Evaluation Impact on the CTSC

Evaluation and Tracking Impact

- **SPARC Request Implementation at the CTSC.** 2 year project to install and implement a tracking system for the activities of the CTSC Cores. Fulfills EAC request for more detailed tracking of CTSC activities. Allows impact evaluation of COVID-19-related assistance and much more.

KL2 Program

- **KL2 Impact measured via bibliometrics - publication**. Kelli Qua and Clara Pelfrey measured the impact of the KL2 Program using bibliometrics (e.g. citation impact, collaboration nationally/internationally) comparing our KL2 Scholars to CWRU-based KO8 and K23 Scholars from the same time period[1] (2020)
- **Changes made to the KL2 Program resulting from evaluation.** Program leadership reviews and discusses the feedback and makes changes in response to this feedback. We have a robust track record for making real-time changes in the KL2 Program in response to scholar feedback (See Table G in Appendix A).

  KL2 Scholar feedback/Changes and improvements implemented:

  Coursework:
  - Desire for training in entrepreneuris/Entrepreneurism added. Used KL2 feedback to improve the training experience by the addition of training in entrepreneurialism and grant writing skills and exposure to study section review processes.
  - More skills in grantsmanship/KL2 Selection Study Section reviewers
  - More flexibility to tailor curriculum/Unique educational opportunities added.
  - Too much coursework/Revamped grantwriting course (CRSP 412) to focus on NIH style specific aims and significance and innovation sections.
  - Addition of specific topics into curriculum: NIH grant style specific aims; mass media for dissemination/Modified communication course (CRSP 413) to include dissemination through mass media, working with journalists.
  - Shorten entrepreneur course/Streamlined Innovation & Entrepreneurship course (CRSP 503) into 2-day intensive format
  - Addition of specific topics into seminar series (below)
  - Allow access to unique skill development/mentoring opportunities for individual Scholars/Added 'dream mentoring' and similar options to enable scholars to obtain skills in specific areas.

  Seminar Series:
  - Shorter talks and more experts on grantsmanship, better guidelines, feedback on presenting/ Instructions for seminar presentations; Candid feedback; Elevator speeches

  Team Science & Networking:

[1] Qua, K., & Pelfrey, C. (2020). Using bibliometrics to evaluate translational science training: Evidence for early career success of KL2 scholars. Journal of Clinical and Translational Science, 1-7. doi:10.1017/cts.2020.516.

- Create more informal opportunities to network/ Connect Today Collaboration Platform for Scholars; KL2 Alumni Reunion

Career Development Plan:

- Feedback on CDP should be kept constructive; delivered in-person/ Clinical Research Appraisal Inventory; Career Development Plan instructions; 2nd KL2 alumnus on mentorship committee; Feedback regarding CDP

Tracking Career Success:

- CV data too voluminous to enter into tracking survey/Instituted GTSS to track career progress and success (Since have migrated to Redcap)

- **Developed a KL2 Logic Model.** The KL2 logic model was used to demonstrate the process and outcome metrics for the KL2 Program and was used in our 2016 and 2017 renewal applications and to develop a detailed evaluation plan .(See Appendix A)

TL1 Program

- **Developed a TL1 Logic Model.** The TL1 logic model was used to demonstrate the process and outcome metrics for the TL1 Program and was used in our 2016 and 2017 renewal applications and to develop a detailed evaluation plan (See Appendix B).

CTSC Collaboration (National)

- **Entire CTSA Consortium analysis of publication impact (publication).** This study uses complementary bibliometric approaches to assess the scope, influence, and interdisciplinary collaboration of publications supported by single CTSA hubs and those supported by multiple hubs. Authors identified articles acknowledging CTSA support and assessed the disciplinary scope of research areas represented in that publication portfolio, their citation influence, interdisciplinary overlap among research categories, and characteristics of publications supported by multi-hub collaborations.[2]
- **Multi-hub collaboration of Retrospective Case Studies in Translational Research (publication).** Started a multi-CTSA hub collaboration on TS Case Studies. This collaboration led to five national presentations and publication of a protocol for conducting TS Case Studies (2020).[3]
- **Collaboration on KL2 Impact compared to other CTSA hubs and measured via bibliometrics**. Kelli Qua and Clara Pelfrey measured the impact of the KL2 Program using bibliometrics (e.g.

[2] Llewellyn, Nicole, Carter, Dorothy, Rollins, Latrice, Pelfrey, Clara, DiazGranados, Deborah, Nehl, Eric. Scope, Influence & Inter-disciplinary Collaboration: The Publication Portfolio of the NIH Clinical and Translational Science Awards (CTSA) Program from 2006 through 2017. Evaluation in the Health Professions. Mar 27, 2019. PMID: 30917690.

