free text. The pathologist is free to report a case using a minimum or a maximum dataset or anything in between. However, data conformity and universality are always preserved. Modified after Ellis [6]
Synoptic reporting	A concise, formatted form of reporting that contains all the data needed for accurate staging, treatment and prognosis of a given disease. These data are termed 'required', 'mandatory' or 'essential'. The synoptic format is defined as the paired 'data element: response' format, as for instance 'number of glomeruli: 16'. The format of the response is at the discretion of the pathologist, meaning that the response may consist of free text, structured text or structured data. The synoptic report usually is a separate portion of the pathology report [9]
Free text	Text without any predefined structure. Another term for 'free text' is 'narrative text'
Structured text	Text with a predefined structure. Examples are checklists or text modules. Structured text is different from 'structured data' in that the information is not stored as discrete information elements and therefore not directly searchable or machine readable. The user is not strictly bound to the given structure and can usually change the information if necessary
Structured data	The information is broken down into discrete information elements. Each information element has a name and defined properties, for instance, values sets or data types. Structured data are machine readable and easily retrievable. Other terms are 'atomic data' or 'discrete data' [6]
Template	An original document that serves as a pattern for a pathology report
Checklist	A list of essential informational elements to be included in the pathology report
Value set	A value set in the context of a pathology report is a defined set of terms. These terms describe the possible 'values' of a data element in a structured report. Examples for 'values' are anatomical locations (mesangial, subendothelial, subepithelial and intramembranous) or a semiquantitative evaluation (not present, mild, moderate and severe). Value sets or values can be bound to coding systems

The definitions are adapted to the context of pathology reporting.

Table 2. Papers about reporting of medical kidney biopsies

References	Focus	Contributors	Anchor	Description
Furness [10]	Workup	P		
Walker [11]	Workup	P	RPS	
Amann and Haas [12]	Workup	P, N		Written mainly for clinicians
Walker [13]	Workup	P		
Chang *et al.* [1]	Report	P	RPS	Most comprehensive paper about reporting
Koss [14]	Workup	P		
Sethi *et al.* [15]	Report	P, N	RPS	Constrained to reports on glomerulonephritis
Sethi and Fervenza [16]	Report	P, N		Constrained to reports on glomerulonephritis

P, pathologist; N, nephrologist; RPS, Renal Pathology Society.

positivity of immunofluorescence [1, 13–15]. Photomicrographs of morphological findings may be added to the pathology report in order to illustrate findings but should not replace text [1].

In recent years, additional analyses have been added in some reports: mass spectrometry allows analysis of proteins, e.g. amyloid depositions [17]. Image analysis quantifies important biomarkers such as interstitial fibrosis in an objective way [18]. Genetic testing can reveal mutations causative for a so far unclear kidney disease with or without a familial background [19].

The organization of the microscopy description into sections, the systematic use of recurrent elements and the accurate description of findings make up the backbone of the report and are the pre-condition for diagnosis and assessment of reversibility and prognosis.

Diagnosis. There is a consensus that the diagnosis—as the most important part of the pathology report—should be clear and concise [1]. Some authors advocate giving two types of diagnoses: a morphologically descriptive diagnosis and a final diagnosis involving the results from clinical information and non-pathology analyses [9, 12]. For glomerulonephritides, the matter has been clarified by a consensus meeting of both pathologists and nephrologists [15]. The recommendation is to report the specific disease entity based on aetiology. In addition, one or multiple patterns of injury should be reported and supplemented by relevant classification schemes and/or scoring systems.

Comment. The comment contains information that is necessary to communicate to the clinician and that is not a diagnosis [20]. Such information could be a statement about the certainty of a diagnosis, a differential diagnosis, an explication or a comparison with a previous kidney biopsy [1]. Because arriving at a diagnosis for a medical kidney biopsy often needs correlation with the clinical findings, an explanation of the available relevant clinical information and how it influenced the diagnosis could be helpful to avoid misinterpretations. Additionally, the comment is often the place where a classification scheme or a scoring system is applied [1]. If a colleague has been asked for advice, this should also be communicated in the comment section.

