USMANU DANFODIYO UNIVERSITY SOKOTO

THE 21st INAUGURAL LECTURE

On Drugs and Poisons-*apropos covid-19*

by

Professor Shaibu Oricha Bello

BSc, MBBS, PhD., FACSc,FWAMS, F. Med.Ed(Phil), Cert.HPE. (Keele)

Professor of Pharmacology

Wednesday, 9th June 2021

The 21st Inaugural Lecture

On Drugs and Poisons-*apropos covid-19*

Delivered under the Chairmanship of

The Vice-Chancellor

Professor Lawal Suleiman Bilbis

BSC, MSc, PhD

by

Professor Shaibu Oricha Bello

BSc, MBBS, PhD., FACSc,FWAMS, F. Med.Ed(Phil), Cert.HPE. (Keele)

Professor of Pharmacology

Published by…….

On Drugs and Poisons-*apropos covid-19*

Felicitations and Preamble

In the name of the Creature, my Lord, your Lord, Allah, The merciful, The Beneficent. May Allah's peace and blessing be bestowed upon the seal of Prophets, Mohammad Son of Abdullah, his households, his companions, and all those who follow their footsteps until the last day, Amen.

The Vice-Chancellor
The Deputy Vice-Chancellors,
Members of the Council and Top Management Staff of UDUS,
Members of UDUTH Board
Deans of Faculties,
Heads of Departments
Distinguished Professors and Scholars
Staffs and students of UDUS
Distinguished Guests, Ladies, and Gentlemen.

Assalamu Aleykum WaRahmatullah, WaBarakaatuh

It is with great pleasure and a sense of delight that I stand before you to deliver the 21st Inaugural Lecture of this vibrant, upwardly moving, and most peaceful university. It is accepted that Inaugural Lectures may take anyor all of the following forms:

1. Concentrate on the development of the department where the Professor holds his chair

2. Center on a general topic which the Professor considers that he has something fresh and stimulating to tell the audience
3. Focus on the Professor's own work within the general framework of his discipline.

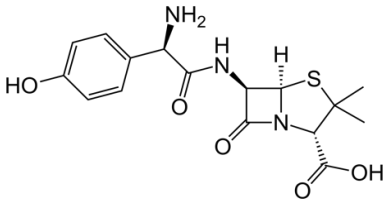
It pleased the Lord, Allah, that I focused on the world of drugs and poisons(pharmacology) since 1998. The year 2020 further- 'micro-focused' me on COVID-19 when I became the Lead in Candidate therapy / Vaccines Clinical trial subcommittee of the Ministerial ExpertCommittee, the Lead in the Candidate therapy subcommittee of the National COVID-19 consortium, a member of the CBN Board of experts on COVID-19 and a member (Representing Nigeria) on the Expert Advisory Group for the assessment of Covid-19 vaccines in the African region,UCN/Vaccine-Preventable Diseases, WHO. Furthermore, I obtained a TETFund grant to identify potential therapeutics for COVID-19. This inaugural lecture is therefore made out for me. It will, therefore, necessarily focus on the general topic of 'drugs and poisons', relate this to the extensive and exciting work my team is doing on COVID-19, its challenges, and how this work has transformed the department of Pharmacology & Therapeutics, College of Health Sciences of this University. *In doing so, I intend to avoid really big pharmacological grammar.*

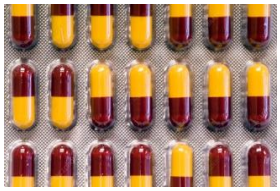
1.0 Introduction

What are drugs? What are poisons, and while we at it, we may as well ask, what are medicines?

- "A**drug** can be defined as a chemical substance of *known structure*, other than a nutrient or an essential dietary ingredient, which, *when administered* to a living organism, *produces a biological effect*"[1]. We need to quickly recognize that vaccines are also drugs.

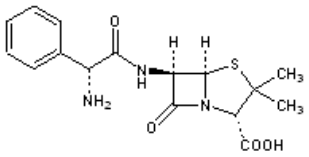
- **Medicines** are unique chemical identities that are ***intended*** for use in *preventing, amelioratingabnormal* body function or *diagnosis* of same. 'Intended' here is not merely an emotion butalso encompasses that sufficient evidence existsfor that intent.





Amoxicillin

(a)



Ampicillin

(b)

Figure 1: Only a slight difference exists between amoxicillin(a) and Ampicillin(b)

The term ‘unique chemical identities’ represents profiling, such that any change in that profile translates to a different entity that requires fresh studies to determine a new profile. In this regard, Ampicillin and Amoxicillin are only different bya hydroxyl group (OH) but are quite different antibiotics with different distribution characteristics and activities (Figure 1).

- **Poisons** are unique chemical identities that introduce *deleterious* abnormalities into body function. (Note that ‘intention’ is not required).

The adage that immediately stands out from the above is that –
“*All Drugs are Poisons*; *all medicines are drugs* but *not all drugs are medicines*”

The job of a pharmacologist includes sorting out the above. The overall cautious and thorough nature of our work often involves apparently unnecessary stringency in allocating a particular chemical to one or two of the above categories. Claims of discoveries of cures for various diseases are rampant but mainstream science usually reports,frustratingly, and infuriatingly that there is**'insufficientevidence**for the claims. Why?

