

Title: A formalization of one of the main claims of “Cost-effectiveness analysis of pharmacogenomics-guided clopidogrel treatment in Spanish patients undergoing percutaneous coronary intervention” by Fragoulakis et al. 2019

Authors: George P. Patrinos, ORCID: 0000-0002-0519-7776

Affiliations: University of Patras, Greece. E-mail: gpatrinos@upatras.gr

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http://purl.org/np/RAn15vsPJEVdJvjNKtBPo_oadtjeP9oc3Si-69FiJ4poQ

Editor: Cristina-Iulia Bucur, ORCID: 0000-0002-7114-6459

Review comments from:

- Tobias Kuhn, ORCID: 0000-0002-1267-0234
- Davide Ceolin, ORCID: 0000-0002-3357-9130
- Margherita Martorana, ORCID: 0000-0001-8004-0464
- Cristina-Iulia Bucur, ORCID: 0000-0002-7114-6459

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Abstract:

Fragoulakis et al. claimed in previous work that pharmacogenomics-guided clopidogrel strategy represents a cost-effective treatment for patients undergoing PCI. We present here a formalization of that claim, stating that all things of class “pharmacogenomics guided clopidogrel therapy” that are in the context of a thing of class “patient undergoing PCI” generally have a relation of type “enables” to a thing of class “cost-effective treatment” in the same context.

1. Introduction

Fragoulakis et al. [1] state that “Our data show that pharmacogenomics-guided clopidogrel treatment strategy may represent a cost-effective choice compared with non-pharmacogenomics-guided strategy for patients undergoing PCI.”. We present here a formalization of the main scientific claim from this quote by using a semantic template called the super-pattern [2].

2. Formalization

Our formalization looks as follows:

CONTEXT-CLASS (“in the context of all ...”): [patient undergoing PCI](#)
SUBJECT-CLASS (“things of type ...”): [pharmacogenomics guided clopidogrel therapy](#)
QUALIFIER: [generally](#)
RELATION-TYPE (“have a relation of type...”): [enables](#)
OBJECT-CLASS (“to things of type...”): [cost-effective treatment](#)

In the context class we use a new minted class “patient undergoing PCI” that is a subclass of “patient” (Q181600) from Wikidata and is related to the class “percutaneous coronary intervention” (Q2008344) from Wikidata. In the subject class, we use a new minted class “pharmacogenomics guided clopidogrel therapy” that is a subclass of “treatment” (Q179661) from Wikidata and is related to the class “pharmacogenomics” (Q1152227) and “clopidogrel” (Q410237) from Wikidata. In the object class we minted a new class “cost-effective treatment” that is a subclass of “treatment” (Q179661) from Wikidata and is related to the class “cost-effectiveness analysis” (Q1754768) from Wikidata.