[3] Sara D, Kukic I, Scholl L, Pelfrey CM, Trochim W. A protocol for retrospective translational science case studies of health interventions. Journal of Clinical and Translational Science. 2020 July; doi: doi:10.1017/cts.2020.514.

citation impact, collaboration nationally/internationally) and are actively collaborating with UNC and Mayo to compare outcomes of our KL2 Scholars (manuscript in preparation).

CTSC Collaboration (Regional)

- **Inter-institutional collaboration and publication**. Does the CTSC foster collaboration among its researchers and between institutions? The answer is yes to both. By measuring co-authored publications, collaboration between CTSC partner institutions increased significantly over the period 2008- 2013. We found that collaboration within our institutions and between our partners increased over the first 5 years of the CTSC grant. We developed a detailed method for measuring internal collaboration[4] which led to a national presentation and publication[5] (2014).
- **Internal connectedness among cores**. We used social network analysis to examine our internal connectedness within the CTSC. The densities of ties within our collaborative increased dramatically in the first 5 years of our grant. This data was used in our CTSC Renewal application.(2014)
- **Collaboration with the community**. Examining collaborative ties with community research partners in northeast Ohio, we found that 92% of our CTSC Cores reported collaboration with the community. Statewide, we found that most of our cores collaborate with other Ohio CTSA hubs and 75% of our cores collaborate with CTSA organizations nation-wide. Our CTSC has fostered extensive collaboration that has benefitted researchers, the community and nationwide research on improving people's health.(2014)

Evaluation Outcomes

- **Community collaboration and publication.** The Evaluation Core collaborated extensively with the Center for Reducing Health Disparities (CRHD) at MetroHealth in a developmental evaluation, which resulted in a scientific publication[6], and a robust system that allows the CRHD to track and evaluate what they have accomplished. (2016)
- **CTSC Logic model developed-informed our metrics.** In 2014, the Evaluation Core took the entire CTSC through a detailed process to examine what it does and what outcomes result. This process took more than a year and resulted in a detailed logic model of our program, which was then used in a retreat to do visioning for the CTSC's future and was used to inform the metrics for the CTSC Renewal in 2016 and 2017.

[4] Jake Luo, Carolyn Apperson-Hansen, Clara M Pelfrey and Guo-Qiang Zhang. RMS: A platform for managing cross-disciplinary and multi-institutional research project collaboration. BMC Medical Informatics and Decision Making. 2014 Nov 30; 14(1):106. PMCID: PMC4264263.

[5] Jake Luo, Clara Pelfrey, Guo-Qiang Zhang. Visualizing and Evaluating the Growth of Multi-Institutional Collaboration Based on Research Network Analysis. 2014 AMIA Clinical Research Informatics Summit. Jan. 2014.

[6] Pelfrey CM, Cain KD, Lawless ME, Pike E, Sehgal AR. A Consult Service to Support and Promote Community-Based Research: Tracking and Evaluating a Community-based Research Consult Service. J Clin Transl Sci. 2017 Feb;1(1):33-39. doi: 10.1017/cts.2016.5. Epub 2016 Dec 29. PMCID: PMC5395251.

- **NCATS Common Metrics (CM) and CTSC Implementation.** In 2015, Clara Pelfrey, our Evaluation Director, helped develop the NCATS Common Metrics (CM). In 2016, we began implementation of the CM by developing teams from the cores involved in the programs: KL2, TL1, Pilot and IRB. Through collaborative sessions, the teams gathered the data and developed new databases to collect, track and report on the data required for the CM. The CM results have spurred several forward-thinking conversations about strategies to improve performance.
    - **Median days to IRB Approval.** IRB data was obtained city-wide from all our affiliated organizations. This led to sharing best practices, which were also written up in Story Behind the Curve and shared with all our partner organizations. The regulatory personnel now hold quarterly meetings across the city.
    - **Pilot Program Publications and Funding.** Pilot Program database was developed to track Pilot Awardee publications and extramural funding. Database was improved to include PMCID on publications and accounting for use in the CM.
    - **KL2 Careers Metric.** The CM process helped kick off migration of KL2 Tracking data to Redcap for safe and consistent collection. This helped lead to bibliometric studies of publication impact both locally and multi-hub collaborations with other CTSA hubs.
    - **TL1 Careers Metric.** Implementing the CM at the CTSC helped us to address the very low numbers of women and URM graduates in our TL1 program. The 7 years of data have now begun to show significant increases in numbers of women and URM graduates from the targeted recruiting.
    - **Informatics Metric.** The process of gathering the Informatics CM data has allowed us to share data city-wide using our common data models, OMOP and TrinetX, on how we are making patient data useful for research studies.