The initial standpoint is to recognize that **the body has a tremendous ability to self-heal**. The steps and multiplicity of chemicals released by the body to combat diseases it encounters cannot be matched artificially due *to its multiplicity and the fact that we do not know all of them (yet)- we probably only know about 10%*. For example, the body deals with and clears 85% of SARS-COV2 infection process without the individual ever knowing. Also, we all (humans) always have about 12 viruses in our body that have been kept in check by the tremendous body defense. Even in the few percent that illness ensues, the body does not and has not given up. Whatever intervention you may give, it is the body itself that finally completes the job of 'healing',not the intervention.

The second standpoint is to recognize that *all drugs almost always cause some harm*.
Paracetamol will attempt to deplete important enzymes from the liver and produce toxic metabolites every time it is taken, but the liver clears this and self-heal. Too much paracetamol could damage the liver. Paracetamol is the commonest cause of acute liver failure in the UK and USA.Meanwhile, paracetamol is heavily used in Nigeria[2] and is even used by some people to *unusually but tasteful**soften*** meat during cooking, for commercial consumption! This has been so rampant that the National Agency for Food and Drug Administration and Control (NAFDAC) had to issue out a warning to point outthat such activities could lead to liver and kidney failures[3].
As regards theso-called 'natural' herbal medicines or naturaceutics, the term is probably misleading because in the context of use, 'natural' suggests a lack of toxicity, which is not so. We should reflect that 'use' as medicine connotes scheduled and regular intake which presents a different scenario to the body. In this context, it isimportant to recognize that consistent and non-variant rice, bean, or pounded yam intake could induce gynecomastiain males (man boobs) due to phytoestrogen![4] Yes, food can be drugs beyond the nutritional values[5].
So, how do we resolve this dilemma of 'seeing' poison in everything?

Paracelsus, a Swiss physician, attempted to resolve this by stating that:
"All things are poison, and nothing is without poison; the dosage alone makes it, so a thing is not a poison."
Or succinctly*: "The dose makes the poison"*.

The job of a pharmacologist, therefore, also includes determining *that dose* of a substance that is not poisonous.

When confronted with a chemical or multi-chemical substance (like herbal agents), the focus, therefore, is not to determine whether it is harmful (because it is given that it is) but instead, to profile and quantify these harms so that deliberate cost-benefit decisions may be taken. *How do we go about doing this?*

Well, drugs as poisons can cause legions of body harms that are almost impossible to completely identify and document. Nonetheless, common, and highly consequential potential harms have been listed for standard evaluations:

All drugs could cause death;therefore, we perform *Median lethal dose(LD_{50})/acute toxicity experiments to determine, among others, what dose will kill 50% of 2 species of experimental animals, using two routes of administrations*. The classical, colloquial poison (marked as such) has extremely low LD_{50}- Hydrogen cyanide=3.7mg/kg. oral, rat, Sodium Cyanide=6mg/Kg oral, rat (compare to water-90,000mg/kg, oral, rat). Consider also that LD_{50} of Nicotine=0.8mg/kg oral, paracetamol 1944mg/kg, oral , rat and Monosodium Glutamate=16,600mg/kg[6]. For good measures, consider that the LD_{50} of *Spinacia oleracea* (popular *efo*) is 2000mg/Kg, oral, rats[7] suggesting that it should be of much more concern than *Monosodium Glutamate*. In this case, the LD_{50} of the natural and dietary agent is close to that of the drug paracetamol. Furthermore, although considered nontoxic in humans, the LD_{50} of Saccharum officinarum (sugar cane) is close to 5000mg/kg oral, rats[8],[9] and the ethyl acetate extract *showed cytostatic activity* in the human tumor cell lines at low concentrations (25.8 to 61.8 µg/ml)[9].

All drugs could slowly damage the liver, kidneys, lung tissue, bone marrow,and blood components in a time-dependent manner, *therefore we conduct sub-acute, chronic, and lifetime studies in animals to determine the type, extent, and dose at which these would occur.*

All drugs could cause respiratory depression; *therefore, we perform respiratory safety pharmacological assessment to determine the type, extent, and dose at which respiratory depression could happen.*

All drugs could cause cardiac arrest (thus we evaluate cardiac safety), Central nervous system depression (thus we evaluate CNS safety), Reproductive system and the growing fetus (thus we conduct reproductive toxicology), damage the DNA (thus we conduct genotoxicity and mutagenicity studies). This is not an exhaustive list but the barest minimum. The final objective of all these studies is *not to reject the drug but to identify, understand and stay far away from the poisonous doses.*

Given that the body is highly capableof self-cure, that the potential of drugs to harm is almost always present while the potential to benefit is not always present or assured, we begin to recognize whythe declaration of 'cure' is often taken with lots of caution. Overall, when confronted with a potential therapy for a disease, the term '*Primum non-nocere' i.e., first, do no harm,* should ring loud, *although it* is usually a cost-benefit trade-off.

Re-stated, when you hold a drug in your hand and you are about to take it, recall that it may cause some harm in your body (almost always), but that it may have tremendous benefit. The questions, therefore, are:

'Does this drug have medicinal value in my body?'

'Is it a poison to my body?'

If a drug is prescribed, it is most likely a medicine but if not prescribed, the likelihood is that it is a poison. This assertion is true to the limit that the prescriber is sufficiently schooled to make

the correct utility and dose decisions, given a correctly determined clinical condition. A level of uncertainty, therefore, usually remains.