3. RDF Code

This is our formalization as a nanopublication in TriG format:

```
@prefix this: <http://purl.org/np/RA15vsPJEVdJvjNKtBPo_oadtjeP9oc3Si-69FiJ4poQ> .
@prefix sub: <http://purl.org/np/RA15vsPJEVdJvjNKtBPo_oadtjeP9oc3Si-69FiJ4poQ#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix sp: <https://w3id.org/linkflows/superpattern/terms/> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
  np:hasProvenance sub:provenance ;
  np:hasPublicationInfo sub:pubinfo ;
  a np:Nanopublication .
}
sub:assertion {
  sub:spi a sp:SuperPatternInstance ;
  rdfs:label "Pharmacogenomics-guided clopidogrel strategy represents a cost-effective treatment for patients undergoing PCI" ;
  sp:hasContextClass <http://purl.org/np/RA9pwySo43TIfbvPuhK4ZuisvMsDvZ6TeR5N6MnKft8Nw#patient_undergoing_PCI> ;
  sp:hasSubjectClass
<http://purl.org/np/RA0xICL4ULhZr5mxC9cyzStCBtpoETQGin6Vr-Ns7JNtA#pharmacogenomics_guided_clopidogrel_therapy> ;
  sp:hasQualifier sp:generallyQualifier ;
  sp:hasRelation sp:enables ;
  sp:hasObjectClass <http://purl.org/np/RAlfRfPak2jsyyVy4knjOmxQSYtociP8Cc007gemMtqQY#cost-effective_treatment> .
}
sub:provenance {
  sub:activity a sp:FormalizationActivity ;
  prov:used sub:quote , <https://pubmed.ncbi.nlm.nih.gov/30647444/> ;
  prov:wasAssociatedWith orcid:0000-0002-0519-7776 .
}
```

```

    sub:assertion prov:wasGeneratedBy sub:activity .
    sub:quote prov:value "Our data show that pharmacogenomics-guided clopidogrel treatment strategy may represent a cost-effective
choice compared with non-pharmacogenomics-guided strategy for patients undergoing PCI." ;
    prov:wasQuotedFrom <https://pubmed.ncbi.nlm.nih.gov/30647444/> .
}
sub:pubinfo {
    sub:sig npx:hasAlgorithm "RSA" ;
    npx:hasPublicKey
"MIGfMA0GCsGSIb3DQEBAQUAA4GNADCBiQKBgQCJlM78d80R+gFMOQB1IG3f7AbqqGOCiv4HmZdlcx1KgEWMUUpPsojFNvx84fC/TltcJ8F8JafnbhDXW2HM2MhdK4yC
04ROEVlvIgSzjDichfHqXvMqdPuMyQp4mmCEY7mUoeEW10mWZqjk+S9TnmIAQbFGcPExp8aosr2aTR7CSQIDAQAB" ;
    npx:hasSignature
"cEQZgFxFgTd99RYcmWsqM1LCUciLc1lXuy6mfjgKhN0BfsMcesqIKR+51xx6lFHD31tnz/bovIDh1YEPORGBe2PEvFMPvRRFd67B9s1awepEPl15tA7wmhkTojPrEUXIS
QaQu93NbpbYMYSGnRx+Shv7jNxhPrxQw7fD6EgJr8=" ;
    npx:hasSignatureTarget this: .
    this: dct:created "2021-11-17T21:22:59.625+02:00"^^xsd:dateTime ;
    dct:creator orcid:0000-0002-0519-7776 , orcid:0000-0002-7114-6459 ;
    npx:introduces sub:spi ;
    npx:supersedes <http://purl.org/np/RAB_yY8X4BUuS9HMBso8SvvPfbX31cb8cCv41SgfyMBew> ;
    <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAWCmrfeUUohltO1_7qFYoWgrYeonMX4FzAFboCSEoL-s> ;
    nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAElwniOy0yO39PlK9QkQ-wqbC3q-R2nXraP5huu8W39k> ;
    nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RA2vCBXZf-icEcVRGhulJXugTGxpsV5yVr9yqC1lbQh4A> ,
<http://purl.org/np/RAA2MfqdBczmz9yVWjKLXNbyfBNcwsMmOqcNUxkklmaIM> ,
<http://purl.org/np/RAjpbMlW3owYhJUBo3DtsuDLXsNAJ8cnGeWAutDVjuAuI> ;
    nt:wasCreatedFromTemplate <http://purl.org/np/RAv68imZrEjfcP2rnEglhzoBqEvc0cQMtp9_1Za0BxNM4> .
}

```

The following nanopublications introduce the newly minted classes in TriG format.

This is the class definition of “patient undergoing PCI”:

```

@prefix this: <http://purl.org/np/RA9pwySo43TIffvPuhK4ZuisvMsDvZ6TeR5N6MNKft8Nw> .
@prefix sub: <http://purl.org/np/RA9pwySo43TIffvPuhK4ZuisvMsDvZ6TeR5N6MNKft8Nw#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

sub:Head {
    this: np:hasAssertion sub:assertion ;
    np:hasProvenance sub:provenance ;
    np:hasPublicationInfo sub:pubinfo ;
    a np:Nanopublication .
}
sub:assertion {
    sub:patient_undergoing_PCI a <http://www.w3.org/2002/07/owl#Class> ;
    rdfs:label "patient undergoing PCI" ;
    rdfs:subClassOf <http://www.wikidata.org/entity/Q181600> ;
    skos:definition "patient undergoing percutaneous coronary intervention" ;
    skos:relatedMatch <http://www.wikidata.org/entity/Q2008344> .
}
sub:provenance {
    sub:assertion prov:wasAttributedTo orcid:0000-0002-0519-7776 .
}
sub:pubinfo {
    sub:sig npx:hasAlgorithm "RSA" ;
    npx:hasPublicKey
"MIGfMA0GCsGSIb3DQEBAQUAA4GNADCBiQKBgQCJlM78d80R+gFMOQB1IG3f7AbqqGOCiv4HmZdlcx1KgEWMUUpPsojFNvx84fC/TltcJ8F8JafnbhDXW2HM2MhdK4yC
04ROEVlvIgSzjDichfHqXvMqdPuMyQp4mmCEY7mUoeEW10mWZqjk+S9TnmIAQbFGcPExp8aosr2aTR7CSQIDAQAB" ;
    npx:hasSignature
"Iv6wAp5BYaY+ltBEBicPls8rQjacsBZifWaNxBQkJaoYJs5/ejUrEiMXVwul4D+4baebEm8rkt6vp336uDcencmlDiZzHZGllioFQTGT1Bc//XZYWBkO/jcGRB3HN0LS
cLz1Fo/dWaB94+qrW9MSTi6eVmIY9YqJH+3mGY6HJRk=" ;
    npx:hasSignatureTarget this: .
    this: dct:created "2021-11-04T10:24:46.053+02:00"^^xsd:dateTime ;
    dct:creator orcid:0000-0002-0519-7776 , orcid:0000-0002-7114-6459 ;
    npx:introduces sub:patient_undergoing_PCI ;
    npx:supersedes <http://purl.org/np/RAuLZtfsHn3NGe0Md81LNvYmBseEtW9v1rVUVfJCpJYUE> ;
    <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAuLZtfsHn3NGe0Md81LNvYmBseEtW9v1rVUVfJCpJYUE> ;
    nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAi6zZAwhaJ23Hzg4lIj1Pir6Take3ZQp-lS9skfBEwfQ> ;
}

