KDIGO 2021 Clinical Practice Guideline for the Management of Blood Pressure in CKD

KDIGO Guideline Co-Chairs:
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Guideline: Kidney Disease: Improving Global Outcomes (KDIGO) Blood Pressure Work Group. KDIGO 2021 Clinical Practice Guideline for the Management of Blood Pressure in Chronic Kidney Disease. Kidney Int. 2021;99(3S):S1–S87

Executive Summary: Cheung AK. Chang TI, Cushman WC, *et al*. Executive summary of the KDIGO 2021 Clinical Practice Guideline for the Management of Blood Pressure in Chronic Kidney Disease. Kidney Int. 2021; 99(3): 559–569

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KDIGO Programs

Guidelines

- KDIGO's core mission. KDIGO is the only organization developing global guidelines in nephrology.

Controversies Conferences

- International Conferences that examine significant topics in nephrology and related disciplines that are not fully resolved. Results in a published paper, usually in *Kidney International*. Often a Controversies Conference will prompt development of a guideline or a guideline update.

Implementation Activities

- Dissemination and Implementation of KDIGO Guidelines
- Controversies Conference Reports and Observations
- Live Clinical Practice Conferences – usually with a nephrology society to bring global KDIGO's work to local audiences, using case studies
- Implementation Summits bring local experts together to discuss local or regional barriers and opportunities
- Core Implementation Kits – educational materials including Speaker's Guides, Reference Tools, and Case Studies to assist with implementation of all KDIGO publications

KDIGO Controversies Conference on BP in CKD

- September 2017 (Edinburgh, Scotland)
- Topics:
  - BP Measurement
  - Management of Hypertension in CKD Patients with Diabetes vs. without Diabetes
  - Management of Hypertension in CKD among Elderly and Individuals with Previous Stroke
  - Management of Hypertension in CKD in Transplant and Pediatric Populations
- Report published in *Kidney International* (2019)
- Led to initiation of an update of the KDIGO BP clinical practice guideline

www.kidney-international.org

KDIGO executive conclusions

Blood pressure in chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference

Check for updates

OPEN

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In September 2017, KDIGO (Kidney Disease: Improving Global Outcomes) convened a Controversies Conference titled *Blood Pressure in Chronic Kidney Disease (CKD)*. The purpose of the meeting was to consider which recommendations from the 2012 KDIGO Clinical Practice Guideline for the Management of Blood Pressure in CKD should be reevaluated based on new evidence from clinical trials. Participants included a multidisciplinary panel of clinical and scientific experts. Discussions focused on the optimal means for measuring blood pressure (BP) as well as managing BP in CKD patients. Consistent with the 2012 Guideline, the conference did not address BP management in patients on maintenance dialysis.

Kidney International (2019) **95,** 1027–1036; https://doi.org/10.1016/j.kint.2018.12.025

KEYWORDS: blood pressure measurement; blood pressure targets; cardiovascular events; guideline; treatment threshold

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[20]See Appendix for list of other Conference Participants.

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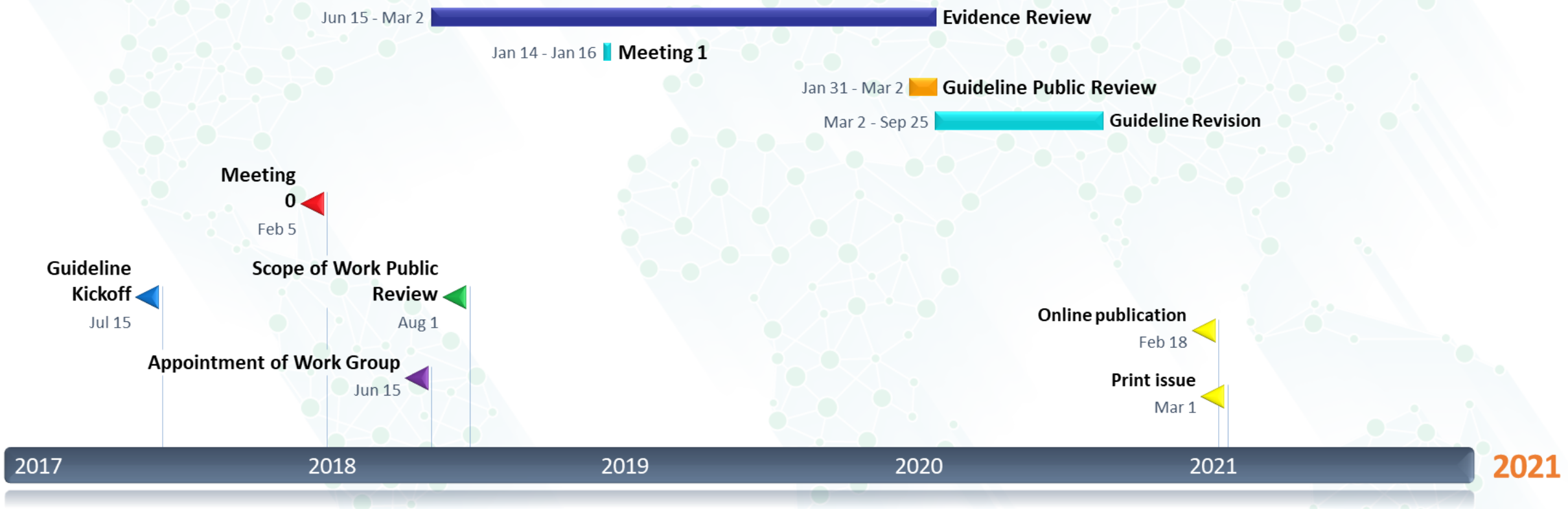
In patients with chronic kidney disease (CKD), the optimal blood pressure (BP) for minimizing the risk of CKD progression and systemic complications, particularly cardiovascular events, is unclear. In 2012, Kidney Disease: Improving Global Outcomes (KDIGO) published a clinical practice guideline on the management of BP in nondialysis CKD.[1] Since then, new data from clinical trials, such as SPRINT (Systolic Blood Pressure Intervention Trial),[2] HALT-PKD (Halt Progression of Polycystic Kidney Disease),[3] and SPS3 (Secondary Prevention of Small Subcortical Strokes),[4] have expanded the evidence base. To examine how the new evidence may influence guideline updates, KDIGO convened a multidisciplinary Controversies Conference titled *Blood Pressure in CKD* in Edinburgh, Scotland in September 2017. Here, we summarize the points of consensus and controversy and identify knowledge gaps and research priorities. The conference agenda, discussion questions, and plenary session presentations are available at http://kdigo.org/conferences/controversies-conference-on-blood-pressure.

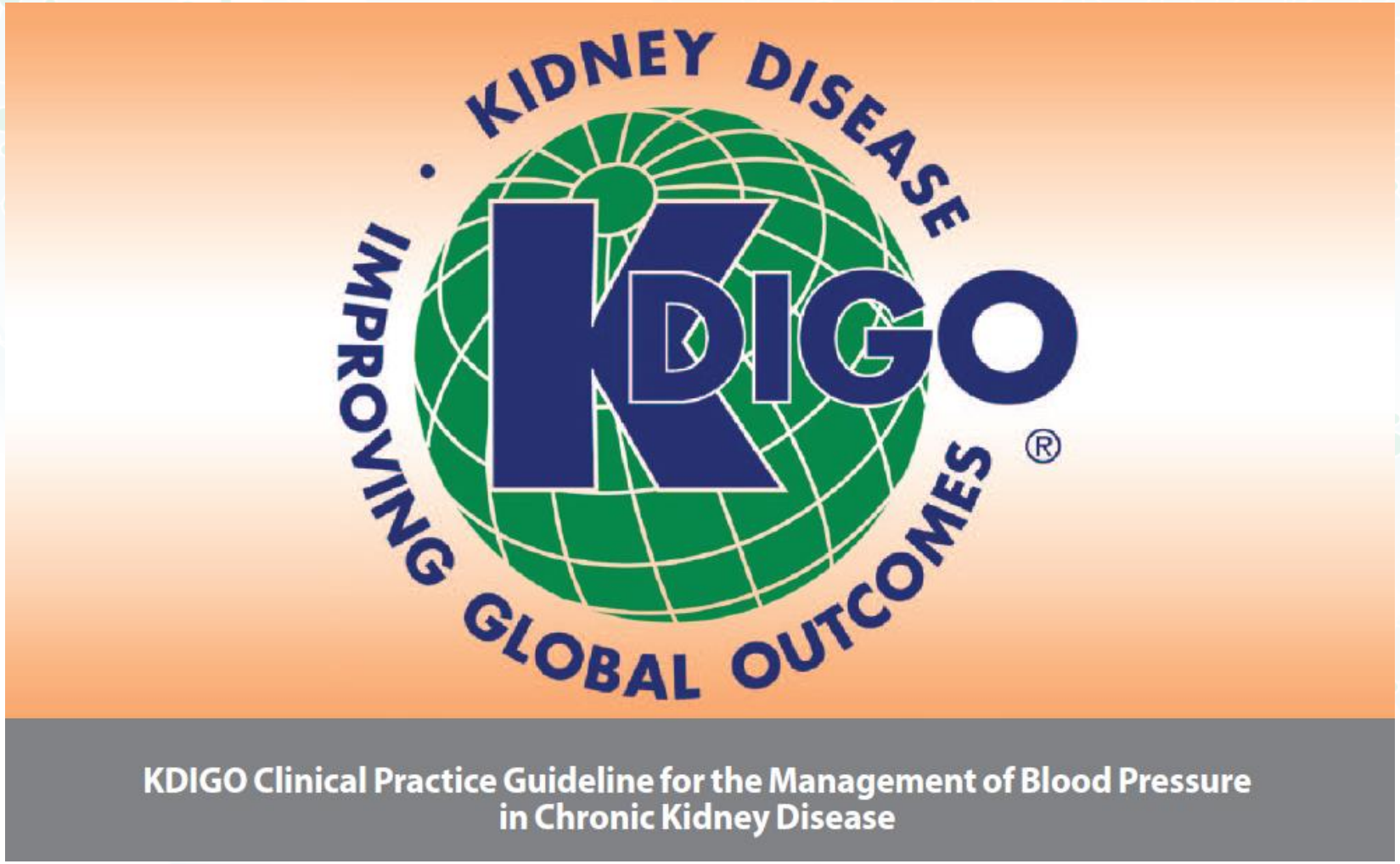
BLOOD PRESSURE MEASUREMENT

A major emphasis during the conference was on BP measurement methods. BP can differ widely depending on measurement setting (e.g., office or home) and the type of device used (e.g., manual or oscillometric sphygmomanometer).[5,6] Proper preparation prior to BP measurement is important (Table 1). Conference discussions focused primarily on the following 3 types of office-based BP measurements: (i) routine, or casual, office, which is conducted without following the recommended preparatory processes outlined in Table 1; (ii) standardized office,

TIMELINE OF GUIDELINE FOR BP MANAGEMENT IN CKD



KDIGO 2012 Guideline: The Beginning



Scope of the Clinical Practice Guideline

Include:

- Patients, adults and children, with CKD not receiving dialysis
- All CKD not receiving dialysis
  - Kidney transplant recipients
- BP measurement techniques
- Interventions addressed with rigorous data (RCTs)
  - Lifestyle
  - Targets
  - Pharmacotherapy

Exclude:

- Dialysis patients
- Interventions covered elsewhere
  - For example, lipids and BP in patients receiving dialysis
- Topics with insufficient data on the risks or benefits on BP in CKD
  - Weight loss
  - Reduction in alcohol consumption
  - Emerging & pipeline therapies

Guideline Goals

- Generate a useful resource for clinicians and patients
  - Address relevant questions with actionable recommendations
  - Take on controversial topics when sufficient evidence
  - Communicate clearly
- Stay true to evidence
- Target audience: Primarily clinicians treating CKD patients, kidney transplant recipients, and children with high blood pressure
- Be mindful of implications for policy and payment
- Propose research questions

WORK GROUP

- Worldwide scope
- Prior GL WG Members
- Deep experience
- Evidence Review Team

WORK GROUP MEMBERSHIP

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WORK GROUP

Missing from photo: Susan Furth, Sheldon Tobe

What Is New Since the 2012 KIDGO Guideline

- More work and emphasis on techniques of BP Measurement
- SPRINT (Systolic Blood Pressure Intervention Trial) and SPRINT-MIND
- Joint analysis of SPRINT and ACCORD; more subgroup analyses of ACCORD
- Large meta-analysis in CKD or non-CKD population

Evidence Review

- ERT - Cochrane Kidney Transplant
  - Existing PICO questions and new PICO questions developed
  - Clinical and important outcomes identified

Critical outcomes	Important outcomes
All-cause mortality	Doubling serum creatinine
Cardiovascular mortality	Acute kidney injury
Kidney failure (ESKD)	Falls
Cardiovascular events - myocardial infarction, stroke, heart failure	Fatigue
Dementia or cognitive impairment	Body weight/Body mass index (BMI)
	Blood pressure

PICO Questions

- Focus on RCTs - mapped to existing Cochrane Systematic reviews
  - New systematic reviews undertaken as required
  - Some focused observational studies reviews
  - General population - Existing systematic reviews

Population	Intervention	Comparator	Outcome
Blood Pressure Measurement			
• Patients with CKD (CKD G1-G5, including transplant) • General population	**Oscillometric (office-based) BP (unattended or attended), ambulatory BP, home oscillometric monitors**	Auscultatory office-based BP monitoring	Sensitivity, specificity, negative predictive value, positive predictive value; Cost-effectiveness

Population	Intervention	Comparator	Outcome
Lifestyle Interventions			
• Adults with CKD (CKD G1-G5) with and without diabetes	• **Low protein diet**	• Usual protein diet	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) with and without diabetes (T1D or T2D)	• **Low salt diet**	• Usual salt diet	• Critical and important outcomes, urinary sodium excretion, SCr, BMI
• Adults with CKD	• **Dietary modifications (including dietary advice or lifestyle management**)	• Standard of care (including lifestyle advice) or any other dietary pattern	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) and high BP	• **Any exercise intervention >8 weeks duration**	• Standard of care	• Critical and important outcomes, fat mass, quality of life

Population	Intervention	Comparator	Outcome
BP Management in Patients with CKD, with and without Diabetes, not Receiving Dialysis			
• Adults with CKD (CKD G1-G5) with and without diabetes (T1D or T2D)	• **Low BP target**	• Standard BP target	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) with and without diabetes (T1D or T2D)	• **ACEi, ARB, aldosterone antagonists**	• Placebo or standard of care	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) with and without diabetes (T1D or T2D)	• **Non-RAS inhibitors (alpha blockers, beta-blockers, CCB, DRI, diuretics)**	• Placebo or RASi	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) with and without diabetes (T1D or T2D)	• **Dual RASi**	• Mono RASi	• Critical and important outcomes
• Adults with CKD (CKD G1-G5) with chronic hyperkalemia	• **Potassium binders**	• Placebo or standard of care	• Critical and important outcomes, hospitalization,

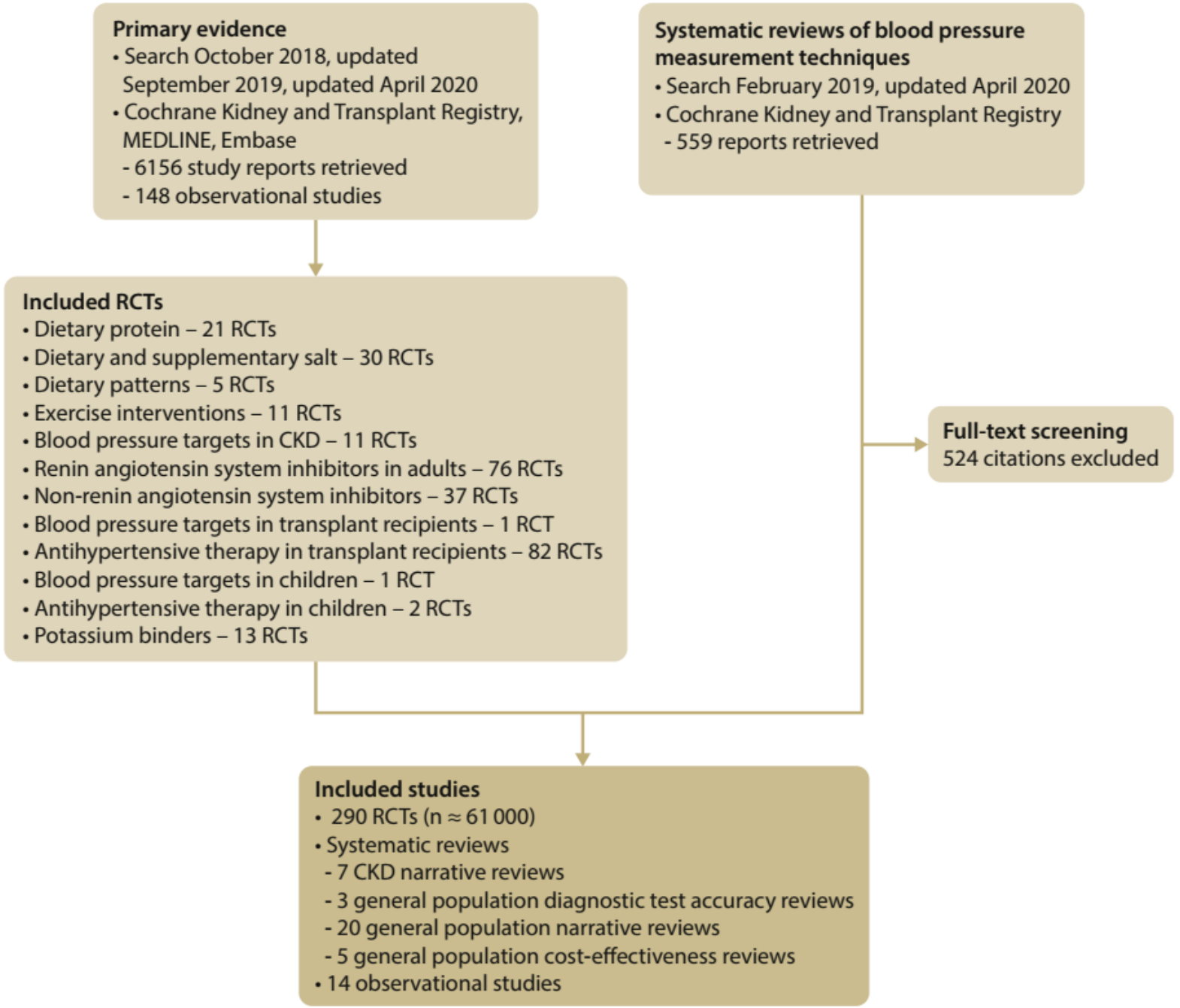
Population	Intervention	Comparator	Outcome
BP Management in Kidney Transplant Recipients			
• Kidney transplant recipients (G1T-G5T)	• **Low protein diet**	• Usual protein diet	• Critical and important outcomes
• Kidney transplant recipients (G1T-G5T)	• **Low salt diet**	• Normal salt diet	• Critical and important outcomes, sodium excretion, SCr
• Kidney transplant recipients (G1T-G5T)	• **Dietary modification (including dietary advice or lifestyle management)**	• Standard of care (including lifestyle advice) or any other dietary pattern	• Critical and important outcomes
• Kidney transplant recipients (G1T-G5T) and high BP	• **Any exercise intervention >8 weeks duration**	• Standard of care	• Critical and important outcomes, BMI, quality of life

Population	Intervention	Comparator	Outcome
BP Management in Kidney Transplant Recipients			
• Adults and children kidney transplant recipients (G1T-G5T)	• **Low BP target**	• Standard BP target	• Critical and important outcomes
• Adults and children kidney transplant recipients (G1T-G5T)	• **RAS inhibitors (ACEi, ARB, aldosterone antagonists) or non-RAS inhibitors (alpha blockers, beta-blockers, CCB, DRI, diuretics)**	• Placebo or standard of care	• Critical and important outcomes
• Kidney transplant recipients (G1T-G5T) with chronic hyperkalemia	• **Potassium binders**	• Placebo or standard of care	• Critical and important outcomes, hospitalization, hypokalemia

Population	Intervention	Comparator	Outcome
BP Management in Children with CKD			
• Children with CKD (CKD G1-G5)	• **Low BP target**	• Standard BP target	• Critical and important outcomes
• Children with CKD (CKD G1-G5)	• **RAS inhibitors (ACEi, ARB, aldosterone antagonists) or non-RAS inhibitors (alpha blockers, beta-blockers, CCB, DRI, diuretics)**	• Placebo or standard of care	• Critical and important outcomes, SCr

Literature Search

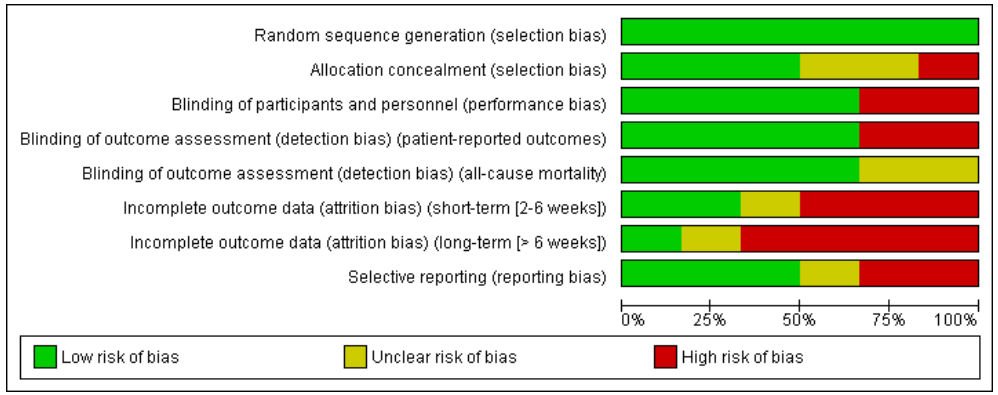
October 2018; February 2019, and Final Update in April 2020