As our empirical knowledge improves and builds up, we should be able to do better at moving away from the poison domain for any substance. Paul Ehrlich, acclaimed as the father of Pharmacology, described an ideal state when we can precisely identify specific chemicals for specific or multiple disease-causing targets-*he called this a 'magic bullet'*[10].Can we shoot for the moon and attempt a magic bullet for COVID-19?

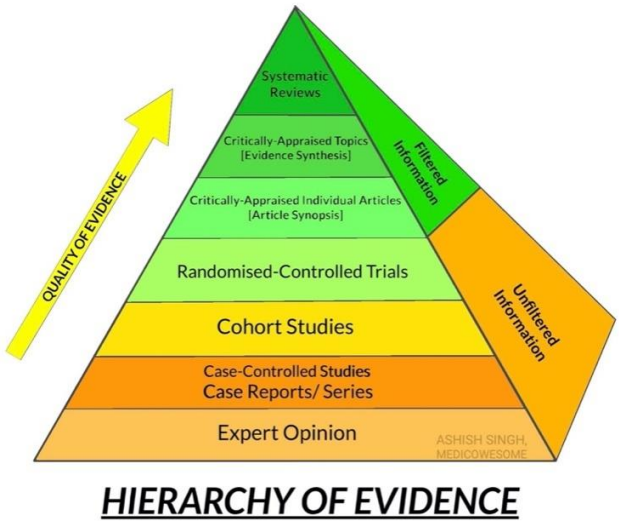
2.0 Medicines from drugs and poisons-*generating the evidence***.**

Medicines are regulatory-approved entities intended for prevention, therapy, or diagnosis of diseases. The term 'medicine' is used interchangeably with 'drugs' due to the duality of the western world. Europe maintains the proper word-medicine (e.g., regulated by European Medicines Agency) while America prefers'drugs' as a generic term (e.g.,regulated Federal Drug Agency) while at the same time differentiating'drugs' (of abuse). National Agency for Food and Drug Administration and Control-NAFDAC, is the Nigerian regulatory agency and was established in 1993. The current WHO maturity level (on an efficiency scale of 1 to 4) of NAFDAC is 2-*and we need maturity level 3 to qualify to manufacture vaccines in Nigeria*[11]. The overall regulatory process is thorough, involves huge documentation and expert reviews with the objective of ensuring that what is approved is not poison but medicines with proven benefits. The initial steps usually involve pre-clinical ex-vivo laboratory and in vivo animal research. To these have recently been added high-level computer modeling and prediction tools like *the versatile software, Schrodinger.* After the cautious introduction of the drug into humans in Phase 1 clinical trials, evidence of efficacy and dose consideration are sought in Phase 2 and 3 clinical trials. The standard high-quality evidence is a *well-conducted,double-blinded,randomized controlled, parallel-group* phase 3 clinical trial (RCTs). All components of this long name indicate levels of stringency.

Unfortunately, many candidates that are shown to be beneficial at early stages finally fail to become medicines mainly because of toxicity and failure to concentrate well at the required site

in the body-*the number often cited is that of every 10,000 such potential chemicals only 7 gets to become medicines(0.07%)*[12]. Failure means loss of investments. Given that *apriori*the drug industry is established by investors to make a profit and not to save humanity, the process is usually cautiously slow and thorough-*usually 15 years at a cost of almost $1billion*. The reason forthe slow process may be divided into *scientific caution* and *protective caution*. The former is self-descriptive but *protective caution* is when potential drug candidates are dropped at the slightest hint of risk because it exposes the company to liability during litigation even though the risk has low potential to translate to adverse effects in the real world. The popular metronidazole(Flagyl) has shown mutagenic potential in vitro which remotely suggests that it may cause gene damage or cancer[13]. However, billions of doses of Flagyl have been ingested by humans and no evidence of genetic damage nor cancer has been identified. In the current protective climate, the very useful Flagyl would not have been selected for development[14]. Overall, the process of identifying a drug and differentiating it from poison could become *cautiously fast and thorough*if another body, e.g., government, takes over all or substantial part of therisks (investments and litigations). In this regard, vaccines were developed rapidly(<1year) for COVID-19 because riskswere taken over by Governments using platforms like operation WARP-speed by the USA and Indemnity coverage by various countries.In order to speed up the process, the United States Government gave billions of dollars to companies with established drug development capacity and pre-ordered vaccines and drugs they were not sure will be successful. Furthermore, the government agreed to cover the cost of litigation from possible side effects. This allowed the companies to maintain *scientific caution* while reducing *protective caution*.

In making the critically important decision that a drug is more of medicines than poison, randomized controlled trials (RCTs) are the gold standard and may be pooled into higher order synthesis of evidence like metanalysis(Figure 2).Hydroxychloroquine or Ivermectin might have shown excellent activities against SARS-COV-2 ex-vivo, but they are not yet medicines for COVID-19 until RCTs show them to be so.



Source[15]

Figure 2: Evidence pyramid used in decision making

Why does the evidence of RCTs trump all others? Well, because of our natural tendencies to be biased in our measurements,observations, and conclusions. Also because of the 'many-body problem'(MBP) in our body. When we perform experiments, we isolate and focus on one system, interrogate it and get some results, which may be quite exciting. Frequently, however, when the same compound encounters the human body, there are thousands of factors that were not present in the isolated experiments that are now modulators of the observed outcome. The result is that what was initially an exciting potential therapy turns out not to be so exciting, or sometimes even harmful. This is part of the reason many news-worthy early discoveries fizzle out and is also the reason to maintain cautious pessimism(not optimism) until RCTs have been conducted to confirm findings.