CTSC Evaluation National Leadership and Service

- **NCATS Study Section.** National CTSA Coordinating Center review panel. March 14, 2017.
- **Ad Hoc reviewer.** Clinical and Translational Science Journal. 2015. J. Clinical and Translational Science. 2020.
- **National Advisory Boards:**
    - External Advisory Committee Member for Evaluation and Assessment, University of Kentucky (UK) Center for Clinical and Translational Science (CCTS). Nov. 2017- present.
    - External Advisory Committee Member for Tracking & Evaluation, University of Illinois, Chicago (UIC) Center for Clinical and Translational Science (CCTS). Nov. 2017- present.
    - External Advisory Committee Member for Evaluation, Institute for Clinical and Translational Science (ICTS), University of Iowa. Jan. 2019 - present.
    - External Advisory Committee Member for Evaluation, Center for Clinical and Translational Science (CCTS), University of Utah Health Sciences. Feb. 2020 - present.
- **National Center for Advancing Clinical and Translational Science (NCATS), NIH**. Co-Lead for Common Metrics Work Group for Workforce Development. Serve as workgroup co-lead providing feedback to PI's Common Metrics workgroup on Workforce Development. Aug. 2015 – Dec. 2016.
- **American Evaluation Association (AEA) Translational Research Evaluation Topical Interest Group (TRE TIG).** 2014-present.
    - Co-chair: 2015-16.

    - Chair: 2016-17.
    - Chair: 2019-20.
- **National Center for Advancing Clinical and Translational Science (NCATS), Methods & Process Domain Task Force (DTF),** sub-group for Institutional Readiness for Team Science. May 2017 – present.
- **CTSA Bibliometrics work group**. Engaged in a national survey of CTSA evaluators regarding use of bibliometrics. March 2017 – present.

CTSC Evaluation Regional Leadership and Service

- **Ohio Program Evaluators Group (OPEG) Board Member.** 3 year elected position. July 2018 – present.
- **Ohio Program Evaluators Group (OPEG) Local Arrangements Working Group** to prepare for the national AEA meeting to be held in Cleveland, OH in 2018. Meeting with the national AEA representatives and preparing AEA 365 blog week of posts on evaluation in Cleveland. Calendar year 2018.

CTSC Evaluation influence via blogs and presentations (Please refer to chronological list in Appendix C)

- American Evaluation Association published blog posts on the AEA365 | A Tip-a-Day by and for Evaluators (2017, 2018a, 2018b)[7]
- Sunbelt Social Networks Conference of the International Network for Social Network Analysis (INSNA)
- American Evaluation Association (AEA) presentations
- American Association of Medical Colleges (AAMC) presentations
- Ohio Program Evaluators (OPEG) presentations
- CTSA national evaluators (Evaluation KFC) presentations

[7] **AEA365 Blog Post, 2017**. Graphic Recording as a visual tool for evaluating Research, Technology and Collaboration by Clara Pelfrey and Johnine Byrne. In: AEA365 | A Tip-a-Day by and for Evaluators. May 17, 2017. http://aea365.org/blog/?s=graphic+recording&submit=Go
AEA365 Blog Post, 2018. Graphic recording as an evaluation tool in community engaged research by Clara Pelfrey, Johnine Byrne and Darcy Freedman. In: AEA365 | A Tip-a-Day by and for Evaluators. April 4, 2018. https://aea365.org/blog/graphic-recording-as-an-evaluation-tool-in-community-engaged-research-by-clara-pelfrey-johnine-byrne-and-darcy-freedman/
AEA365 Blog Post, 2018a. There is so much to see and do in Cleveland, you might want to stay a few extra days by Clara Pelfrey. In: AEA365 | A Tip-a-Day by and for Evaluators. Sept. 2018.

Table E. Selected *Key* Metrics (evidence to evaluate the effectiveness of the KL2 program)

Resources/ Inputs	Activities	Results/Outcomes/Impact		
		Short-term	Intermediate	Long-term
[1,4,6,7,8]Mentor publication, training, and funding record Participating departments and programs Participating institutions Program budget Team Science Education [E] Diversity Plan [A,G]	[3]Applications to program [1]Annual KL2 Selection Meeting [1,2]Scholars recruited to program [1,2]URM applicants and entering scholars [5]Courses taught [1,2]CDPs reviewed & updated annually [13]Diversity climate	[4]Clinical competencies obtained (CRAI survey) [1,5]URM complete KL2 program [F,G] [13]Improved diversity climate [4,6,10,11,12] # Publications[D] [10] # Research presentations [4,14] Course completion & program feedback [4] Mentoring effectiveness	[9,10] Faculty or leadership positions[B] [6,10,11,12] # Publications[D] [7, 8,10] Grant funding obtained[B] [12] ↑ Interdisciplinary collaboration	[9,10] Faculty or other research positions[B] [7,8,10,12]Grants[C] [6,10,11,12] ↑ Publications/ citations[D] [10] # Patents [9,10] Leadership accomplishments