EVIDENCE SYNTHESIS

- Standard Cochrane methods – Two independent reviewers
  - Data abstraction
  - Critical appraisal – using validated tools

Risk of bias graph example

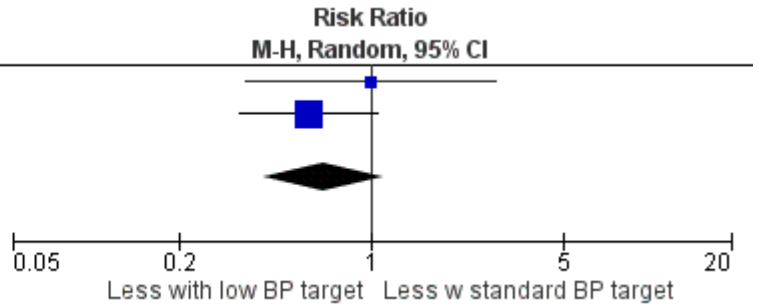


- Data-analysis
  - Random effects meta-analysis and generic inverse variance
    - Relative risk for dichotomous outcomes
    - Mean difference for continuous outcomes
  - Heterogeneity assessed using the I^2 statistic

Forest plot example – BP target – CV Mortality

Study or Subgroup	Low BP target Events	Total	Standard BP target Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
ACCORD Study 2016	7	867	7	859	23.6%	0.99 [0.35, 2.81]
SPRINT CKD 2017	18	1330	30	1316	76.4%	0.59 [0.33, 1.06]
Total (95% CI)		**2197**		**2175**	**100.0%**	**0.67 [0.40, 1.11]**
Total events	25		37			

Heterogeneity: Tau² = 0.00; Chi² = 0.71, df = 1 (P = 0.40); I² = 0%
Test for overall effect: Z = 1.55 (P = 0.12)



Grading Recommendations

- GRADE methodology
  - The quality of the evidence – Level A, B, C, D
    - Study limitations
    - Inconsistency
    - Indirectness
    - Imprecision
    - Publication bias
  - Strength of the recommendation – Level 1, “We recommend” or Level 2, “We suggest”
    - One face-to-face meeting – New Orleans Jan 2019
      - Balance of benefits and harms
      - Quality of the evidence
      - Patient values and preferences
      - Resources and other considerations

GUIDELINE FORMAT

KDIGO guidelines continue to use the GRADE methodology, but we have strengthened the link between the recommendation statements and underlying evidence base.

Guidelines now include a mix of recommendations and "practice points" to help clinicians better evaluate and implement the guidance from the expert Work Group.

All recommendations follow a consistent and structured format and are similar in style to previous KDIGO recommendations.

Practice points are a new addition to KDIGO guidance, and may be formatted as a table, a figure, or an algorithm to make them easier to use in clinical practice.

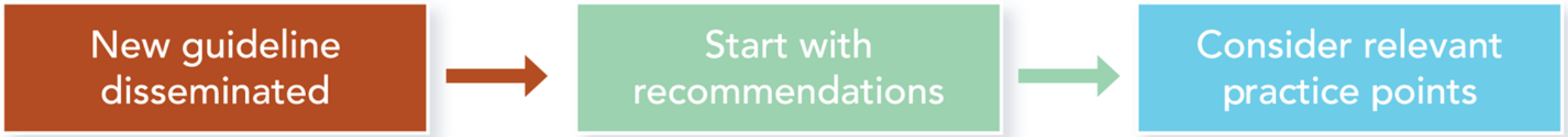
Guidelines will be published in print form and simultaneously posted online in MAGICapp; the online format will facilitate rapid updates as new evidence emerges.

Below is an FAQ outlining the rationale for this shift along with an example recommendation in the new format.

GUIDELINE FORMAT

How should I use practice points when caring for my patients?

- As noted, practice points are consensus statements about a specific aspect of care, and supplement recommendations for which a larger quantity of evidence was identified.
- Note that practice points represent the expert judgment of the guideline Work Group, but may also be based on limited evidence.
- Unlike recommendations, practice points are not graded for strength of recommendation or quality of evidence.
- Users should consider the practice point as expert guidance, and use it as they see fit to inform the care of patients.



MAGICAPP (MAKING GRADE THE IRRESISTIBLE CHOICE)

- Electronic guideline publishing software

- KDIGO is piloting this online platform to:
  - directly link evidence to recommendations
  - increase transparency of guideline process
  - improve accessibility of guidelines through digital publishing
  - create “living guidelines” that ease update process
  - allow generation of patient decision aids

www.magicevidence.org; www.magicapp.org

MAGICapp – Evidence to Recommendation

- Summary of findings tables presented in MAGICapp
- Tables are linked directly to recommendations - transparency

KDIGO Clinical Practice Guideline for the Management of Blood Pressure in Chronic Kidney Disease

v0.28 published on 10/1/20 Edit

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9.1

Population	Intervention	Comparator
Adults with chronic kidney disease	Low blood pressure target (≤120 mmHg)	Standard blood pressure target

Outcomes

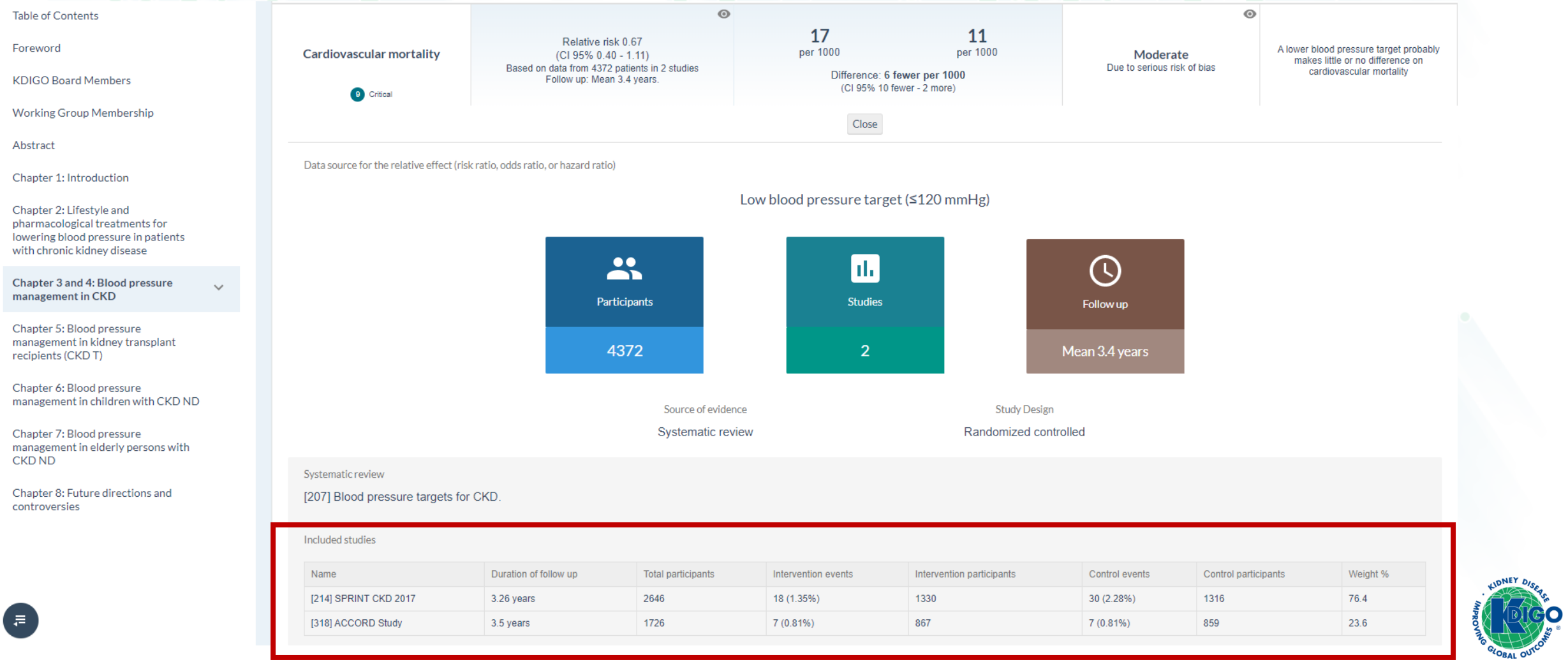
Under development | All-cause mortality | Cardiovascular mortality | End-stage kidney disease or >50% loss of GFR | Cardiovascular events | Myocardial infarction | Stroke | Heart failure | Probable dementia | Acute kidney injury | Falls | Fatigue | Serious adverse events | Hyperkalemia | Hypokalemia | >30% loss in eGFR | >40% loss in eGFR | Mild cognitive impairment

Evidence profile | References

Outcome Timeframe	Study results and measurements	Absolute effect estimates Standard blood pressure target	 Low blood pressure target (≤120 mmHg)	Certainty of the Evidence (Quality of evidence)	Plain text summary
All-cause mortality 9 Critical	Relative risk 0.75 (CI 95% 0.57 - 0.99) Based on data from 4372 patients in 2 studies Follow up: Mean 3.4 years.	53 per 1000	40 per 1000 Difference: **13 fewer per 1000** (CI 95% 23 fewer - 1 fewer)	**Moderate** Due to serious risk of bias	A lower blood pressure target probably decreases all-cause mortality
Cardiovascular mortality 9 Critical	Relative risk 0.67 (CI 95% 0.40 - 1.11) Based on data from 4372 patients in 2 studies Follow up: Mean 3.4 years.	17 per 1000	11 per 1000 Difference: **6 fewer per 1000** (CI 95% 10 fewer - 2 more)	**Moderate** Due to serious risk of bias	A lower blood pressure target probably makes little or no difference on cardiovascular mortality
End-stage kidney disease or >50% loss of GFR 9 Critical	Relative risk 0.93 (CI 95% 0.46 - 1.87) Based on data from 2646 patients in 1 study Follow up: 3.26 years.	12 per 1000	11 per 1000 Difference: **1 fewer per 1000** (CI 95% 6 fewer - 10 more)	**Low** Due to serious risk of bias, Due to serious imprecision	A lower blood pressure target may have little or no effect on end-stage kidney disease or >50% loss of GFR

MAGICAPP – EVIDENCE TO RECOMMENDATION

- Studies and references linked directly to tables
- Ease of updating – new studies added to existing evidence



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Working Group Membership

Abstract

Chapter 1: Introduction

Chapter 2: Lifestyle and pharmacological treatments for lowering blood pressure in patients with chronic kidney disease

Chapter 3 and 4: Blood pressure management in CKD

Chapter 5: Blood pressure management in kidney transplant recipients (CKD T)

Chapter 6: Blood pressure management in children with CKD ND

Chapter 7: Blood pressure management in elderly persons with CKD ND

Chapter 8: Future directions and controversies

Cardiovascular mortality 9 Critical	Relative risk 0.67 (CI 95% 0.40 - 1.11) Based on data from 4372 patients in 2 studies Follow up: Mean 3.4 years.	17 per 1000 / 11 per 1000 Difference: **6 fewer per 1000** (CI 95% 10 fewer - 2 more)	**Moderate** Due to serious risk of bias	A lower blood pressure target probably makes little or no difference on cardiovascular mortality

Close

Data source for the relative effect (risk ratio, odds ratio, or hazard ratio)

Low blood pressure target (≤120 mmHg)

Participants	Studies	Follow up
4372	2	Mean 3.4 years

Source of evidence: Systematic review

Study Design: Randomized controlled

Systematic review

[207] Blood pressure targets for CKD.