Alternative. An alternative to this setting is to merge diagnosis and comment as a summary of the message to the clinician.

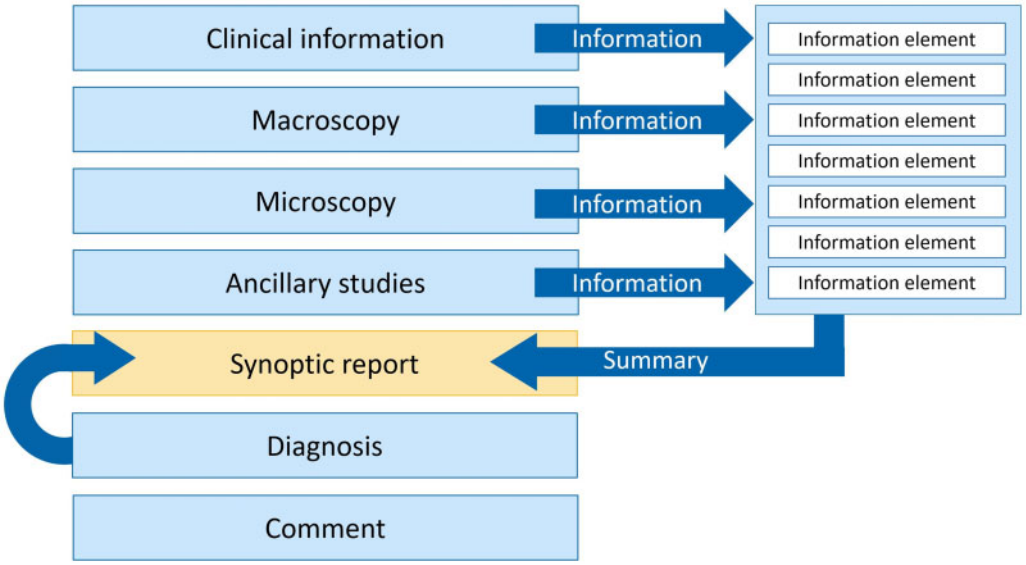

FIGURE 2: Generation of a synoptic report. The information presented in a synoptic report is generated from clinical information, macroscopy, microscopy and ancillary studies and also contains the diagnosis. A synoptic report is presented as a separate part of the pathology report.

Comparison of the kidney biopsy report with the surgical pathology report

Medical kidney biopsy reports have special features that distinguish them from surgical pathology reports even when the basic structure is the same:

i. The need for detailed clinical information. This information often directly influences the differential diagnosis. It is not possible to make a diagnosis of immunoglobulin A vasculitis on a morphological basis alone: pathologists need the clinical diagnosis based on the classic symptoms of purpura, arthritis and abdominal pain.
ii. The detailed and systematic microscopy description.
iii. The content of the diagnosis field, which is in part a morphological descriptive diagnosis and an integrated diagnosis based on clinical information.

SYNOPTIC PATHOLOGY REPORTS

Typically, pathology reports (while organized in the sections clinical information, macroscopy, microscopy, diagnosis and comment; see Figure 1) use free text. However, more detailed macroscopic and microscopic investigations as well as continuously increasing numbers of additional analyses and prognostic scoring systems make the pathology report more and more comprehensive. This is exacerbated by the fact that pathologists describe morphological changes that have no direct relevance for the care of the patient. This is typically done to document the pathologist's own interpretation of changes, to explain the criteria for a certain score and to provide a rationale for the diagnosis. This documentation is useful because interpreting morphological changes can be challenging [21, 22].