Data Sources

[1] Program database, [2]Spreadsheets with Scholar rosters, demographics,[3]Application data (Webgrants), [4]Scholar & mentor surveys (Redcap Survey), [5]University Registrar,[6]PubMed, [7]NIH Reporter,[8]University Grants and Contracts database, [9]LinkedIn, Internet searches, CVs,[10]KL2 Scholar Tracking system (GTSS),[11]My NCBI (My Bibliography), [12]Elsevier Pure (formerly SciVal) Reporting Module, [13]Diversity Climate Survey, [14]Course Evaluations

NCATS Common Metrics (finalized and proposed) for Workforce Development

[A] New educational innovations,
[B] Sustainable careers in CTR,
[C] Percentage of grants,
[D] Scholar publications,
[E] Team science education,
[F] Representation of URM & women,
[G] Innovative processes targeted to URM

Table F: Timing of administration of evaluation instruments in KL2 program

Assessment Measure	Baseline	Annually	At Exit	Post-Grad
Clinical Research Appraisal Inventory (CRAI)[2]				
Career Development Plan (CDP)[3]				
Mentoring Profile Questionnaire & Outcome Measures (MPQ)[4]				
Mentorship Effectiveness Scale (MES)[5]				
Satisfaction Program Exit Interview (SPEI)[7]				
Satisfaction with Program Components (SPC)[8]				
Graduate Tracking Survey System (GTSS)[9]				
Annual Mentor Evaluation of Scholars[10]				
Annual Scholar Evaluation of Mentors				

[2]CRAI: 92-item clinical research efficacy rating scale assessing confidence in 10-domains (Mullikin, 2007, Lipira 2010, Robinson 2013, Eller 2014).(18-20)
[3]CCD: assesses scholars' plans in 4 domains: objectives, methods, research, time line (Horwitz, 2011).(22)
[4]MPQ: 15-item questionnaire assessing the nature of the mentoring relationship & outcomes (Berk, 2005).(27)
[5]MES: 11-items assessing scholars' perceived effectiveness of their mentors (Berk, 2005).(27)
[7]SPEI: 4-question interview protocol with numerous probes assessing satisfaction with the KL2 program.
[8]SPC: 30-items assessing satisfaction with program components (Interdisciplinary Clinical Research Career Development (MCRCD) survey designed by K-12 Evaluators, 2005)
[9]GTSS: Rockefeller University CTSA-based tracking system for trainees (customized to the CTSC). This survey tracks publications, grants, patents and clinical trials as well as several other career outcomes annually (Romanick, 2015)(28)
[10]Annual Mentor Evaluation of Scholars: 36-item survey measuring the scholar's clinical research competencies; narrative evaluation of progress, accomplishments, independence and time commitments. (Adapted from Miller, 1990.)(29)
[11] Annual Scholar Evaluation of Mentors (mentoring competency assessment)(30)

Table G. KL2 Evaluation feedback and resulting program improvements		
Content Area	**Scholar Feedback**	**KL2 Changes Made**
Coursework	• More skills in grantsmanship • More flexibility to tailor curriculum • Too much coursework • Addition of specific topics into curriculum: NIH grant style specific aims; mass media for dissemination • Shorten entrepreneur course • Allow access to unique skill development/mentoring opportunities for individual Scholars	• KL2 Selection Study Section reviewers • Unique educational opportunities • Revamped grantwriting course (CRSP 412) to focus on NIH style specific aims and significance/innovation sections • Modified communication course (CRSP 413) to include dissemination through mass media, working with journalists. • Streamlined Innovation & Entrepreneurship course (CRSP 503) into 2-day intensive format • Addition of specific topics into seminar series (below) • Added 'dream mentoring' and similar options to enable scholars to obtain skills in specific areas.
Seminar Series	• Shorter talks and more experts on grantsmanship, better guidelines, feedback on presenting	• Instructions for seminar presentations • Candid feedback • Elevator speeches
Team Science & Networking	• Create more informal opportunities to network	• LinkedIn Group • KL2 Alumni Reunion
Career Development Plan	• Feedback on CDP should be kept constructive; delivered in-person	• Clinical Research Appraisal Inventory • Career Development Plan instructions • 2nd KL2 alumnus on mentorship committee • Feedback regarding CDP
Tracking Career Success	• CV data too voluminous to enter into survey	• Instituted GTSS to track career progress & success