Observed treatment outcomes without RCTs are not reliable because of the existence of many alternative plausible explanations for the observed result (which we call redundancies) and because of the lack of a comparator to subtract the background 'no treatmenteffect.In order to illustrate this point, we may consider an arbitrary scenario. Imagine that a group of 3000 patients may have been prescribed or self-prescribed hydroxychloroquine (HCQ) for COVID-19 and claim 2990 of them got well and unfortunately 10 died. Ordinarily, this scenario is easily translated that the *wonderful drug saved 2990 people* and that the *disease killed 10 people*. HCQ

will, therefore, have many advocates arguing for its deployment, and they willinclude a further unverified,*inaccurate statement* that after all, we have been using HCQ for malaria and it is safe. If we were to run an RCT and therefore have a matched group of 3000 patients at the same setting that we gave something physically similar HCQ but is an inert compound and we did not let the clinician nor the patient know this (blinding) until the end of RCT, the result will be quite revealing if we have 2995 getting well and 5 dying. This result would just have clarified that the drug was killing 5 in 3000 patients. Initially promising HCQ, thereby*just became a poison* in this setting. Furthermore, HCQ was never harmless with malaria at any time in the past; it was just that the *benefit was higher than the harm*. Also, drugs interact with diseases differently. A drug that was not harmful when used in one disease may become harmful in another disease condition even at the same dose due to disease-mediated mechanisms. Malaria, for example, does not significantly affect the heart in adults, but COVID-19 significantly damages the heart. HCQ may, therefore, reveal no cardiac effect when used in the treatment of adult Malaria but causes cardiac arrest in patients with COVID-19 because the heart is already compromised. This raised the troubling question: *how many of our COVID-19 cases might have died from the treatment (as poison) and not the disease?*

There are also downstream consequences of getting the labels wrong. If a regulatory agency erroneously approves a candidate therapy as effective while it is not effective, placebo-controlled RCTs become difficult to conduct and almost unethical because physicians are then obliged to offer the approved therapy to patients, thus causing harm and makingdiscovering an effective drug more remote. If this candidate were a vaccine, it could paradoxically increase the rate of infection by a phenomenon known as the PELTZMAN effect-*people now take exposure risks or reduce exposure protections because they felt they were protected when they were really not protected. Vaccinated people may therefore have more infections than unvaccinated people who maintained nonpharmacological cautions.*

Another important reason for obtaining clear evidence is to give us the ability to measure the actual impact of our interventions. To do this, science developed a measure known as “Number needed to treat” or NNT[16]. The NNT is a measure of the number of cohorts you need to have given an intervention to positively treat at least 1 person. For malaria, NNT has been calculated as 1 in 5. This means that for every 5 patients given antimalarial, only 1 person actually

benefited directly from the drug. How did we know this? – by getting, for example, 10 people with malaria and conducting an RCT where wetreated5 with antimalaria and 5 without antimalaria but a placebo in the same setting. Usually, all 5 treated with antimalaria got cured and 4 not treated with antimalaria also got cured. The extra benefit was thus only 1 person. Nevertheless, when confronted with a patient with malaria, we cannot predict which group a person would belong to, hence we usually treat everybody- *but given the knowledge of our actual treatment effect, we are very careful that we do not harm the patient in the first place and that the treatment is justified.* It is more humbling when you consider that the NNT for eclampsia is 1 in 74[16] and that the NNT of Dexamethasone for COVID-19 is 1 in 36[16].

3.0 COVID-19 and Upside-down science

SARS-COV-2 is a virus *that could kill* and is spread by droplets getting in contact with mucosa, frequently by respiration. This is a scary scenario*because we must breathe*. The potential to decimate a community was quite easy to predict. The world rightly went into a stampede and went into lockdown/restrictionsto delay the spread of SARS-COV-2 and give enough time for scientists to identify effective therapies and vaccines. Again, in this search, we need to sort out the medicines from the poisons.