Included studies

Name	Duration of follow up	Total participants	Intervention events	Intervention participants	Control events	Control participants	Weight %
[214] SPRINT CKD 2017	3.26 years	2646	18 (1.35%)	1330	30 (2.28%)	1316	76.4
[318] ACCORD Study	3.5 years	1726	7 (0.81%)	867	7 (0.81%)	859	23.6

Blood Pressure in CKD Guideline Contents

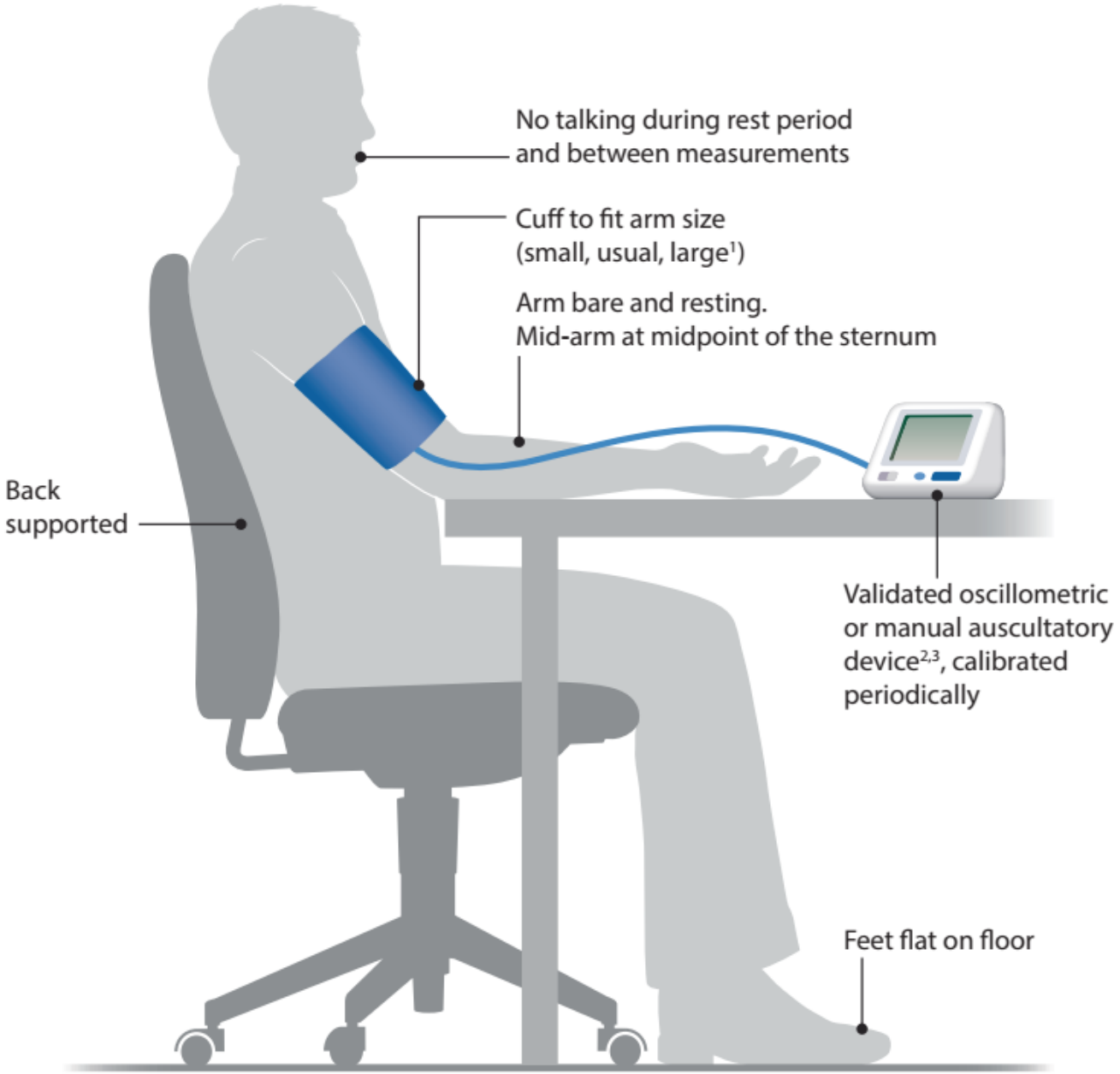
- Chapter 1. Blood pressure measurement
- Chapter 2. Lifestyle interventions for lowering blood pressure in patients with CKD not receiving dialysis
  - Sodium intake
  - Physical activity
- Chapter 3. Blood pressure management in patients with CKD, with or without diabetes, not receiving dialysis
  - Blood pressure targets
  - Treatment with antihypertensive drugs, including RAS inhibitors (RASi)
  - Role of dual therapy with RASi
- Chapter 4. Blood pressure management in kidney transplant recipients (CKD G1T-G5T)
- Chapter 5. Blood pressure management in children with CKD

Blood Pressure Measurement

Recommendation 1.1. We recommend standardized office BP measurement in preference to routine office BP measurement for the management of high BP in adults (1B).

1 Properly prepare the patient	1 Have the patient relax, sitting in a chair (feet on floor, back supported) for > 5 min 2 The patient should avoid caffeine, exercise, and smoking for at least 30 min before measurement 3 Ensure patient has emptied his/her bladder 4 Neither the patient nor the observer should talk during the rest period or during the measurement 5 Remove all clothing covering the location of cuff placement 6 Measurements made while the patient is sitting or lying on an examining table do not fulfill these criteria
2 Use proper technique for BP measurements	1 Use a BP measurement device that has been validated, and ensure that the device is calibrated periodically 2 Support the patient's arm (e.g., resting on a desk) 3 Position the middle of the cuff on the patient's upper arm at the level of the right atrium (the midpoint of the sternum) 4 Use the correct cuff size, such that the bladder encircles 80% of the arm, and note if a larger- or smaller-than-normal cuff size is used 5 Either the stethoscope diaphragm or bell may be used for auscultatory readings
3 Take the proper measurements needed for diagnosis and treatment of elevated BP	1 At the first visit, record BP in both arms. Use the arm that gives the higher reading for subsequent readings 2 Separate repeated measurements by 1–2 min 3 For auscultatory determinations, use a palpated estimate of radial pulse obliteration pressure to estimate SBP. Inflate the cuff 20–30 mm Hg above this level for an auscultatory determination of the BP level 4 For auscultatory readings, deflate the cuff pressure 2 mm Hg per second, and listen for Korotkoff sounds
4 Properly document accurate BP readings	1 Record SBP and DBP. If using the auscultatory technique, record SBP and DBP as onset of the first Korotkoff sound and disappearance of all Korotkoff sounds, respectively, using the nearest even number 2 Note the time of most recent BP medication taken before measurements
5 Average the readings	Use an average of ≥ 2 readings obtained on ≥ 2 occasions to estimate the individual's level of BP
6 Provide BP readings to patient	Provide patients with the SBP/DBP readings verbally and in writing

Blood Pressure Measurement



- Quiet room (no talking by patient or observer)
- No smoking, caffeine, or exercise for ≥30 min before measurement
- Empty bladder
- Note the time of most recent BP medication taken before measurements
- Relax for >5 min
- At first visit, record BP in both arms. Use the arm that gives the higher reading for subsequent readings
- Separate repeated measurements by 1–2 minutes
- Use an average of ≥2 readings obtained on ≥2 occasions
- Provide patients with the SBP/DBP readings verbally and in writing

[1]Use the correct cuff size, such that the bladder encircles 80% of the arm, and note if a larger- or smaller-than-normal cuff size is used

[2]See validated electronic devices lists at www.stridebp.org

[3]For auscultatory readings, either the stethoscope diaphragm or bell may be used. Use a palpated radial pulse obliteration pressure to estimate SBP, then inflate the cuff 20–30 mm Hg above this level for auscultatory determination of BP level. Deflate the cuff pressure 2 mm Hg per second, and listen for Korotkoff sounds

Standardized BP Measurement

- Key is proper preparations
  - Abstinence from caffeine, exercise and smoking for >30 min
  - Feet on floor; arm and back supported
  - Keep quiet (and not talked to) and relaxed for >5 min
  - Use validated equipment
  - Correct cuff size and position
- Advantages
  - Employed in large RCTs (e.g., ACCORD and SPRINT)
  - Minimizes misclassification and over-treatment or under-treatment of high BP
- Disadvantages
  - Requires staff training and retraining
  - Requires more time of patients, providers and staff

Blood Pressure Measurement

Practice Point 1.1: An oscillometric BP device may be preferable to a manual BP device for standardized office BP measurement; however, standardization emphasizes adequate preparations for BP measurement, not the type of equipment.

Practice Point 1.2: Automated office BP (AOBP), either attended or unattended, may be the preferred method of standardized office BP measurement.

Practice Point 1.3: Oscillometric devices can be used to measure BP among patients with atrial fibrillation.