Table H. KL2 Program domains, data/metrics for measurement and how the data are used for evaluation.		
Domain	**Data/Measure**	**Use of Data**
Scholars and Mentors		
Scholar selection	• Applications to KL2 program • Feedback from selection meeting	• Monitor demographics, disciplines and URM to ensure diversity in program • Improve selection meeting
Scholar/mentor relationships	• Tracking CDP • Evaluation of mentors by Scholars (Mentorship Profile Questionnaire & Outcomes Measure and the Mentorship Effectiveness Scale) • Mentor evaluation of scholars competencies • Notes from mentoring meeting with Dr. Dweik	• Annual review & reflection to monitor progress on career plan • Measuring the scholar's clinical research competencies; narrative evaluation of progress, accomplishments, independence and time commitments • Assess functioning of mentor-mentee match
Scholar Career Development	• Knowledge & skills acquired (CDP tracking) • Publications/presentations • Grants (applications and awards) • Team participation/collaboration (publications)	• Monitor progression of change in strength/focus areas • Satisfactory progression of clinical research self-efficacy • Determine K-to-R transition, grant success • Assess interdisciplinary collaboration • Identify areas for future development
Career success	• GTSS: annual progress in degree completion, publications, grants, patents, clinical trials, promotions, honors, presentations & changes in leadership roles	• Assess scholar success in developing into productive CT scientists
Use of CTSC resources by Scholars	• Pilot applications from Scholars • Use of Request Management System (RMS)	• Determine if scholars are adequately using CTSC resources

Scholar diversity	• Disciplines, institutions, colleges, and departments of applicants • Ethnicity, race and gender	• Ensure interdisciplinary nature of KL2 program in both faculty and scholars • Ensure representation of URM
Overall Program Evaluation		
Coursework	• Course quality, content, relevance, & satisfaction via end-of-course survey	• Timely CQI changes in course content, instructors
Overall Program	• Exit interviews & Satisfaction with program components survey	• Timely CQI changes to improve program
New Initiatives		
K-Club	• Attendance (KL2, individual K, TL1 trainees) • Feedback from attendees	• Asses value to attendees
Mentor education KL2 graduates	• # Scholars in mentor training • Scholars feedback re: training	• Usage & value of mentor education

Appendix A

Figure 1: CTSC Institutional Career Development Core ("KL2 Program") Logic Model: The goal of the KL2 Program is to educate leaders for the nation's multidisciplinary clinical and translational research workforce, to accelerate clinical research education, and to educate all members of the clinical research team.

Resources/Inputs	Activities	Results/Outcomes* –> Impact		
		Short-Term (Changes in learning)	**Intermediate (Changes in action)**	**Long-Term (Changes in conditions)**
Research/clinical facilities & academic infrastructure Core curriculum Faculty Career & Research mentors Program directors/ staff KL2 Steering Committee TWD Advisory Board Diversity Advisory Committee (proposed) KL2 funding Institutional & CTSC support services Evaluation support Applicants Assessment of individual development needs	Recruit, select, and retain scholars, especially from URM Provide skills in CTS competencies & team science Provide interdisciplinary CTR resources Provide mentoring & protected research time Provide RCR education Provide opportunities for professional development and networking Provide mentor development Evaluate program for continuous improvement Provide efficient management and communications systems Career Development Plans **Participation** Scholars Faculty Mentors Post-doctoral trainees Program leadership	Scholars demonstrate increased self-efficacy in clinical research competencies Achievement of competency in areas requiring individual training Improved oral and written skills for dissemination of scientific findings Enhanced grant writing skills Enhanced skills for team science C/T research Increased understanding of interdisciplinary research Continuous improvement of KL2 program Enhanced program diversity	Increased dissemination of research findings (publications, presentations) Increased independent grant funding obtained Scholars promoted to positions of leadership Scholars receive honors & recognition Scholars mentor junior investigators/trainees Enhanced faculty diversity in URM Increased # of diversity grants obtained Enhanced interdisciplinary collaboration Improved quality of KL2 program	Scholars become leaders in CTS Increased # faculty involved in CTR Accelerated dissemination and translation of CTS findings Improved efficiency & quality of the CTS research enterprise More diverse CTS workforce **Impact** Improved human health locally, nationally, internationally Improved clinical practices Increased diversity in the clinical translational science workforce

* Metrics for evidence of success and data sources are shown in the evaluation section of the KL2 program.