Despite the increasing amount of information and longer reports, pathologists tend to inconsistently document negative results. However, negative results are often as important as positive results. Not having this documentation forces clinicians to interpret the text of the pathology report, leading to uncertainty and doubt and requiring further time-consuming communication [23]. For example, the explicit statement that a Congo red stain has been carried out and was negative assures the clinician that amyloidosis has been ruled out. Thus, even if many nephrologists do have a deep understanding of kidney pathology, pathology reports can be difficult to read and interpret for the clinician, resulting in unnecessary confusion.

In oncology, a clearly laid out report format for pathology reports has been developed. This format gives the recipient of the report a concise compilation of the information that is necessary for the classification of disease, choice of adequate treatment and estimation of prognosis. This concise compilation is a summary or a synopsis, hence the name of this reporting format 'synoptic report'.

A synoptic report consists of all required information, which is presented in the 'data element: response' format. The 'response' is at the discretion of the reporting pathologist and may consist of free text, structured text or structured data if it only contains the required information [9]. This implies that negative findings are also reported explicitly.

The synoptic report usually is a separate part of the pathology report (Figure 2) [9]. Thus the synoptic format will not limit the pathologist in his/her need for detailed documentation in additional free text. On the other hand, the microscopic description can be omitted if the pathologist considers the synoptic report to be sufficient.

History

Synoptic reporting has a long history going back to the College of American Pathologists (CAP) publishing the first guidelines for mandatory data to be included in a pathology report in 1986 [24]. In 1992, Zarbo published the results of a large multi-organization study on pathology reporting in colorectal cancer [23]. By far the most important factor for the reports to contain all clinically relevant information was the use of standardized reporting or checklists. As a result of this and similar studies [7], the CAP and other pathology societies have been publishing and updating 'cancer reporting protocols' or 'datasets' based on the principles of synoptic reporting [25–27]. These protocols are quite similar, but not identical. The differences between

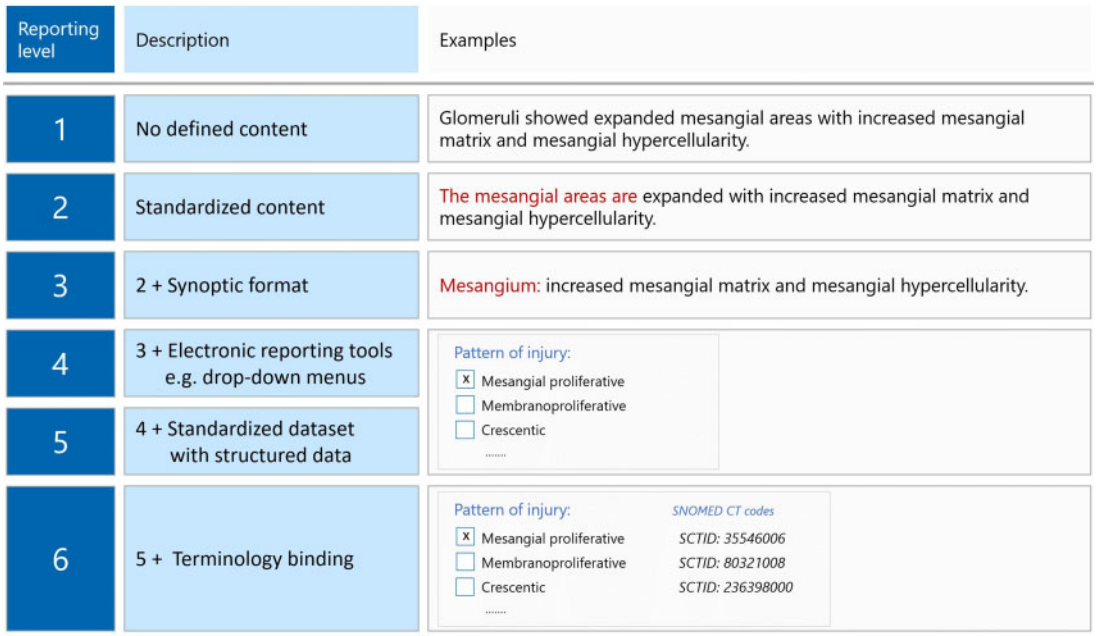

FIGURE 3: Levels of reporting modified after Ellis and Srigley [33]. The text in red in the example for Level 2 indicates a standardized text element. The text in red in the example for Level 3 indicates the name of the data element.

protocols made international cooperation and comparison unnecessarily difficult. Thus, in order to develop internationally agreed upon datasets, the International Collaboration on Cancer Reporting was established in 2011 [28] and has since published and updated pathology standards in oncology.