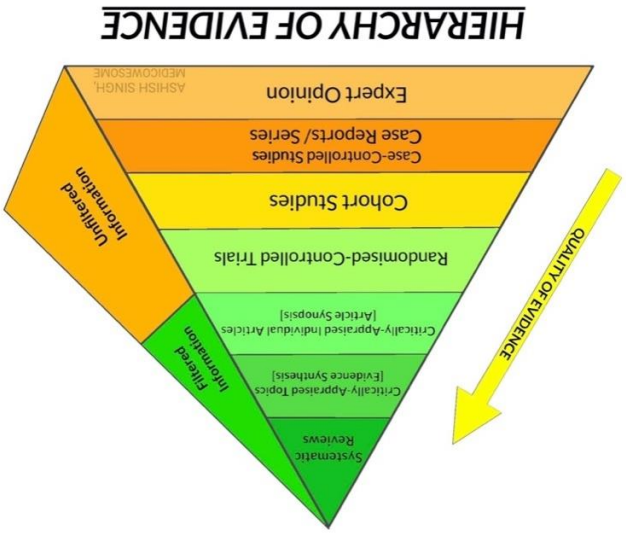


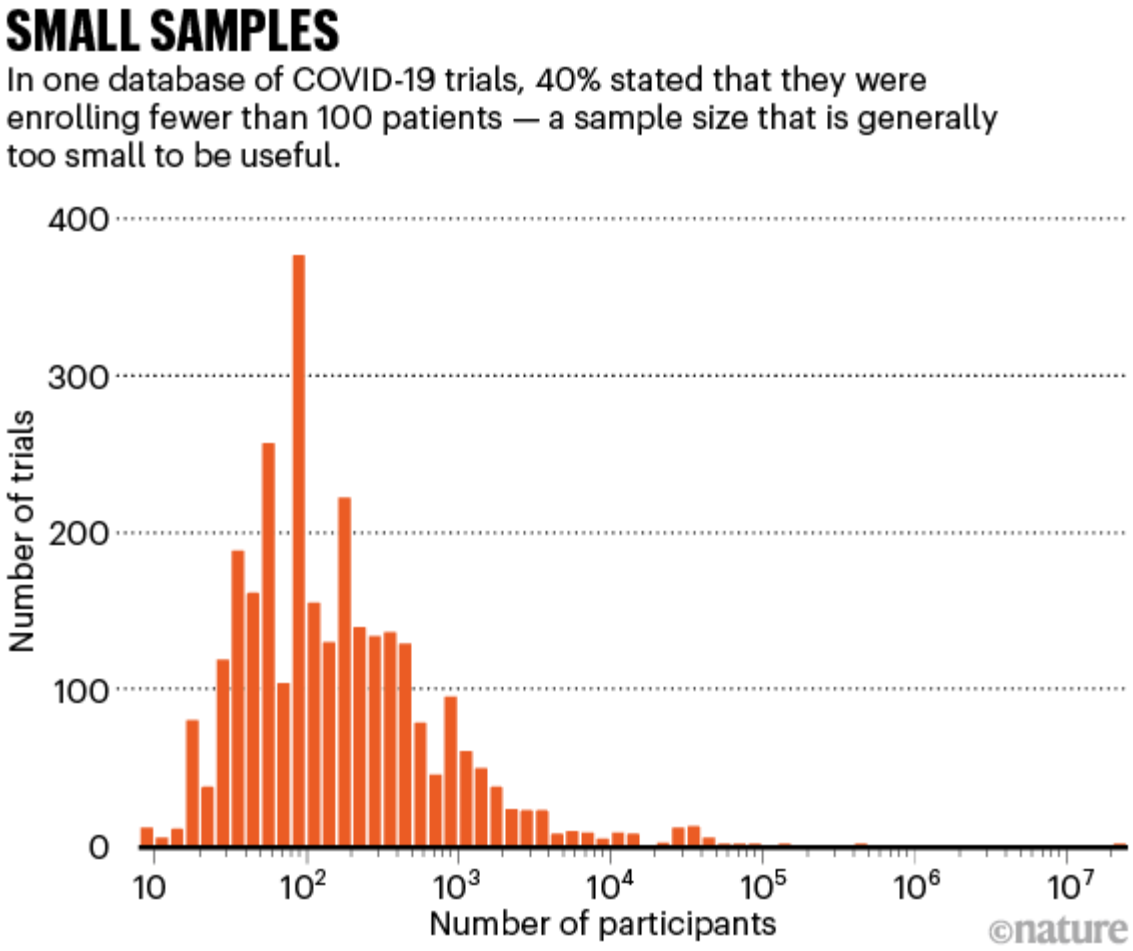
Figure 3: Evidence pyramid used in decision making in COVID-19 era

Either due to panic or mass hysteria, evidence was unfortunately turned upside down on itself(Figure 3,4,5 and 6). Expert opinion ruled the day with one expert contradicting the other. Many people became experts and either reported findings on the pages of newspapers/television or even confidently suggest that injecting disinfectants would be a viable option[17]. Case series and cohort studies, both ordinarily at the bottom of the evidence pyramid, became highly rated evidence with physicians lining up in beautiful ward coats on television to report results of their series of cases as proof of efficacy[18]. Based on such case series, some countries make HCQ state COVID-19 protocols[19], often to disastrous consequences. Scientists became impatient with RCTs, especially when they contradicted beautifully rationalized expert opinion or case series of popular physicians[20]. The scenario became more worrisome when the profiles of some of the actors going against scientific principles are reviewed. Most people assumed expertise in therapeutics, designed and ran a clinical trial with faulty protocols, and insisted on the validity of their results, with attendant media and political maneuvers[20].

Without a clear attempt at even rudimentary modeling, Michael Levitt, a winner of the Nobel Prize for chemistry, put forward that he expected the pandemic would end in the United States in 2020 and kill no more than 175,000 Americans[21]. Luc Montagnier, another Nobel Prize winner, who conducted groundbreaking work on HIV-AIDS claimed that he believed the coronavirus was created in a Chinese laboratory[21]. David Kurten, a member of the London Assembly claimedthere is a "real danger" that COVID-19 vaccines could leave women infertile[21]. Examine the case of Michael Yeadon, Ph.D., a former vice president of Pfizer, where he spent 16 years as an allergy and respiratory researcher and later co-founded a biotech firm that Novartis purchased for $325 million. He supported the vaccine infertility assertion, wrote a petition to the British house, and declared that deaths caused by COVID-19 will soon "fizzle out" and Britons "should immediately be allowed to resume a normal life."[21]Huge doses of misinformation are added to this troubling scenario[22].