Appendix B

Figure 3. Logic Model and Metrics for the CTSTP. Goal: Train future leaders in C/T research.

Resources/Inputs	Outputs		Results/Outcomes –> Impact		
	Activities (What we do)	Services and Events (How we do it)	Short-Term (Changes in learning)	Intermediate (Changes in action)	Long-Term (Changes in conditions)
Research & clinical facilities at CWRU, VA CCF, UHCMC, MHMC, SOM, SON & SOE academic infrastructure Core TL1/KL2 curriculum C/T Science & 6+ other PhD programs Research-intensive residencies/fellowships >100 faculty mentors Program directors/ staff Steering Committee, TWD Advisory Board TL1 funding Institutional funding University IT & other support services	Recruit outstanding trainees & mentors in C/T research Provide MD or DNP education *integrated* with PhD training Provide C/T research training in research track residency & fellowship programs, or postdoctoral fellowships Increase diversity in the program Provide opportunities for professional development Provide RCR training Create trainee and trainee/alumni communities Provide faculty and staff support for the communities Evaluate all aspects of program	Offer courses in the SOM, SON, SOE & PhD programs Involve trainees and PhD mentors in recruiting Provide director guidance and faculty mentoring Match trainees to mentors Training: IDPs, RCR, grantsmanship Provide support & community for URM students Connect students & alumni Provide research seminars, annual retreats Provide professional development workshops Integrate clinical & research training for MD-PhD students Track & evaluate inputs, outputs, outcomes	Predoctoral: complete MD or DNP degree requirements Complete PhD degree requirements Postdoctoral: complete research-intensive residency or fellowship. Publications Scientific presentations Predoctoral: individual fellowship funding Postdoctoral: K awards, other fellowships Develop skills for independent and team science C/T research	Publications Postdoctoral grant funding Predoctoral trainees placed in residency program or research position Postdoctoral trainees obtain faculty position or other research position K awards and other fellowships Research grants Launch C/T research program	Improved human health locally, nationally, internationally Improved clinical practices Increased diversity in the clinical translational science workforce Leadership accomplishments Lead C/T research programs Faculty positions or other research positions Publications Citations Research grants

Selected *Key* Metrics (things to count or measure to evaluate the effectiveness of the program)

Resources/Inputs	Outputs	Results/Outcomes/Impact: Short-term	Results/Outcomes/Impact: Intermediate	Results/Outcomes/Impact: Long-term
[1,4,6,7,8]Mentor publication, training, and funding record Participating departments and PhD programs Participating institutions Program budget Team Science Training [E] Diversity Plan [A]	[3]Applications to program [1,2]Students recruited to program [1,2]URM applicants and entering students [4,5]Courses completed [5]Course grades [4]Seminars and workshops attended [2]IDPs completed [2]RCR training completed [4]Residency placements	[1,5]Students completing degrees [1,5]URM students completing degrees [F,G] [4]Diversity climate survey [1,2,5]Time to degree [4,6]Publications [D] [4]Research presentations [4]Pre-doctoral grants or fellowships	[4]Residency or research position placements [B] [1,4]Diversity of residency or research position placements [B] [1]Residency programs [4,6]Publications [D] [4,7]Post-doctoral grants and fellowships [B]	[4,9]Faculty or other research positions [B] [4,7]Grants [C] [4,6]Publications and citations [D] [4]Leadership accomplishments Improved clinical practices Increased diversity of the research workforce

Data Sources: [1]Program database, [2]SOM Graduate Education databases, [3]AMCAS application data, [4]Student, mentor & alumni surveys (e.g diversity survey), [5]University Registrar, [6]PubMed, [7]NIH Reporter, [8]University Grants and Contracts database, [9]LinkedIn, Internet searches.

NCATS Common Metrics (*proposed*) for Workforce Development
[A]New educational innovations, [B]Sustainable careers in CTR, [C]Percentage of grants, [D]Trainee publications, [E]Team science training, [F]Representation of URM/women,
[G]Innovative processes targeted to URM

Table E. Evaluation domains and metrics.

Trainee progression and completion of program requirements: publications, scientific presentations, grants, awards/honors, leadership accomplishments, curricular progression (courses, qualifying exam/thesis proposal, PhD dissertation), TTD.

Trainee recruiting and qualifications of applicants and matriculants: Competitiveness, diversity (URM, gender, disabilities, scientific fields), size and institutional sources of applicant pool, recruiting approaches (involvement of trainees and mentors).

Development and utilization of CTSTP curriculum: Team science, RCR, IDPs, K Club professional development, retreats, seminars, grants workshops.