- May increase likelihood of adherence to proper BP measurement protocols
- Removes potential sources of inaccuracies with manual measurement
- May reduce white-coat effect
- Frees staff to complete other duties
- Used in prior RCTs and prospective cohort studies

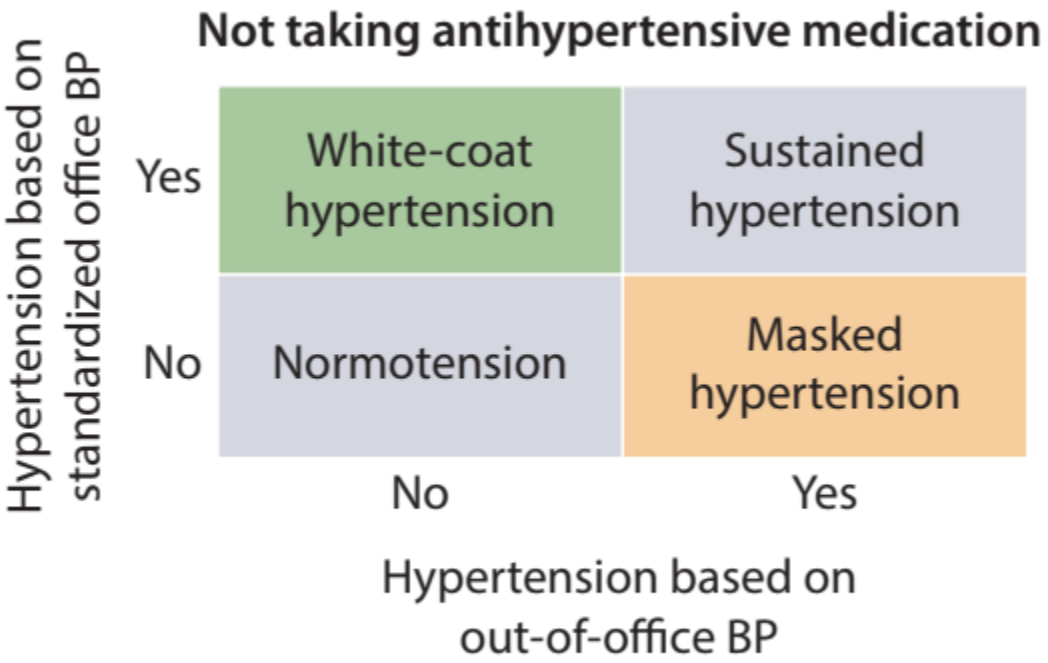
But, probably not as important as proper preparations

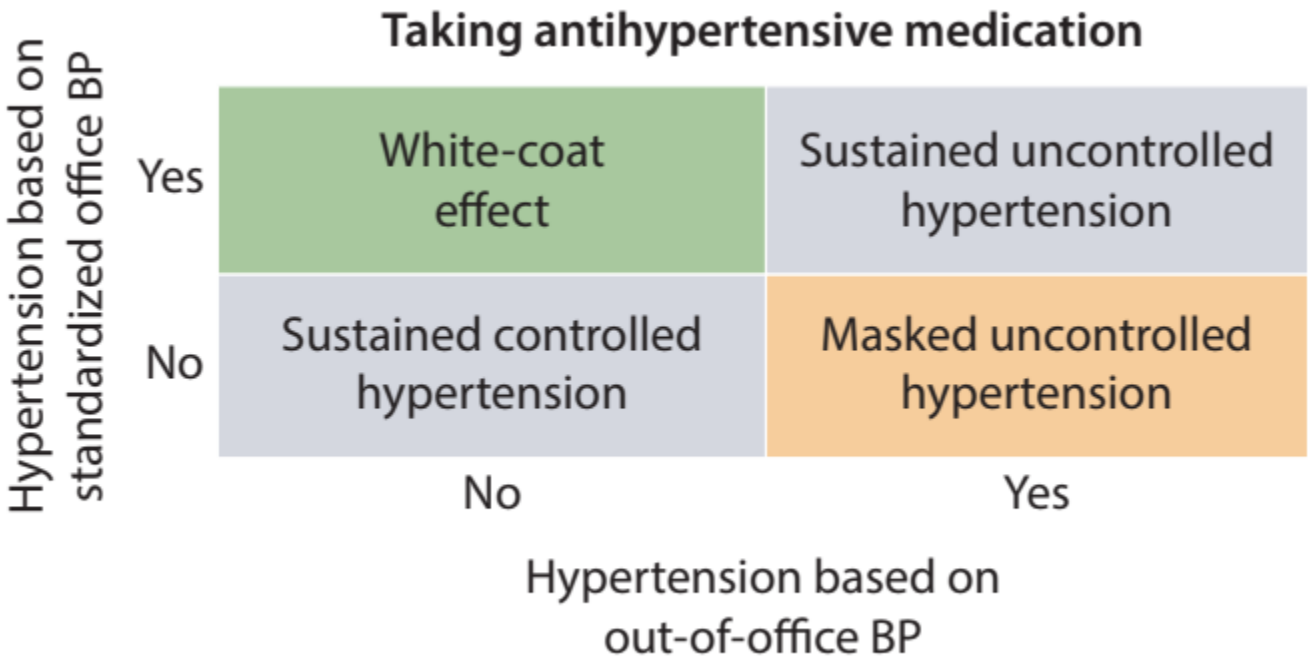
Blood Pressure Measurement Method and Device Used in Select RCTs and Prospective Observational Studies

Study	Year	Population	Type of study	Method/device
Framingham	1970s	General	Observational	Manual
MDRD	1994	CKD (eGFR < 55 ml/min/1.73 m^2)	Clinical trial	Manual
UKPDS	1998	T2D (baseline SCr 1.06 mg/dl [94 µmol/l])	Clinical trial	Automated
AASK	2002	CKD (GFR 20–65 ml/min/1.73 m^2)	Clinical trial	Manual
ADVANCE	2007	T2D (baseline SCr 0.97 mg/dl [86 µmol/l]; 19% CKD)‡	Clinical trial	Manual
CRIC	2009	CKD (eGFR < 70 ml/min/1.73 m^2)	Observational	Manual and automated
ACCORD	2010	T2D (baseline SCr 0.9 mg/dl [80 µmol/l]; 37% CKD)	Clinical trial	Automated/Omron™
SPS3	2011	Recent lacunar stroke (baseline eGFR 80 ml/min/1.73 m^2; 16% CKD)§	Clinical trial	Automated/Colin electronic device
ONTARGET†	2012	CVD or T2D (baseline SCr 1.05 mg/dl [93 µmol/l]; 24% CKD, eGFR < 60 ml/min/1.73 m^2)	Clinical trial	Automated/Omron™
CKD–JAC	2013	CKD (eGFR < 60 ml/min/1.73 m^2)	Observational	Manual
SPRINT	2015	High CVD risk (baseline SCr 1.07 mg/dl [95 µmol/l]; 28% CKD, eGFR 20–< 60 ml/min/1.73 m^2)	Clinical trial	Automated/Omron™

Blood Pressure Measurement

Recommendation 1.2: We suggest that out-of-office BP measurements with ambulatory BP monitoring (ABPM) or home BP monitoring (HBPM) be used to complement standardized office BP readings for the management of high BP (2B).





Lifestyle Interventions for Lowering BP in Patients with CKD not Receiving Dialysis

Recommendation 2.1.1: We suggest targeting a sodium intake <2 g of sodium per day (or <90 mmol of sodium per day, or <5 g of sodium chloride per day) in patients with high BP and CKD (2C).

Practice Point 2.1.1: Dietary sodium restriction is usually not appropriate for patients with sodium-wasting nephropathy.

Practice Point 2.1.2: The Dietary Approaches to Stop Hypertension (DASH)-type diet or use of salt substitutes that are rich in potassium may not be appropriate for patients with advanced CKD or those with hyporeninemic hypoaldosteronism or other causes of impaired potassium excretion because of the potential for hyperkalemia.

Lifestyle Interventions for Lowering BP in Patients with CKD not Receiving Dialysis

Recommendation 2.2.1: We suggest that patients with high BP and CKD be advised to undertake moderate-intensity physical activity for a cumulative duration of at least 150 minutes per week, or to a level compatible with their cardiovascular and physical tolerance (2C).

Practice Point 2.2.1: Consider the cardiorespiratory fitness status, physical limitations, cognitive function, and risk of falls when deciding on the implementation and intensity of physical activity interventions in individual patients.

Practice Point 2.2.2: The form and intensity of physical activity should be considered and modified as necessary in individual patients. There may still be important health benefits even if physical activity falls below targets proposed for the general population.

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

Recommendation 3.1.1: We suggest that adults with high BP and CKD be treated with a target systolic blood pressure (SBP) of <120 mm Hg, using standardized office BP measurement (2B).

This recommendation is weak according to GRADE because there is less certainty that the benefits outweigh the harms in the following scenarios:

- CKD G4 and G5
- Diabetes
- Individuals with SBP 120-129 mm Hg
- Patients with very low baseline diastolic BP, particularly in the presence of coronary artery disease
- Specific etiology of CKD
- Severely increased proteinuria
- Older age
- Younger age
- Very frail
- "White coat" hypertension
- Severe hypertension

Individualization is KEY

Rationale for Target SBP <120 mm Hg in CKD

- For most patients with CKD, a cardiovascular event is a more likely outcome than ESKD.[1]
- SPRINT confirmed cardiovascular and survival benefits in non-diabetic CKD.[2]
- ACCORD showed marked reduction in stroke in diabetes, but only included 401 patients with eGFR <60 ml/min/1.73m^2; nonetheless, benefits of SBP <120 mm Hg in the standard glycemia arm similar to those seen in SPRINT.[3,4]
- Meta-analyses demonstrate reduction of CV risk proportional to BP lowering, though some show lower proportional risk reduction in the presence of CKD and of DM.[5,6,7]

[1]O'Hare J Am Soc Nephrol 2007;18: 2758. [2]Cheung JASN 2017; 28: 2812. [3]Papademetriou Am J Nephrol 2016; 43: 271. [4]Tsuijimoto Hypertension 2018;72;323. [5]BPLTC BMJ 2013;347:f5680; [6]Ettehad Lancet 2016;387:435; [7]Malhotra JAMA Int Med 2017;177:1498

Low BP Target (<120 mm Hg) vs. Standard BP Target (<140 mm Hg)

Outcome Timeframe	Study results and measurements	Absolute effect estimates		Certainty of evidence (Quality of evidence)	Plain text summary
		Standard BP target (<140 mm Hg)	Low BP target (<120 mm Hg)		
All-cause mortality (Mean follow-up 3.4 years)	Relative risk: 0.75 (95% CI 0.57 – 0.99) Based on data from 4372 patients and 2 studies*	53 per 1000	40 per 1000	Moderate (Due to serious risk of bias)	A lower BP target probably decreased all-cause mortality
		Difference: 13 fewer per 1000 (95% CI 23 fewer – 1 fewer)			
Cardiovascular mortality (Mean follow-up 3.4 years)	Relative risk: 0.67 (95% CI 0.40 – 1.11) Based on data from 4372 patients and 2 studies*	17 per 1000	11 per 1000	Moderate (Due to serious risk of bias)	A lower BP target probably makes little or no difference on cardiovascular mortality
		Difference: 6 fewer per 1000 (95% CI 10 fewer – 2 more)			
End-stage kidney disease or >50% loss of GFR (Mean follow-up 3.26 years)	Relative risk: 0.93 (95% CI 0.46 – 1.87) Based on data from 2646 patients and 1 study†	12 per 1000	11 per 1000	Low (Due to serious risk of bias; Due to serious imprecision)	A lower BP target probably may have little or no effect on end-stage kidney disease or >50% loss of GFR
		Difference: 1 fewer per 1000 (95% CI 6 fewer – 10 more)			
Acute kidney injury (Mean follow-up 3.26 years)	Relative risk: 1.45 (95% CI 1.10 – 1.91) Based on data from 2646 patients and 1 study†	33 per 1000	48 per 1000	Low (Due to serious risk of bias; Due to serious imprecision)	A lower BP target may increase acute kidney injury
		Difference: 15 more per 1000 (95% CI 3 more – 30 more)			

*Cheung AK, Rahman M, Reboussin DM, et al. Effects of Intensive BP Control in CKD. Journal of the American Society of Nephrology. 2017;28(9):2812-2823; Cushman WC, Evans GW, Byington RP, et al. Effects of intensive blood-pressure control in type 2 diabetes mellitus. The New England Journal of Medicine. 2010;362(17):1575-1585

†Cheung AK, Rahman M, Reboussin DM, et al. Effects of Intensive BP Control in CKD. Journal of the American Society of Nephrology. 2017;28(9):2812-2823

Meta-Analysis of Trials of Intensive vs. Less-Intensive BP Lowering in CKD on Mortality Outcome

RESULTS This study identified 30 RCTs that potentially met the inclusion criteria. The CKD subset mortality data were extracted in 18 trials, among which there were 1293 deaths in 15 924 participants with CKD. The mean (SD) baseline systolic BP (SBP) was 148 (16) mm Hg in both the more intensive and less intensive arms. The mean SBP dropped by 16 mm Hg to 132 mm Hg in the more intensive arm and by 8 mm Hg to 140 mm Hg in the less intensive arm. More intensive vs less intensive BP control resulted in 14.0% lower risk of all-cause mortality (odds ratio, 0.86; 95% CI, 0.76-0.97; *P* = .01), a finding that was without significant heterogeneity and appeared consistent across multiple subgroups.