Methodologies for generating evidence were also compromised. Rather than an attempt at falsification of hypothesis, studies were designed instead to prove a hypothesis. Such 'must be successful' studies led to wastage and almost unethical trials[23]. For example, though earlier studies were almost definitive in showing the lack of efficacy of HCQ in COVID-19, scientists still went ahead to conduct 250 different RCTs involving nearly 89,000 patients[24], probably in

futile attempts to provethat in vitro finding translate to clinical findings. It can easily be shown that for the important mortality outcome of COVID-19 (a dichotomous outcome), to anticipate an incidence of 2% vs 7% in two comparative groups at an alpha of 0.05 and power of 80%, you need a sample size of 538. Yet most of the trials with this endpoint use a sample size below 100[24]- *a wasteful exercise that is probably unethical.*



Source[24]

Figure 4: Preponderance of low powered trials for COVID-19

What happened to the hierarchy of scientific evidence- What happened to science?

Fortunately, major regulatory agencies and groups of dedicated mainstream scientists rigorously and persistently pursued the evidence and tried to separate the poisons from the medicines. From

an elegant Clinical trial with simple design (The Recovery Trial), Dexamethasone has been firmly established to reduce mortality in severe COVID-19[25]. Various trials (with acronyms, ACTT, ACTT-1, SIMPLE and CARAVAN) revealed Remdesivir to be of benefit is reducing hospital stay/time to recovery by 3-5 days but the absence of mortality benefit (the most important outcome) makes its global recommendation challenging, especially considering that the cost of the required 5 days course is $3120[26],[27]. Furthermore, the WHO SOLIDARITY trail failed to show any benefit , though this trial has been described as being unusually complex in design and analysis[28]. It is extremely gladdening that Nigeria held on to good science and never made recommendations without strict evidence- *a high score for the Federal Ministry of health, NCDC, NAFDAC and the teams of experts.*

Emerging evidence now suggests that SARS-COV-2 was in circulation in October 2019 and may not have started in China[29]. On the contrary, the predicted curve of death in Africa has not occurred although the prediction had an excellent scientific premise.

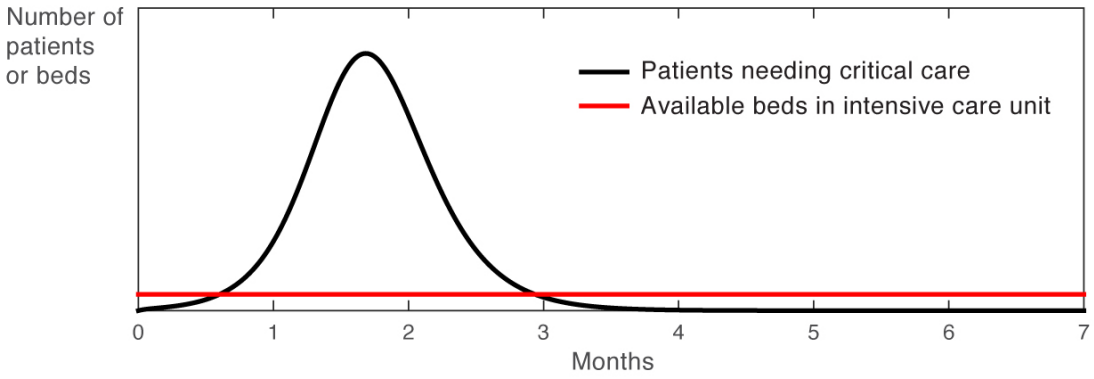


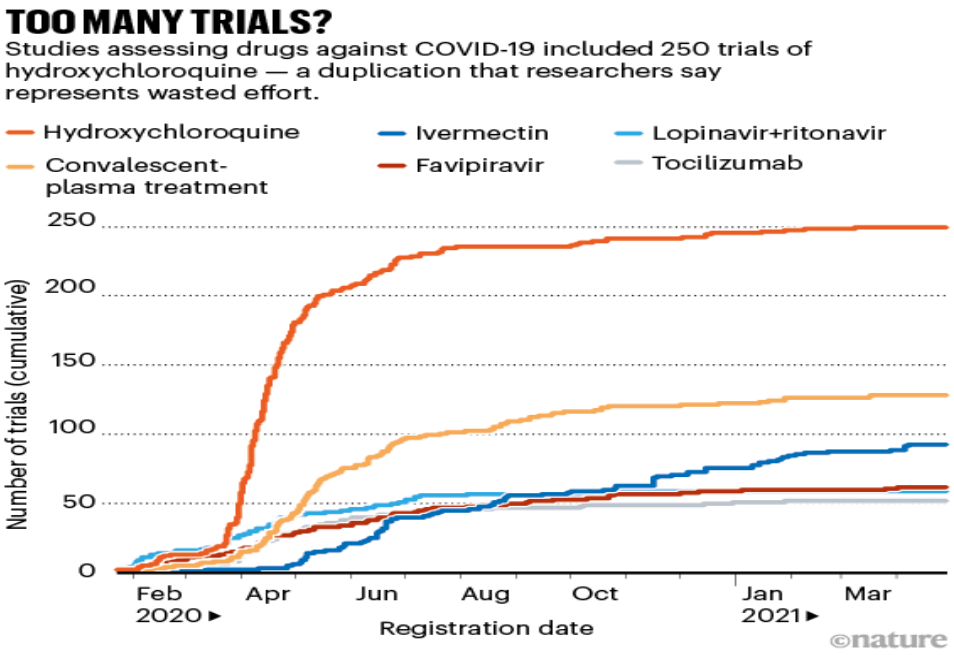
Figure 5: Curve of death from COVID-19

Hydroxychloroquine was shown to be ineffective against covid-19[30] and could have killed some patients, therefore a poison in the settings of COVID-19[31]

Popular Zinc, Vitamin C, Vitamin D were also shown to be ineffective[32] and could be harmful[33].