Alumni outcomes: positions attained, research activities, grants, leadership accomplishments.

Mentors: number, quality and diversity of mentors, participation in mentor development activities, collaborative connections, publication and grant productivity, trainee evaluation of mentors.

Program: effectiveness of program design, curriculum and events: assessed by Steering Committee and trainee Council (section 3.1).

Program leadership: assessed by Advisory Board, trainees.

Appendix C

Chronological list of national evaluation presentations:

1. Evaluation Key Function Committee (KFC) Cohort Presentation. Social Network Analysis2: Intra-CTSC co-author publication analysis and Inter-CTSA collaboration network analysis. Webinar presentation to CTSA national evaluators. Nov. 7, 2013.
2. Webinar Presentation. Measuring the Value of the CTSC: Planning & executing an Evaluation Retreat. Webinar presentation to AEA Translational Science Topical Interest Group. Dec. 2014.
3. Symposium Presentation. Stages of Community Engagement: Tracking and Evaluation in a Community Research Consult Service within the Clinical & Translational Science Collaborative (CTSC) . Clara M. Pelfrey, Mary Ellen Lawless, Katrice Kain, Ashwini Sehgal. American Evaluators Association (AEA), Denver, CO. Oct. 2014.
4. Symposium Presentation. Higgins, PA, Moore, SM, Pelfrey, CM, Papp, K. 'Using Social Network Analysis to Demonstrate Intra- and Inter-Institutional CTSA Collaborations.' State of the Science Congress on Nursing Research, Washington, DC. Sept. 2014.
5. Symposium Presentation. Jake Luo, Clara Pelfrey, Guo-Qiang Zhang. Visualizing and Evaluating the Growth of Multi-Institutional Collaboration Based on Research Network Analysis. 2014 AMIA Clinical Research Informatics Summit. Jan. 2014.
6. Webinar Presentation. Clara Pelfrey and Mary Ellen Lawless. How to Measure Community Engagement? Tracking and Evaluating a Community-Based Research Consult Service. CTSA Community Engagement Managers. Feb. 17, 2015.
7. Session Presentation and Session Chair. Clara Pelfrey, Mary Ellen Lawless, Katrice Cain, Ashwini Sehgal. Evaluating Outcomes in Community Engagement: Mixed methods approach including Social Network Analysis and a Process Marker Model. American Evaluation Association, Chicago, IL. Nov. 2015.
8. Session Presentation. Clara Pelfrey. How to Measure Community Engagement? Tracking and Evaluating a Community-Based Research Consult Service. Ohio Program Evaluators Group Spring Exchange. May 8, 2015.
9. Poster Presentation. Clara Pelfrey, Katrice Cain, Mary Ellen Lawless, Earl Pike, Ashwini Sehgal. Evaluating a Community Research Consult Service - Getting to Outcomes and Impacts. Session number 2483, Poster A186 at the Translational Science 2017 meeting in Washington, DC, April 19-21, 2017.
10. Poster presentation. Clara M. Pelfrey, Sumita B. Khatri, Billie Kyriakides, Jenn Angelo, Amy Hise, Susan Freimark, Sharon L. Stein, Lisa Mencini, Luanne Paynick, Leslie Dickson, Pamela B. Davis. Evaluating leadership development for women in academic medicine: A framework for assessing impacts of the FLEX Professional Development Program. Group on Women in Science and Medicine (GWIMS), AAMC meeting, Nov. 4, 2017, Boston, MA.
11. Session Presentation. Clara Pelfrey, Katrice Cain, Mary Ellen Lawless, Earl Pike, Ashwini Sehgal. Developmental evaluation of a community-based research consult service reveals the multi-directional nature of translational research. Wed. Nov 08, 2017 at the Evaluation 2017 meeting in Washington, DC, Nov. 2017.
12. Session Chair. Clara Pelfrey. Learning What Works and Why in Implementing Common Metrics for a Multi-Site Program: Lessons from the CTSA Common Metrics Initiative. Fri. Nov 10, 2017 at the Evaluation 2017 meeting in Washington, DC, Nov. 2017.