```

```

    nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RA2vCBXZf-icEcVRGhulJXugTGxpsV5yVr9yqCI1bQh4A> ,
<http://purl.org/np/RAA2MfqdBczmz9yVWjKLXNbyfBNcwsMmOqcNUxkk1maIM> ,
<http://purl.org/np/RAOGu9Lh0BD4tbIRB9RG6RGRA_ObDh75NTbIqaWgxxs8M> ,
<http://purl.org/np/RAjpBMLw3owYhJUBo3DtsuD1XsNAJ8cnGeWAutDVjuAuI> ;
    nt:wasCreatedFromTemplate <http://purl.org/np/RAdpgRpigXtt8iPV9uOPf3wIT3qzOI8Sg2Q72CNV8g-Yo> .
}

```

This is the class definition of “pharmacogenomics guided clopidogrel therapy”:

```

@prefix this: <http://purl.org/np/RAOxICL4ULhZr5mxC9cyzStCBtpoETQGIn6Vr-Ns7JntA> .
@prefix sub: <http://purl.org/np/RAOxICL4ULhZr5mxC9cyzStCBtpoETQGIn6Vr-Ns7JntA#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
    np:hasProvenance sub:provenance ;
    np:hasPublicationInfo sub:pubinfo ;
    a np:Nanopublication .
}

sub:assertion {
  sub:pharmacogenomics_guided_clopidogrel_therapy a <http://www.w3.org/2002/07/owl#Class> ;
    rdfs:label "pharmacogenomics guided clopidogrel therapy" ;
    rdfs:subClassOf <http://www.wikidata.org/entity/Q179661> ;
    skos:definition "A clopidogrel therapy assisted by pharmacogenomics." ;
    skos:relatedMatch <http://www.wikidata.org/entity/Q1152227> , <http://www.wikidata.org/entity/Q410237> .
}

sub:provenance {
  sub:assertion prov:wasAttributedTo orcid:0000-0002-0519-7776 .
}

sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
    npx:hasPublicKey
    "MIGfMA0GCSqGSIb3DQEQBAQUAA4GNADCBiQKBgQCJlM78d80R+gFMoQB1IG3f7AbqqGC0iV4HmZd1cx1KgEWMUUpPsojFNvx84fC/TltcJ8F8JaFnbdXW2HM2MhdK4yC
    04ROEV1vGszjDiChfiqXvMqdPuMyQp4mmCEY7mUoeEW10mWZqjk+S9TnmiAQbFGcpExP8aosr2aTR7CSQIDAQAB" ;
    npx:hasSignature
    "QNIcAE5wfsq1p8Z7J+KLQOWAlpbm5/VZFeRJe6JkKIB6TvXTd1O2OKOTDYMP2ys15bU9yibaKOA/7YRQnaf6cTbgOmaTlmV5+zffRjl15SG+z+4A1R7HLIfR2G2x9Z4kz
    55rQL+AQbvYgkDxiVMSsbdJdraQ5t/SBCJcEHOh2xuQ=" ;
    npx:hasSignatureTarget this: .
    this: dct:created "2021-11-04T11:02:34.246+02:00"^^xsd:dateTime ;
    dct:creator orcid:0000-0002-0519-7776 , orcid:0000-0002-7114-6459 ;
    npx:introduces sub:pharmacogenomics_guided_clopidogrel_therapy ;
    npx:supersedes <http://purl.org/np/RA4BJg9pLse6z1BRbZIOgARyflzOY9Qw33ix3lsHcazOE> ;
    <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAvOAyEg-J8ynm2NrkCgg5XqGuqRo-dXcGFvgDLxtY6ck> ;
    nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAi6zZAwhaJ23Hzg4lIj1Pir6Take3ZQp-1S9skfBEwfQ> ;
    nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RA2vCBXZf-icEcVRGhulJXugTGxpsV5yVr9yqCI1bQh4A> ,
    <http://purl.org/np/RAA2MfqdBczmz9yVWjKLXNbyfBNcwsMmOqcNUxkk1maIM> ,
    <http://purl.org/np/RAjpBMLw3owYhJUBo3DtsuD1XsNAJ8cnGeWAutDVjuAuI> ;
    nt:wasCreatedFromTemplate <http://purl.org/np/RAdpgRpigXtt8iPV9uOPf3wIT3qzOI8Sg2Q72CNV8g-Yo> .
}