Over four hundred different drugs have been shown to be ineffective[34] .

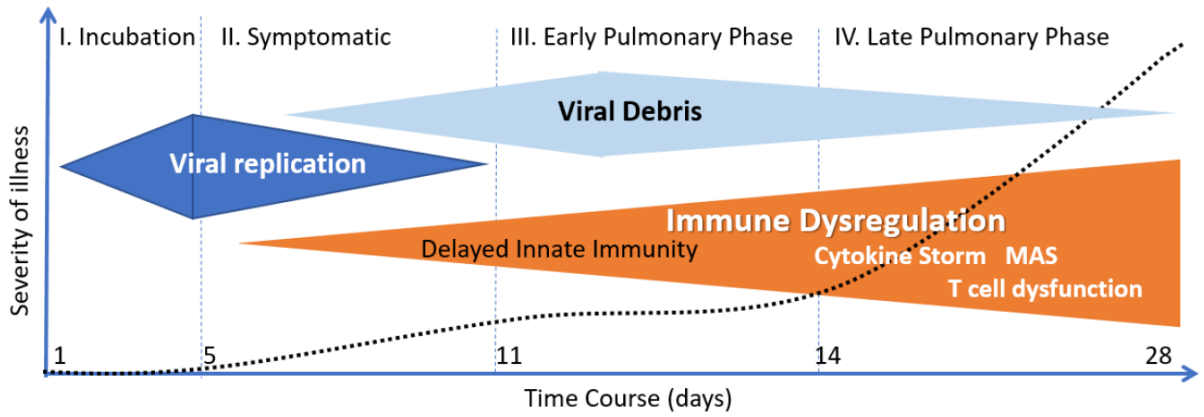
Only Dexamethasone has shown consistent efficacy and even then, only for severe illness[35]. We have had tremendous success with Vaccines, but as regards therapeutics, COVID-19 appears to be winning the race. *There appear to be more poisons than medicines for COVID-19.* Why?



Source[24]

Figure 6: Preponderance of fastidious trials in COVID-19 era

A careful review of SARS-COV-2 and COVID-19 dynamics suggests a plausible reason(Figure 7). Traditionally, viral infection, viral load, and disease-severity are causally and temporarily linked, so that 'killing' the virus results in amelioration of symptoms (e.g.-HIV-AIDS). This was the premise that compounds like HCQ, Azithromycin, ivermectin, etc., that demonstratedstrong in vitro activities against SARS-COV-2 were predicted to be good candidates for COVID-19. SARS-COV-2 infection turned out to be an enigma. Most of the viral multiplication and viral presence appears to be in the asymptomatic stage when patients are not even aware of the infection and have not approached a physician[36],[37]. In the 15% of patients that finally present at the hospital, the virus is on its downward trend and usually only exists in the body in the first 4-10 days of contact with the hospital[38],[39].



Source[20]

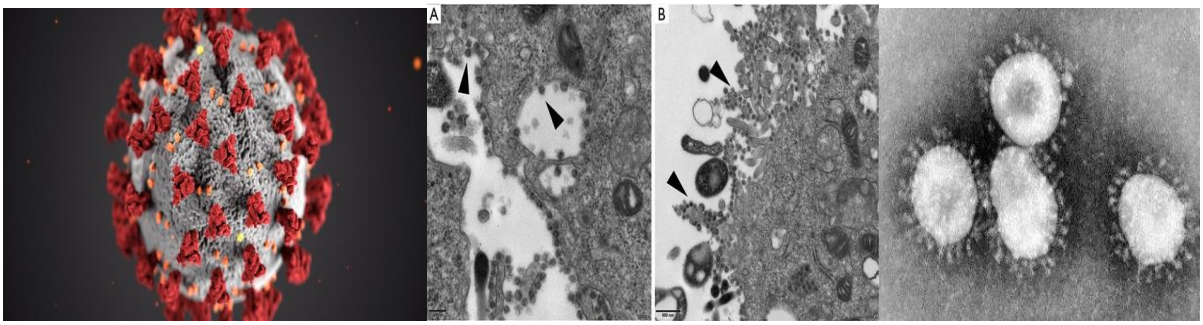
Figure 7: Viral dynamics in COVID-19

Meanwhile, even at this time, the virus has triggeredrunaway events, like dysregulated inflammation, 'cytokine storm'[40], and tissue damagesthat are self-propagating and would continue even in the absence of the virus[41]. 'Virus-killing' drugs would, therefore, predictably have little effect on COVID-19 outcome. Furthermore, these dynamics appear to be highly variable from person to person depending on innate antiviral comptencies[42],[43]. How do we overcome these challenges?