13. Session facilitator. Assessing the Organizational and Individual Readiness for Developmental Evaluation within the context of the CTSA Program (Chair: Doug Easterling). Fri. Nov 10, 2017 at the Evaluation 2017 meeting in Washington, DC, Nov. 2017.
14. Poster Presentation. Clara Pelfrey, Katrice Cain, Mary Ellen Lawless, Earl Pike, Ashwini Sehgal. Evaluating a Community Research Consult Service - Getting to Outcomes and Impacts. Session number 2483, Poster A186 at the Translational Science 2017 meeting in Washington, DC, April 19-21, 2017.
15. Poster presentation. Clara M. Pelfrey, Sumita B. Khatri, Billie Kyriakides, Jenn Angelo, Amy Hise, Susan Freimark, Sharon L. Stein, Lisa Mencini, Luanne Paynick, Leslie Dickson, Pamela B. Davis. Evaluating leadership development for women in academic medicine: A framework for assessing impacts of the FLEX Professional Development Program. Group on Women in Science and Medicine (GWIMS), AAMC meeting, Nov. 4, 2017, Boston, MA.
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17. Session Chair. Clara Pelfrey. Learning What Works and Why in Implementing Common Metrics for a Multi-Site Program: Lessons from the CTSA Common Metrics Initiative. Fri. Nov 10, 2017 at the Evaluation 2017 meeting in Washington, DC, Nov. 2017.
18. Session facilitator. Assessing the Organizational and Individual Readiness for Developmental Evaluation within the context of the CTSA Program (Chair: Doug Easterling). Fri. Nov 10, 2017 at the Evaluation 2017 meeting in Washington, DC, Nov. 2017.
19. Session Chair 1230: “How are we moving the needle? Using translational research evaluation techniques to identify factors that promote/inhibit turning discoveries into better health”, AEA meeting, Oct. 31, 2018.
20. Panel speaker: Translational science case studies: Factors that promote or inhibit moving scientific discoveries into better medicine/health (Multi-hub collaboration with Mozhdeh Bahranian, University of Wisconsin; William Trochim, Weill Cornell; Linda Scholl, University of Wisconsin and Elias Samuels University of Michigan.) AEA Meeting, Oct. 31, 2018.
21. Panel Speaker. Development and use of Retrospective Case Studies in clinical and translational science. Session entitled : Evaluation, Learning, and Strategic Management in Translation Science Programs”. ACTS panel, March 2019.
22. Poster presentation. Evaluating Leadership Development for Women in Academic Medicine: Quantitative outcomes of the FLEX Leadership Development Program. Clara M. Pelfrey, Sumita B. Khatri, Philip A. Cola, Billie Kyriakides, Joshua A. Gerlick. AAMC Meeting, Phoenix, AZ, Nov. 9, 2019.
23. Poster presentation. Evaluating Leadership Development for Women in Academic Medicine: Qualitative Outcomes of the FLEX Leadership Development Program. Joshua A. Gerlick, Sumita B. Khatri, Philip A. Cola, Billie Kyriakides, Clara M. Pelfrey. AAMC Meeting, Phoenix, AZ, Nov. 9, 2019.
24. Co-Author. A Bibliometric Analysis of the Four Year KL2 Program at the Clinical and Translational Science Collaborative (CTSC). Kelli Qua and Clara Pelfrey. Minneapolis, MN. AEA meeting abstract 2019. Nov. 14, 2019.

25. Symposium presenter. Advances in the Use of Retrospective Case Studies for Understanding Translational Research. Clara Pelfrey, Linda Scholl, Elias Samuels, Mohdeh Bahrainian. Minneapolis, MN, AEA meeting Nov. 15, 2019.
26. Think Tank Discussion Facilitator. 1054: Myth vs. Reality: Are You Responsible With Your Metrics? Clara Pelfrey, Di H Cross (NIH, OEPR), Joshua Schnell [Clarivate Analytics], Paula Fearon [Lexical Intelligence, LLC] in Research, Technology & Development Evaluation Think Tank. Minneapolis, MN, AEA meeting Nov. 15, 2019.
27. Panel Speaker. Current Trends in Qualitative Methodology for Translational Science Research and Evaluation. Session ID: 2571. ACTS Meeting in Washington, DC. Converted into a webinar due to COVID-19. Over 400 attendees. July 8, 2020.
28. Author. Dodson, S., Kukic, I., Scholl, L., Pelfrey, C., & Trochim, W A Protocol for Retrospective Translational Science Case Studies of Health Interventions. Transforming Research virtual conference sponsored by Bioscientifica. Oct. 15, 2020.

Regional Presentations:

1. Invited Presenter in "Emerging Tools and Technology in Evaluation" Panel, Research Technology and Development (RTD) Topical Interest Group (TIG) with the American Evaluation Association. Offsite meeting. Title: Stumbling blocks in research: Comparative analysis of retrospective case studies to identify barriers and promoters of translational science. MetroHealth Medical Center, Cleveland, OH, Oct. 31, 2018.
2. Invited Presenter. Kelli Qua, Clara Pelfrey: Five strategies for using bibliometrics to evaluate scholarly performance. Ohio Program Evaluators Fall Conference (Online). September 25, 2020.