```

This is the class definition of “cost-effective treatment”:

```

@prefix this: <http://purl.org/np/RAlfRfPak2jsyyVy4knjOmxQSYtociP8Cc007gemMtqQY> .
@prefix sub: <http://purl.org/np/RAlfRfPak2jsyyVy4knjOmxQSYtociP8Cc007gemMtqQY#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/ntemplate/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
    np:hasProvenance sub:provenance ;
    np:hasPublicationInfo sub:pubinfo ;
}

```

```

    a np:Nanopublication .
}
sub:assertion {
  sub:cost-effective_treatment a <http://www.w3.org/2002/07/owl#Class> ;
  rdfs:label "cost-effective treatment" ;
  rdfs:subClassOf <http://www.wikidata.org/entity/Q179661> ;
  skos:definition "cost-effective treatment" ;
  skos:relatedMatch <http://www.wikidata.org/entity/Q1754768> .
}
sub:provenance {
  sub:assertion prov:wasAttributedTo orcid:0000-0002-0519-7776 .
}
sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
  npx:hasPublicKey
    "MIGfMA0GCsGSIb3DQEBAQUAA4GNADCBiQKBgQCJlM78d80R+gFMOQB1IG3f7AbqqGOCiv4HmZdlcx1KgEWMUUpPsojFNvx84fC/TltcJ8F8JafnbhDXW2HM2MhdK4yC
    04ROEVlVigSzjDichFfiqXvMqdPuMyQp4mmCEY7mUoeEW10mWZqjk+S9TnmiAQbFGcpExP8aosr2aTR7CSQIDAQAB" ;
  npx:hasSignature
    "f+XJLoVxSGhXnuQYxbgd+cAlljMEdNppqO11jalPaJlnUREFKWRB5A9mhsvEuV1TWGzHfzi1wEL8FiguHgg7YUTJlAlpb8qA98/MFkWtXeYzIjwOgmUFUrSIBQF0cEV
    X5OV8D3nzwwa+Y2glBes1lpIkSRgAH4b3KMy8+PbNBg=" ;
  npx:hasSignatureTarget this: .
  this: dct:created "2021-11-04T10:28:39.058+02:00"^^xsd:dateTime ;
  dct:creator orcid:0000-0002-0519-7776 , orcid:0000-0002-7114-6459 ;
  npx:introduces sub:cost-effective_treatment ;
  npx:supersedes <http://purl.org/np/RAjD4-Q2kO_cIUE52rde2uWbV3RtuCR90geXW90il2YX4> ;
  <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RAjD4-Q2kO_cIUE52rde2uWbV3RtuCR90geXW90il2YX4> ;
  nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAi6zZAwhaJ23Hzg4lIj1Pir6Take3ZQp-1S9skfBEwfQ> ;
  nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RA2vCBXZf-icEcVRGhulJXugTGxpsV5yVr9yqCI1bQh4A> ,
  <http://purl.org/np/RAA2MfgdBCzmz9yVWjKLXNbyfBNcwsMmOqcNUxkk1maIM> ,
  <http://purl.org/np/RAOGu9Lh0BD4tbIRB9RG6RGRA_ObDh75NTbIqaWgxxs8M> ,
  <http://purl.org/np/RAjpBM1w3owYhJUBo3DtsuDLXsNAJ8cnGeWAutDVjuAuI> ;
  nt:wasCreatedFromTemplate <http://purl.org/np/RAdpgRpigXtt8iPV9uOPf3wIT3qzOI8Sg2Q72CNV8g-Yo> .
}

```

References

- [1] Fragoulakis V, Bartsakoulia M, Díaz-Villamarín X, Chalikiopoulou K, Kehagia K, Ramos JGS, Martínez-González LJ, Gkotsi M, Katrali E, Skoufas E, Vozikis A, John A, Ali BR, Wordsworth S, Dávila-Fajardo CL, Katsila T, Patrinos GP, Mitropoulou C. Cost-effectiveness analysis of pharmacogenomics-guided clopidogrel treatment in Spanish patients undergoing percutaneous coronary intervention. *Pharmacogenomics J.* 2019 Oct;19(5):438-445. doi: 10.1038/s41397-019-0069-1.
- [2] Bucur, C.I., Kuhn, T., Ceolin, D., Ossenbruggen, J. van. Expressing high-level scientific claims with formal semantics. In: *Proceedings of the 11th Knowledge Capture Conference 2021*. doi: 10.1145/3460210.3493561.