Benefits

A winning argument is the completeness and unambiguity of the necessary information for patient management [29–32]. Another one is increased efficiency: clinicians find relevant information easily [30] and—with some pre-conditions—pathologists generate reports quickly [31].

Levels of structured reporting

The generation of synoptic reports was for many years paper-based with, for example, printed pdf files. Alternatively, text processing software such as Microsoft Word was used. These reports conform to Level 3 of 6 levels of more and more advanced structured reporting (Figure 3) [5, 33].

From the 2000s onward, electronic systems with structured data have been developed [7]. These systems have the potential for more user-friendly interfaces: drop-down menus, dynamic windows and easily accessible knowledge support for reporting pathologists. When structured data are bound to international terminologies, then the highest level of structured reporting, Level 6, is achieved, because then data are both machine-readable and can be used across systems, institutions and even nations [33]. This opens a wealth of possibilities. For example, data are immediately available for quality assurance. This allows end users or healthcare systems to monitor variations in diagnostic patterns and react promptly if aberrant patterns are detected [34, 35]. For research projects, extraction of patterns and knowledge gains from large datasets become possible.

STRUCTURED REPORTING OF MEDICAL KIDNEY BIOPSIES

Status

There is no reason why synoptic reporting should be restricted to oncology [6]. And indeed, synoptic reports are suggested for bone marrow specimens, placenta pathology and oral epithelial lesions, among others [36–38]. Chang *et al.* [1] state that 'the endeavour to standardize the medical renal biopsy report is of interest to both the nephropathology and nephrology communities'. However, it is also recommended 'that the essential parameters within the microscopic description be stated in prose rather than as individual bullet points' [1]. This reporting format in prose conforms to Level 2 of the Ontario scale [33]: the content is standardized and consists of free text.

Even if certain nephropathology findings are not suitable for synoptic reporting, others are [39]. For example, the number of glomeruli can easily be reported in a synoptic format, preferably as structured data. Choosing structured data for reporting is important because structured data have so many advantages in terms of reuse.

Looking at the diagnosis section of the report, an effort towards standardization was made by a group of renal pathologists and nephrologists in 2015 [14]. Many of the elements recommended by this group complied with a synoptic format (Figure 3). First, the essential information is represented clearly. Second, there are some mandatory components in the synoptic data element: response format such as 'pattern of injury: mesangial proliferative glomerulonephritis'. The proposed format would correspond to Level 3 of 6 levels of reporting. However, the synoptic format is not followed completely and some elements are reported according to Level 2 reporting (Figure 3). Another limitation is that this guideline is restricted to glomerulonephritides and does not cover other medical renal diseases (e.g. tubulointerstitial disease).