CONCLUSIONS AND RELEVANCE Randomization to more intensive BP control is associated with lower mortality risk among trial participants with hypertension and CKD. Further studies are required to define absolute BP targets for maximal benefit and minimal harm.

Malhotra R. JAMA Int Med 2017: 177: 1-8

Risk of CKD Progression with Intensive BP Lowering Therapy

>30% loss in eGFR 4 Important	Relative risk 2.07 (CI 95% 1.46 - 2.94) Based on data from 2646 patients in 1 study Follow up: 3.26 years.	33 per 1000	68 per 1000 Difference: **35 more per 1000** (CI 95% 15 more - 64 more)
>40% loss in eGFR 4 Important	Relative risk 1.56 (CI 95% 0.88 - 2.76) Based on data from 2646 patients in 1 study Follow up: 3.26 years.	14 per 1000	22 per 1000 Difference: **8 more per 1000** (CI 95% 2 fewer - 25 more)

- Intensive BP control causes initial drop in GFR, without increase in tubular injury markers, and with reduction in albuminuria – probably due to altered intrarenal hemodynamics.
- However, overall rate of decline in eGFR was higher with intensive BP control in SPRINT (in both CKD and non-CKD cohorts), ACCORD, and SPS.
- Difference in rate of decline after initial 6 months in SPRINT: 0.47 vs. 0.32 ml/min/1.73 m^2/year in intensive vs. standard: if sustained over 20 y, this would cause only a 3 ml/min difference.

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

Practice Point 3.1.1: It is potentially hazardous to apply the recommended SBP target of <120 mm Hg to BP measurements obtained in a non-standardized manner.

Practice Point 3.1.2: Clinicians can reasonably offer less intensive BP-lowering therapy in patients with very limited life expectancy or symptomatic postural hypotension.

Challenges for Implementation of SBP Target

- SBP <120 mm Hg conflicts with some, but not all national and international guidelines

- Resource implications
  - Standardized office BP measurement (supplemented by ABPM or HBPM)
  - Costs of intensive BP control
    - Direct costs of drug therapy
    - Indirect costs – e.g. electrolyte monitoring

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

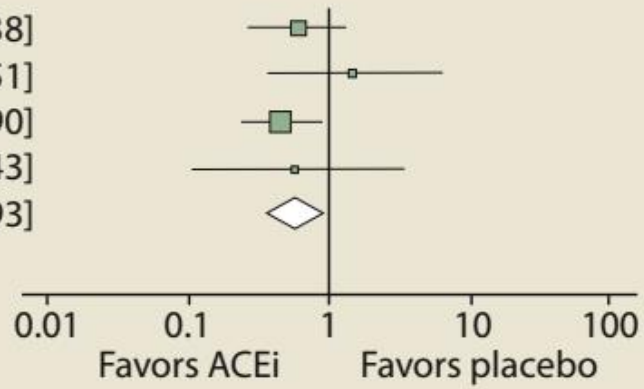
Recommendation 3.2.1: We recommend starting renin-angiotensin-system inhibitors (RASi) (angiotensin-converting enzyme inhibitor [ACEi] or angiotensin II receptor blocker [ARB]) for people with high BP, CKD, and severely increased albuminuria (G1-G4, A3) without diabetes (1B).

Cardiovascular events in patients with CKD G3-G4, A3 without diabetes

	ACEi		Placebo/ no treatment			Risk ratio	Risk ratio
Study or subgroup	Events	Total	Events	Total	Weight	M–H, random, 95% CI	M–H, random, 95% CI
Albuminuria/proteinuria							
AIPRI 1996	9	300	14	283	33.4%	0.61 [0.27, 1.38]	
GISEN 1997	4	78	3	88	10.5%	1.50 [0.35, 6.51]	
Hou 2006	14	216	16	112	48.8%	0.45 [0.23, 0.90]	
REIN Stratum-1 1999	2	99	3	87	7.3%	0.59 [0.10, 3.43]	
Subtotal (95% CI)		693		570	100.0%	0.58 [0.36, 0.93]	
Total events	**29**		**36**				

Heterogeneity: $Tau^2 = 0.00$; $\chi^2 = 2.14$, df = 3 ($P = 0.54$); $I^2 = 0\%$

Test for overall effect: $Z = 2.26$ ($P = 0.02$)



Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

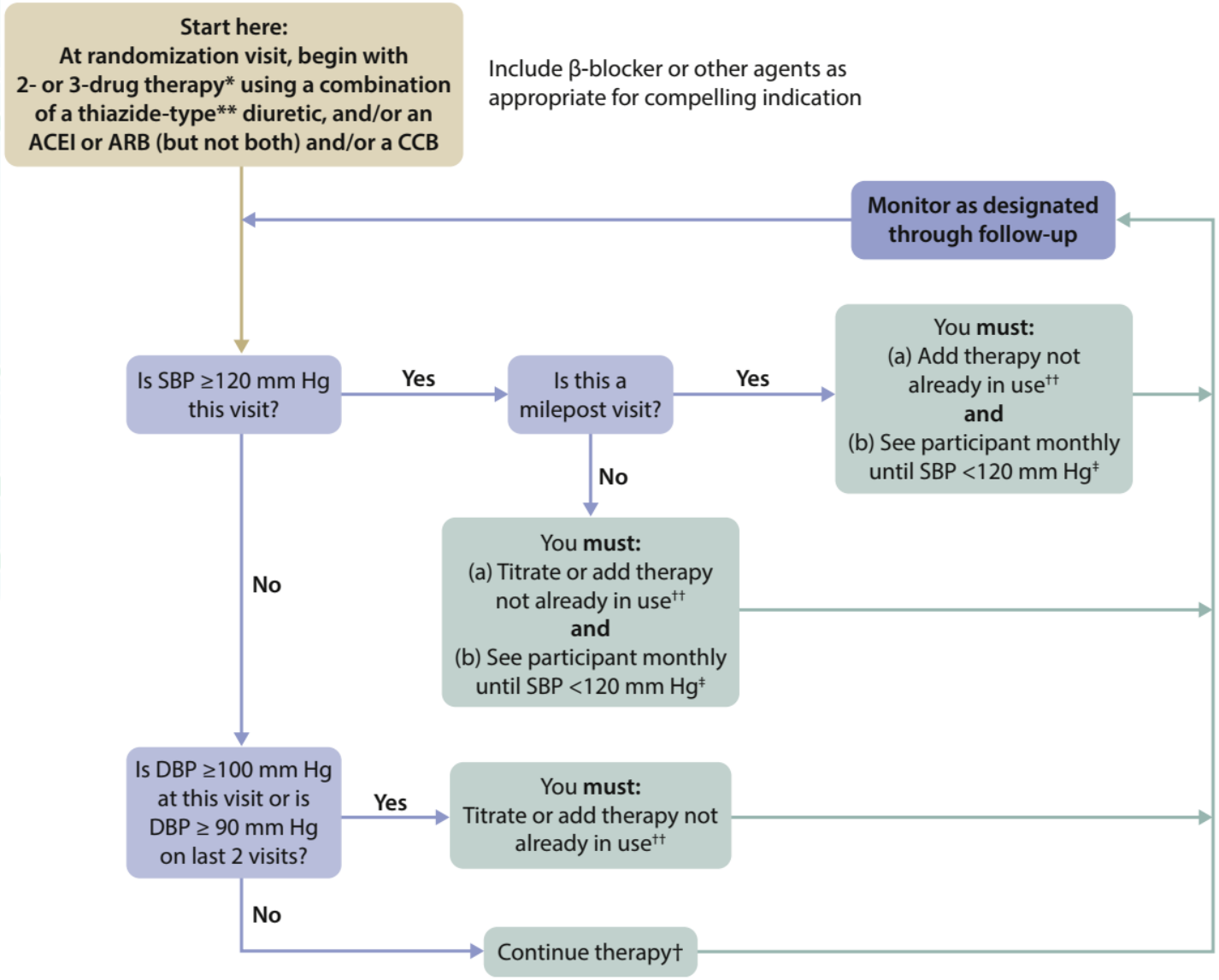
Recommendation 3.2.2: We suggest starting RASi (ACEi or ARB) for people with high BP, CKD, and moderately increased albuminuria (G1-G4, A2) without diabetes (2C).

Recommendation 3.2.3: We recommend starting RASi (ACEi or ARB) for people with high BP, CKD, and moderately-to-severely increased albuminuria (G1 to G4, A2 and A3) with diabetes (1B).

Albuminuria category	Diabetes	No diabetes
A1	PP (not graded)	PP (not graded)
A2	1B	2C
A3	1B	1B

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

SPRINT protocol



Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

Practice Point 3.2.1: It may be reasonable to treat people with high BP, CKD, and no albuminuria, with or without diabetes, with RASi (ACEi or ARB).

Practice Point 3.2.2: RASi (ACEi or ARB) should be administered using the highest approved dose that is tolerated to achieve the benefits described because the proven benefits were achieved in trials using these doses.

Practice Point 3.2.3: Changes in BP, serum creatinine, and serum potassium should be checked within 2-4 weeks of initiation or increase in the dose of a RASi, depending on the current GFR and serum potassium.

Practice Point 3.2.4: Hyperkalemia associated with use of RASi can often be managed by measures to reduce the serum potassium levels rather than decreasing the dose or stopping RASi.

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

Practice Point 3.2.5: Continue ACEi or ARB therapy unless serum creatinine rises by more than 30% within 4 weeks following initiation of treatment or an increase in dose.

Practice Point 3.2.6: Consider reducing the dose or discontinuing ACEi or ARB in the setting of either symptomatic hypotension or uncontrolled hyperkalemia despite medical treatment, or to reduce uremic symptoms while treating kidney failure (estimated glomerular filtration rate [eGFR] <15 ml/min per 1.73 m^2).

Practice Point 3.2.7: Mineralocorticoid receptor antagonists are effective for management of refractory hypertension but may cause hyperkalemia or a reversible decline in kidney function, particularly among patients with low eGFR.