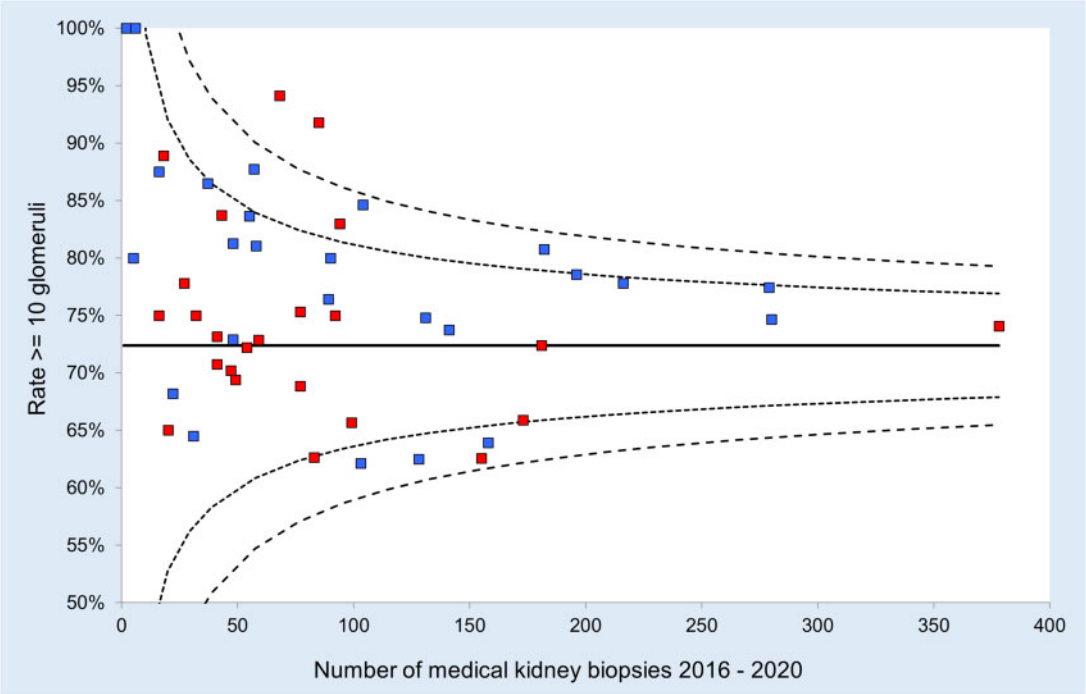

FIGURE 4: Funnel plot showing the rate of medical kidney biopsies with ≥10glomeruli per nephrology unit in Flanders, Belgium (red) and Norway (blue). Data from the Flemish Collaborative Glomerulonephritis Group Registry and the Norwegian Renal Registry. Data are raw data and not corrected for possible confounders. Line: mean; dotted line: 95% control limit; dashed line: 99.7% control limit.

What is still missing from guideline papers is recommendations for structured datasets with discrete data fields, defined data properties and standardized value sets corresponding to Level 5 of structured reporting—even if possible values are mentioned in some publications [1, 15, 40]. Moreover, none of the papers gives any guidance on the use of coding systems [41]. Integrating codes would represent the highest level of structured reporting (Level 6) and would provide true interoperability with all the advantages that follow.

A vision of medical kidney biopsy reporting

What would an ideal scenario for reporting look like? Can we design a scenario that serves the nephropathologist, the nephrologist and secondary users such as registries, researchers and health policymakers? For the nephropathologist, it should not be a burden to write the pathology report. Reporting tools should assist the pathologist in an unobtrusive and time-saving way in his main task, which is to observe the changes in a kidney biopsy, assess morphologic patterns and make a meaningful diagnosis. The nephrologist needs the report to contain all necessary information in order to assess the prognosis and make a treatment plan [16]. This information should be unambiguous and quick to find. Secondary users need to collect large volumes of data for epidemiologic investigations, research purposes and healthcare planning. Therefore they are dependent on the electronic transfer of structured data bound to international terminologies. For quality assessment, timely access is required. In order to make this scenario a reality, certain requirements must be met. The following description is not exhaustive, but it lists some key points.

Structured data

Information should be available as structured data if there is clear added value. If information from the pathology report will be reused, e.g. in quality assessments or research projects, and if there is agreement on how to structure the information, then this information should be available as structured data [42]. At this point it is worth pointing out that not every type of information is suitable for structuring and in many instances it might be better to use free text. The number of glomeruli is a good example of easy-to-structure information that can be reused, e.g. to assemble cohorts of biopsies for research projects. Also, based on this data element, the quality of kidney biopsies taken at specific nephrology units can be monitored (Figure 4) [43].