Blood Pressure Management in Patients with CKD, with or without Diabetes, not Receiving Dialysis

Recommendation 3.3.1: We recommend avoiding any combination of ACEi, ARB, and direct renin inhibitor (DRI) therapy in patients with CKD, with or without diabetes (1B).

Blood Pressure Management in Kidney Transplant Recipients (CKD G1T-G5T)

Practice Point 4.1. Treat adult kidney transplant recipients with high BP to a target BP of <130 mm Hg systolic and <80 mm Hg diastolic using standardized office BP measurement (see Recommendation 1.1.).

Recommendation 4.1. We recommend that a dihydropyridine calcium channel blocker (CCB) or an ARB be used as the first-line antihypertensive agent in adult kidney transplant recipients (1C).

Rationale for Target Practice Point in Kidney Transplant

- No informative RCT evidence for optimal BP target in Kidney Transplant Recipients (KTRs).

- KTRs value graft survival highly, and many would value death with a functioning graft more highly than return to dialysis.[1]

- Intensive BP control associated with a higher (albeit slightly) rate of loss of GFR over time in SPRINT and a higher risk of "AKI" (single, denervated kidneys may be at higher risk).

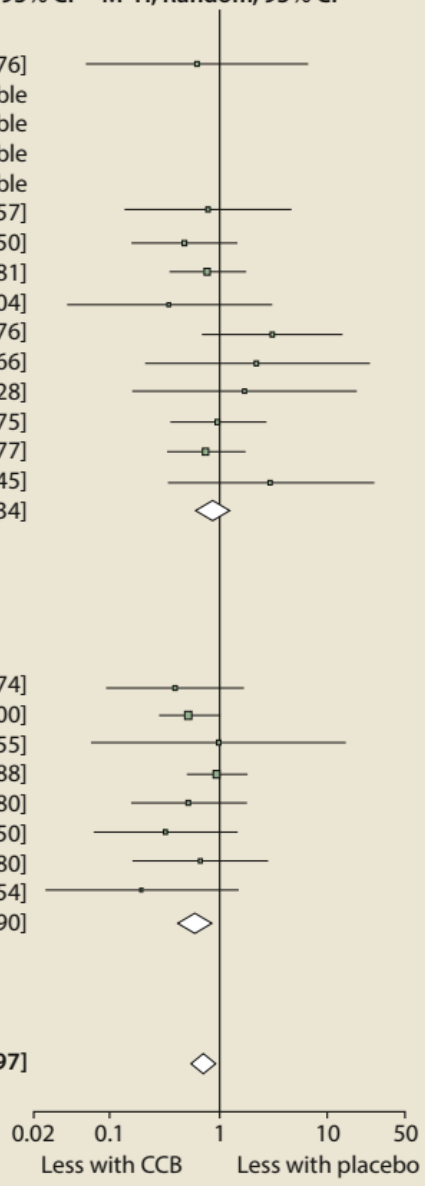
[1]Tong A. Transplantation 2017; 101: 1887-1896

CCB vs. Placebo/No Treatment for the Outcome of Graft Loss

Non-dihydropyridine

Dihydropyridine

Study or subgroup	CCB Events	CCB Total	Placebo/no treatment Events	Placebo/no treatment Total	Weight	Risk ratio M–H, Random, 95% CI
Non-dihydropyridine						
Alcaraz 1991	1	23	2	30	1.3%	0.65 [0.06, 6.76]
Campistol 1991	0	12	0	25		Not estimable
Chen 2013a CyP+	0	31	0	31		Not estimable
Chen 2013a CyP−	0	29	0	29		Not estimable
Chen 2013b	0	11	0	11		Not estimable
Chrysostomou 1993	2	32	3	39	2.4%	0.81 [0.14, 4.57]
Dawidson 1991	4	30	7	26	5.8%	0.50 [0.16, 1.50]
Frei 1990	9	65	11	64	10.8%	0.81 [0.36, 1.81]
Guerin 1989	1	14	3	15	1.5%	0.36 [0.04, 3.04]
Ladefoged 1994	6	19	2	20	3.3%	3.16 [0.72, 13.76]
Patton 1994	2	32	1	36	1.3%	2.25 [0.21, 23.66]
Pirsch 1993	2	32	1	28	1.3%	1.75 [0.17, 18.28]
Santos 2002	5	15	5	15	6.9%	1.00 [0.36, 2.75]
Wagner 1986	7	30	10	33	10.3%	0.77 [0.34, 1.77]
Wahlberg 1992	3	20	1	20	1.5%	3.00 [0.34, 26.45]
Subtotal (95% CI)		395		422	46.4%	0.91 [0.61, 1.34]
Total events	**42**		**46**			
Heterogeneity: $Tau^2 = 0.00$; $\chi^2 = 7.05$, df = 10 (P = 0.72); $I^2 = 0\%$						
Test for overall effect: Z = 0.49 (P = 0.62)						
Dihydropyridine						
Harper 1996	2	24	9	44	3.4%	0.41 [0.10, 1.74]
Lehtonen 2000	13	94	23	90	18.7%	0.54 [0.29, 1.00]
Morales 1989	1	15	1	15	1.0%	1.00 [0.07, 14.55]
Morales 1994	13	47	14	50	17.2%	0.99 [0.52, 1.88]
Rahn 1999*	4	130	7	123	4.9%	0.54 [0.16, 1.80]
Van den Dorpel 1994	2	25	6	25	3.1%	0.33 [0.07, 1.50]
Van Riemsdijk 2000	3	98	5	112	3.6%	0.69 [0.17, 2.80]
Wilkie 1994	1	17	5	17	1.7%	0.20 [0.03, 1.54]
Subtotal (95% CI)		450		476	53.6%	0.62 [0.43, 0.90]
Total events	**39**		**70**			
Heterogeneity: $Tau^2 = 0.00$; $\chi^2 = 4.65$, df = 7 (P = 0.70); $I^2 = 0\%$						
Test for overall effect: Z = 2.54 (P = 0.01)						
Total (95% CI)		**845**		**898**	**100.0%**	**0.74 [0.57, 0.97]**
Total events	**81**		**116**			
Heterogeneity: $Tau^2 = 0.00$; $\chi^2 = 13.48$, df = 18 (P = 0.76); $I^2 = 0\%$						
Test for overall effect: Z = 2.20 (P = 0.03)						
Test for subgroup differences: $\chi^2 = 1.88$, df = 1 (P = 0.17); $I^2 = 46.8\%$						



Blood Pressure Management in Children with CKD

Recommendation 5.1: We suggest that in children with CKD, 24-hour mean arterial pressure (MAP) by ABPM should be lowered to ≤50th percentile for age, sex, and height (2C).

Practice Point 5.1: We suggest monitoring BP once a year with ABPM, and monitoring every 3–6 months with standardized auscultatory office BP in children with CKD.

Practice Point 5.2: In children with high BP and CKD, when ABPM is not available, manual auscultatory office BP obtained in a protocol-driven standardized setting targeting achieved SBP <90th percentile for age, sex, and height of normal children is a reasonable approach.

Practice Point 5.3: Use ACEi or ARB as first-line therapy for high BP in children with CKD. These drugs lower proteinuria and are usually well tolerated, but they carry the risk of hyperkalemia and have adverse fetal risks for pregnant women.

Rationale for BP Target Recommendation in Children

- Rests heavily on ESCAPE trial:
  - Probable benefit in slowing CKD progression, and reducing left ventricular hypertrophy, with no increased risk of adverse events.
  - Children with proteinuria may benefit more; risks may be higher in those with salt-wasting disease.

Escape Trial Study Group. NEJM 2009: 361: 1639-1650

Top 10 Key Takeaways for Clinicians

1 Standardized office BP measurement

Standardized BP measurement emphasizes the importance of appropriate preparations and the measurement technique, not the type of device. The relationship between routine office BP and standardized office BP is highly variable; therefore, it is not possible to apply a correction factor to translate a given routine BP value to a standardized BP value.

2 Home BP monitoring

HBPM may be particularly important for the management of BP when a clinic visit is not practical, for example, during the coronavirus disease 2019 (COVID-19) pandemic. However, at present, HBPM should only be used to complement standardized office measurement and not guide treatment decisions, if standardized office BP is available.

3 BP target in CKD not treated with dialysis

Adults with high BP and CKD should be treated to a target SBP <120 mm Hg which must be measured using standardized office BP preparations and techniques. When measured under standardized conditions, targeting SBP <120 mm Hg reduces the risks of CV events and all-cause mortality in CKD; however, the effects on progression of kidney disease are uncertain.

4 BP target in CKD subgroups

The SBP target of <120 mm Hg also applies to the subgroups of older adults and those with increased albuminuria. The balance of benefits and harms is less certain in people with CKD G5 and in those with severely increased albuminuria (A3).

5 BP target in patients with diabetes

The benefits of intensive BP lowering are less certain among patients with concomitant CKD and diabetes, compared to patients with CKD without diabetes.

6 Antihypertensive agents in CKD

RASi (ACEi or ARB) should be used in patients with CKD and increased albuminuria, with or without diabetes. The evidence for use of RASi in patients with moderately increased albuminuria is lower in quality than in severely increased albuminuria.

7 Lifestyle interventions

Low sodium intake (<2 g/day) and moderate-intensity physical activity (≥150 min/week) are suggested in accordance with recommendations for the general population.

8 BP target in KTR

For adult kidney transplant recipients, a target of <130/<80 mm Hg, using standardized office measurement, is still a reasonable goal. A lower SBP goal (<120 mm Hg) for kidney transplant recipients would require additional data on the risks and benefits in this population.

9 Antihypertensive agents in KTR

Dihydropyridine CCB or ARB should be used as the first-line antihypertensive agent in adult kidney transplant recipients given their efficacy in and the importance of preventing graft loss.

10 BP management in children

BP target in children with high BP and CKD should be lowered to ≤50th percentile for age, sex, and height according to 24-hour MAP by ABPM. When ABPM is not available, standardized auscultatory office measurement should be used to target SBP <90th percentile.