Many structured data elements will have a set of values to choose from (Table 1). For a pathologist, it should always be possible to choose the 'right' value in any given situation. To achieve this, terms like 'equivocal' or 'not determined' might be included in value sets. Sometimes a choice of 'other' combined with a free-text field can be a solution. Whenever possible, value sets should be bound to international terminologies (Figure 3, example to Level 6). The most important value sets are the ones used in the diagnosis section of the report. Since diagnoses can have some degree of uncertainty, it could be equally useful to add a classifier about the certainty of a given diagnosis.

There exists no ready-to-use terminology for coding the diagnosis of medical kidney biopsies. This is surprising, as there is a multitude of ontologies available [44–47]. However, clinically oriented coding systems such as the European Renal Association–European Dialysis and Transplant Association (ERA-EDTA) primary renal diagnosis (PRD) codes [48] or the International Classification of Diseases, Tenth Revision (ICD-10) codes do not cover all the needs of nephropathologists. For example, the World Health Organization classification of lupus nephritis into six subclasses is missing in both coding systems. The most adequate coding system is the Systematized Nomenclature of Medicine–Clinical Terms(SNOMED CT), but

even here terms are missing [49]. This can be illustrated by the example of primary focal segmental sclerosis. SNOMED CT contains the parent concept (236403004) focal segmental glomerulosclerosis with the child (236404005) classical focal segmental glomerulosclerosis. None of these concepts unambiguously identifies primary focal segmental glomerulosclerosis. An indicator for the lack of a usable system is the fact that kidney biopsy registries mainly use proprietary coding systems, sometimes in combination with international terminologies [41]. Another indicator for lack of a ready-to-use coding system is research consortia using and often combining a variety of coding systems, designing new ontologies or relying on natural language processing for retrieval of information from pathology reports [47, 50–52]. The project Kidney Biopsy Codes is an international initiative with the goal of addressing this issue by establishing a tailor-made terminology for nephropathologists [53].

Nephropathologists and nephrologists are widely using histologic scoring systems. These systems provide a quick and prognostically relevant overview of the current status of the kidney disease in general [54] or a specific disease [55–57]. Scoring systems are well defined and easy to represent as structured data. Often an ideal solution is to represent the components of a score as structured data elements, preferably rendering absolute values and not categories. Recording absolute values allows for reuse in different scoring systems and secures information when scoring systems are changing. Furthermore, assessing data on a granular level makes them suitable for reuse in research projects or quality assessments and improvements. This can be illustrated by the following example. Assuming the number of glomeruli is 22, the number of globally sclerosed glomeruli is 2 and the number of segmental sclerosed glomeruli is 0. The percentage of globally sclerosed glomeruli is calculated to be 9%. This percentage results in a glomerulosclerosis score of 0 according to the total renal chronicity score [54] and in a total glomerulosclerosis score of 1 according to the modified National Institutes of Health lupus nephritis chronicity scoring system [57]. In this example, despite different scores, the raw information remains the same. It could be preserved and more accurate if (also) recorded as absolute numbers. Of course, recording absolute numbers might become cumbersome and time-consuming, for example, when assessing the degree of endocapillary hypercellularity. The key here is to find a balance between accuracy and efficiency in deciding which parameters to register as structured data. In fact, it may then be more appropriate to assess only the category of endocapillary hypercellularity, in the interest of a quick and complete response.

There are ongoing efforts to improve classifications of medical kidney diseases and to exactly define morphological patterns in kidney biopsies [40, 58]. All these activities contribute positively to the generation of well-structured pathology report templates.

The level of detail for the information provided in the report can vary according to the needs of the recipient. For instance, research projects might have a great demand for structured information, for example, when investigating the prognostic significance of electron microscopy characteristics, whereas clinicians in the same setting are happy with a more concise message. In contrast, sometimes (e.g. in lupus nephritis) it is the clinician asking for the results of a detailed histologic scoring system to establish the correct treatment scheme, whereas the epidemiologist is only interested in the occurrence of the disease as such. To allow for flexibility, a categorization of mandatory and non-mandatory data is helpful [6].

Users' interface

In the Netherlands, most pathologists [using the PALGA (Pathologisch Anatomisch Landelijk Geautomatiseerd Archief) system to establish structured reports] indicate that standardized structured reporting templates do facilitate a speedy draft of the report [59]. However, research has shown conflicting evidence on the topic. Pathologists might feel that synoptic reporting is more time-consuming than narrative reporting [60]. It is important to realize that the provision of structured data elements alone does not ensure efficient and satisfactory reporting [6].

Several measures improve the perceived as well as the measured efficiency of structured reporting [7]. The template for structured reporting should be integrated in the laboratory information system so that the pathologist does not have to relate to different systems. Information should be recorded when it is generated and should only be recorded once. Actions should be able to be carried out with as few clicks and as little scrolling as possible. There should be intuitive solutions to quickly choose the right option in value sets. A well-designed user interface actively supports the pathologist in the reporting task. Scores can be created automatically based on the absolute values recorded as structured data. Conditional windows, showing only adapted information to the specific case, are a measure making it faster and easier to carry out synoptic reporting [32]. For example, a negative immunopathologic investigation could be answered with just one checkmark for 'negative'; it is then not necessary to show the single data elements for the immunoglobulins, complement factors or light chains, which all would be checked for negative by the system. An important element, both supporting the pathologist and increasing the data quality, is knowledge support. Knowledge support should be integrated into the user interface of the application so that pathologists can easily access necessary additional information. Using the example of the 'number of glomeruli' data element again, knowledge support would provide a description on how glomeruli should be counted. Such descriptions will ensure that different pathologists determine this number in the same way, rendering comparable results. Examples of the pathologists' user interface and the presentation of the pathology report to the clinician are shown in Supplementary data S1 and S2 .

Ideally the content of the information model that structured reporting is based on should be developed by the international community of nephropathologists. For example, the OpenEHR Clinical Knowledge Manager is an online application that could enable such an international collaborative endeavour [61, 62].

Recipients' requirements

The recipients of the pathology report have different requirements than the producers. For the nephrologist, it is important to quickly grasp the essential information. Therefore content and formatting of the report should be adapted to this need. Structured data rather than free text will provide a fast overview of pathology findings. Valenstein [63] has established four design principles for effective communication in pathology reports: the use of headlines for key findings such as the diagnosis, a standard layout where recipients will always find the same type of information in the same place, the breakdown of information into appropriate parts that can be easily perceived and remembered and the removal of distractors such as unneeded information. Sethi *et al.* [15, 16] provide illustrative examples on how to organize content to answer the central questions of the nephrologist.

Since more and more patients actively participate in treatment decisions and have access to their pathology reports, it may be useful to include explanations of terms so they can be understood by laypersons [64].

Finally, it is worth mentioning that implementation of digital pathology enables applications of powerful computational tools such as machine learning [65–67]. To develop these applications, big datasets with properly classified and annotated digital images are needed [51]. This can only be achieved if structured data and international terminologies are used on a large scale.

CONCLUSION

Systematic reporting for medical kidney biopsies using a synoptic format and structured data where appropriate is possible and presents many advantages for pathologists, nephrologists and secondary users. Benefits include complete, concise and clear pathology reports containing machine-readable data accessible for timely reuse in quality assessments and research projects. In order to successfully introduce templates with structured data, software systems with a high-quality user interface are needed. It is also crucial to think about truly international standardization—both the information model and the coding system behind the report. This review is an invitation to the nephropathology community to reflect and collaborate on these issues.

DATA AVAILABILITY STATEMENT

The data underlying this article were provided by the Norwegian Renal Registry and the Flemish Collaborative Glomerulonephritis Group by permission. Data will be shared on request to the corresponding author with permission of the registries.

SUPPLEMENTARY DATA

Supplementary data are available at ckj online.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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