Main Points of Controversy

Point	Counterpoint
Standardized office measurement of BP is not practical. It takes too much time in the clinic.	All large trials examining BP targets and hard outcomes used standardized measurement. Since the benefits associated with proper measurement outweigh the burden of time or cost, such effort is worthwhile. Moreover, the relationship between routine non-standardized and standardized office BP measurement is unpredictable for any individual patient, and thus a correction factor cannot be applied. Would you accept significant degree of bias or inaccuracy for measurement of serum creatinine, potassium, body weight, or age?
KDIGO recommends attended or unattended measurements but SPRINT and ACCORD used unattended BP.	Both trials used standardized office measurements, attended and unattended, with an automated device. The SPRINT protocol did not specify whether to obtain attended or unattended measurements, and similar CV risk reductions were observed irrespective of attended or unattended measurement. Differences between attended and unattended BP values are notably small, so proper patient preparation and measurement is key.
The SBP target recommendation is based on a single trial. The data were extrapolated from general population to CKD, with and without diabetes.	SPRINT enrolled patients without diabetes. It is the only large trial that examined CV events as the primary outcome and mortality as a secondary outcome with a prespecified CKD subgroup comparing two BP targets. The results are robust and there was no effect modification by baseline CKD status for these outcomes. In the standard glycemic subgroup of the ACCORD trial (which enrolled patients with diabetes), the primary CV benefit of intensive SBP lowering was similar to that observed in SPRINT. Future research should be conducted in specific CKD subpopulations to examine the broad applicability of the more intensive SBP target.
Subgroups (e.g., proteinuria >1 g, CKD G4 and G5, ADPKD or other etiology) were not sufficiently addressed by SPRINT.	We agree that patients with proteinuria >1 g/d, CKD G5, and ADPKD were excluded from the SPRINT trial; and the proportion of patients with CKD G4 was quite small. However, there is no evidence or strong theoretical reasons at this time to suggest that these subgroups would behave differently. In ADPKD, there is evidence that a target SBP <110 mm Hg is beneficial compared to a higher SBP target. We agree that caution should be exercised in these subgroups and more research specifically targeting these subgroups are needed. However, until there is evidence to the contrary, the SBP target <120 mm Hg appears to be reasonable for these subgroups.
The findings of the ACCORD trial are not consistent with the findings from SPRINT.	ACCORD did not recruit many patients with CKD because SCr >1.49 mg/dl was an exclusion criterion. ACCORD had a factorial design and in those randomized to standard glycemic control, a target SBP <120 mm Hg was shown to be beneficial compared to <140 mm Hg. These findings are similar to those observed in SPRINT.
There is a greater risk of stroke with SBP target <120 mm Hg vs. <140 mm Hg.	In SPRINT (including CKD) and ACCORD (primarily without CKD), stroke risk was lower or similar, but not greater, with target SBP <120 mm Hg versus SBP <140 mm Hg.
Older adults are more likely to fall with lower SBP.	Injurious falls, syncope, postural hypotension, and serious adverse events were not different between the lower and standard target arms of SPRINT. This was also the case in the older adult subgroup. In addition, CV, survival, and cognitive benefits were reported with a lower SBP target in SPRINT and in other studies in CKD.[1,2]

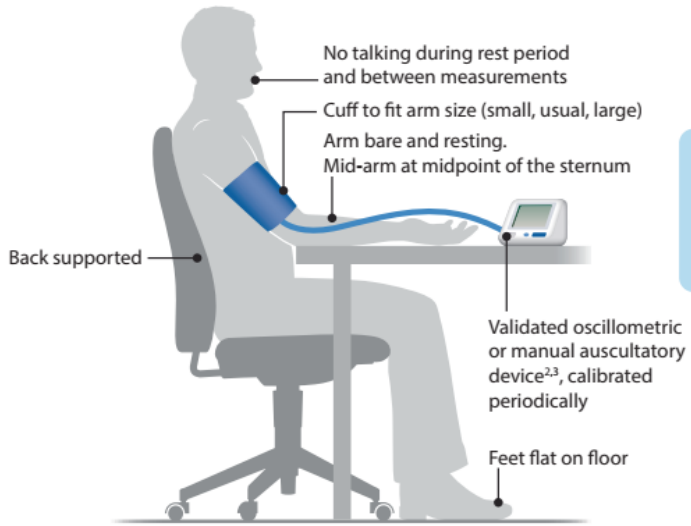
Main Points of Controversy

Point	Counterpoint
It may be more realistic to have two targets, one for which there is great certainty of benefit and another which is more aspirational (e.g., SBP <140 for all; SBP < 120 for some).	This alternative was discussed in detail by the BP Work Group but was eventually rejected, on the basis that: i) there are actually no data showing a benefit of <140 mm Hg compared to a target of, say, <160 mm Hg in CKD; ii) all subgroup within CKD may actually benefit from SBP <120 mm Hg; and iii) that this more complex scheme may encourage clinicians to continue adopting a SBP target <140 mm Hg for all CKD patients and deny many the potential advantages of tighter control. The relatively weak grading of the recommendation statement implies that the many people would want the recommended course of action, but some would not. Clinicians should understand the nature and rationale of the recommendations and engage in shared decision-making with their patients.
Other institutions recommend different targets based on the identical evidence.	This is a common consequence of scientific discourse. Just as there are also other guidelines that recommend the same SBP target of <120 mm Hg, there can be differences in the interpretation of the same evidence base. Our SBP target recommendation is arrived after a thorough systematic review of the literature and the health gains from such intensive control are contingent upon using SBP values obtained using standardized office measurement. Targets, intensive or not, are not meaningful if the protocol for proper patient preparation and measurement techniques are not followed.
In order to meet more intensive targets, frail and multimorbid patients using polypharmacy (including analgesics, sedatives, laxatives, prostate medications) will have more adverse events.	Age and frailty were not treatment effect modifiers of lower SBP on the CV and mortality benefits in SPRINT. Further, there were no differences in serious adverse events between the standard and intensive SBP arms. One caveat to this statement is nursing home residents and those with short life expectancy, as they were not included in the SPRINT trial. The number of BP medications to achieve the SBP target during the trial also did not appear to be a determinant of these outcomes. Nevertheless, individualization of treatment is key.
It is impractical and unwise to recommend targets that most healthcare professionals cannot follow.	The KDIGO Work Group takes the view that patients should not be penalized for suboptimal clinical practice. Good practice takes time to be adopted, and as such, recommending substandard practice of BP measurement or guidance for the sake of convenience will only perpetuate the status quo of suboptimal management and likely continue to lead to suboptimal outcomes.
In some countries, patients with CKD G3 are followed mainly by primary care physicians and these clinicians may not follow the recommendations from KDIGO	The guideline aimed to provide the best possible guidance for the treatment of patients with high BP and CKD. Because the KDIGO Work Group considers the guideline to be appropriate, the likelihood of their immediate acceptance should not be the major criterion driving the recommended guidance. Implementation is the next step in the process where further knowledge translation will need to be performed.
SPRINT and ACCORD demonstrated an increased risk of AKI and faster decline of GFR with target SBP <120 mm Hg vs. SBP <140 mm Hg.	The reported AKI events were generally mild (AKI Stage I) and did not appear to lead to kidney failure during the trial in the ACCORD cohort, the SPRINT cohort, and the SPRINT-CKD cohort. The decline of eGFR in both standard and intensive SBP arms in SPRINT was slow and the difference between the two arms was small. At the same time, intensive SBP lowering led to less, rather than more, albuminuria which may portend a better long-term prognosis of the kidney. Lastly, a recent meta-analysis showed intensive BP control reduces the risk of kidney failure in those with proteinuria at baseline. Although the long-term effects of intensive SBP lowering (<120 mm Hg) on albuminuria or GFR decline are uncertain, its effects on CV, mortality, and cognitive effects are convincing.

Overall Summary

- Update to 2012 KDIGO guideline on BP Management in CKD
- Provide recommendations and practice points on:
  - BP measurement
  - Lifestyle interventions for lowering BP in patients with CKD not receiving dialysis
  - BP management in patients with CKD, with or without diabetes, not receiving dialysis; in kidney transplant recipients (CKD G1T-G5T); and in children in CKD
- Standardized blood pressure measurement is consistent with large clinical trials with clinically important outcomes that used this measurement technique to define BP targets.
- CKD patients with high BP should limit their salt intake and undertake moderate intensity physical activity.
- CKD patients with high BP should be treated to a SBP target of <120 mm Hg using ***standardized office BP measurement. Individualization is KEY!***
- RASi (ACEi or ARB) should be used in patients with CKD and increased albuminuria, with or without diabetes. the recommendation and evidence in those with severely increased albuminuria and in diabetic patients with moderately increased albuminuria are particularly strong.
- Kidney transplant recipients should be treated to a target of <130/<80 using standardized office BP measurement.
- Children with CKD should be treated to lower 24h MAP by ABPM to ≤50th percentile for age, sex, and height

Central Illustration



- Quiet room (no talking by patient or observer)
- No smoking, caffeine, or exercise for ≥30 min before measurement
- Empty bladder
- Relax for >5 min

Lifestyle
- Salt intake <2 g/d (<90 mmol/d)
- Physical activity: 150 min/week moderate-intensity

	Pediatric patients	Adults with CKD with and without diabetes	Adult kidney transplant recipients
Targets	24 h MAP by ABPM ≤50th percentile for age, sex, and height	SBP <120 mm Hg	<130/<80 mm Hg
Preferred drugs	ACEi or ARB	ACEi or ARB • G1–G4, A3 without diabetes (1B) • G1–G4, A2 without diabetes (2C) • G1–G4, A2 or A3 with diabetes (1B)	Dihydropyridine CCB or ARB

POTENTIAL IMPLICATIONS

Potential implications of the 2021 KDIGO blood pressure guideline for adults with chronic kidney disease in the United States

2021 KDIGO Guideline

What's new for adults with CKD and high BP?

Recommends treatment to SBP <120 mmHg using standardized office BP measurement

Recommends ACEi/ARBs for adults with albuminuria and high BP (SBP ≥120 mmHg)

Current Study Goals

Determine potential implications of 2021 KDIGO guideline compared to:

2012 KDIGO guideline

2017 ACC/AHA guideline

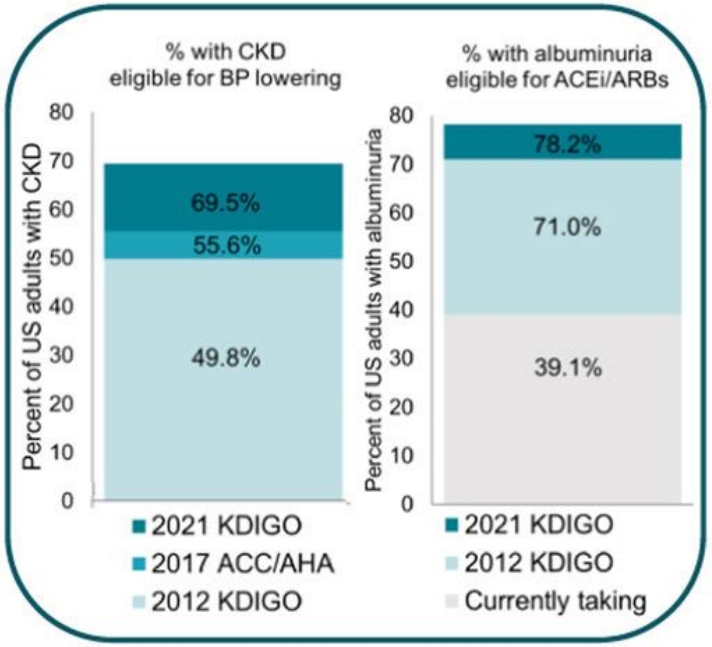
Data Source

nhanes National Health and Nutrition Examination Survey 2015-2018

N=9,419 adults aged ≥20 years with CKD

BP based on mean of up to 3 standardized measurements

Results



CONCLUSION:

Based on the 2021 KDIGO guideline, 69.5% of US adults with CKD are eligible for BP lowering. Among those with albuminuria, 78.2% are eligible but only 39.1% take ACEi/ARBs.

kidney INTERNATIONAL ISN

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Question and Answer