One option is *global prophylaxis*. Given the high rate of spontaneous cure, and the rapid clearance of drugs, global drug prophylaxis would *not be tenable and probably unethical*considering that *all drugs are poisons, and a large population would be administered potentially toxic drugs they don'tneed and will probably never need*. A *test-and-treat strategy* will be confronted with the huge cost of testing. *Focused prophylaxis* to *contacts of cases* is one possible pathway and has been tried with claims of some success but the initial similar policy in India with HCQ failed [44]probably because of the high variability in viral dynamics previously stated. A superior option is to identify drug candidates that are highly effective at low doses, have low off-target effects (low toxicities), and is active at all the non-redundant critical points of SARS-COV-2/COVID 19 pathogenesis. Re-stated, a drug that has high medicinal value and extremely low poison tendencies that will be anti-viral, anti-inflammatory, anti-cytokine, immune-boosting as well as enhance repair of tissue damage—*by definition, such a drug would be a magic bullet for COVID-19.* Such a drug will thus have been optimized to positively

influence-SARS-COV-2 and COVID-19 at whatever stage the drug encounters the disease in the body. Identifying such a drug will otherwise be very challenging but new-age technologies have provided the capacity to reliablyevaluatemultiple scenarios at an acceptable cost. In this regard, one such versatile software, Schrodinger, has a predictiveness of 98%[45],[46].

4.0A bold effort to identify *magic bullet*s for COVID-19



(a) **(b)**

Sources[47],[48]

Figure 8: SARS-COV-2 virus model (a) and actual SARS-COV-2 virus plate (b)

SARS-COV-2 virus(Figure 8) announced itself in Wuhan China in late December 2019 and touched down in Nigeria on 27thFebruary 2020. It has since run devastating, disrupting waves all over the world. In its deadly run, as of mid-May,2021, it has claimed the lives of over3.2Milion people, 2,065 of whom are Nigerians[49]. The virus is mutating (Figure 9) even in Nigeria(Figure 10). The COVID-19 saga is, therefore, probably not yet over. There are whispers that SARS-COV-2 could develop into a species extinguishing phenomena[50]- *for both human and non-human mammals!*This is disturbing because a mutating virus, like a common cold virus, that re-infects, but one that kills only 3% of cases, could decimate 50% of people after 20 re-infections![50]Reports show that we now have four SARS-COV-2 variants with this potential-B.1.117(UK), B.1.315(South Africa), P1 (Brazil),and B.1.617(India)-*we call these variants of concern (VOC*). Some of these variants have reduced sensitivity or outrightly escape currently available vaccines. As we march along, suppose we have a more lethal variant?
The Indian Variant is already proving to be more lethal but a new variant in south India, N440K, appears to be 15 times more lethal[51]. Also, a third(≈33%) of new infections in Seychelles are

among fully vaccinated people[52]. Given that COVID-19 will still occur in some people that have been administered a highly effective vaccine, effective therapies are still needed.

Variant	Origin Location	Origin Date	Relative Transmissibility Rating	Range	Previous Transmissibility Estimates	Comments
B(?)	Wuhan, China	~1/2020	**0.82**	0.79 - 0.85	N/A	Original variant (estimate not very reliable)
B.1	Europe(?)	~1/2020	**1.10**	0.99 - 1.22	N/A	Basic variant with D614G mutation; transmissibility increased from ~0.96 prior to 11/2020
B.1.1	Europe(?)	~2/2020	**1.07**	0.99 - 1.15	N/A	Basic variant with D614G mutation
B.1.2	USA	~2/2020	**1.01**	0.97 - 1.04	N/A	
B.1.243	Hawaii, USA	~4/2020	**0.98**	0.91 - 1.04	N/A	
B.1.234	USA	~4/2020	**0.98**	0.88 - 1.09	N/A	
B.1.160	Europe	~2/2020	**1.00**	0.93 - 1.08	N/A	
B.1.177	Europe	~2/2020	**1.03**	0.94 - 1.13	N/A	
B.1.427	California, USA	~9/2020	**1.16**	1.10 - 1.22	1.18 - 1.24	One of the two widespread CA variants
B.1.429	California, USA	~7/2020	**1.20**	1.14 - 1.25		Slightly more potent of the two CA variants
B.1.575	NW USA	~10/2020	**1.19**	1.09 - 1.30	N/A	Common in East US
B.1.1.519	Mexico	~7/2020	**1.22**	1.10 - 1.33	N/A	Common in US, especially South
R.1	Japan	~10/2020	**1.37**	1.27 - 1.48	N/A	Present in East US
B.1.526	New York, USA	~11/2020	**1.41**	1.24 - 1.58	N/A	Almost as fast-spreading as B.1.1.7, very minor differences between the three
B.1.526.1	New York, USA	~9/2020	**1.39**	1.28 - 1.49	N/A	
B.1.526.2	New York, USA	~11/2020	**1.41**	1.22 - 1.60	N/A	
B.1.351	South Africa	~5/2020	**1.44**	1.29 - 1.60	1.20 - 2.13	Although relatively widespread, outbreaks mostly confined to SA
B.1.525	Nigeria	~12/2020	**1.52**	1.44 - 1.60	N/A	Present in Europe and US
B.1.1.7	UK	~10/2020	**1.52**	1.41 - 1.63	1.43 - 1.90	Widespread across the world, dominant variant in Europe and US as of 5/2021
P.1	Brazil	~11/2020	**1.79**	1.39 - 2.19	1.45 - 1.76	Slowly spreading in several US locations
B.1.617.2	India	~12/2020	**3.19**	2.61 - 3.77	N/A	The fastest-growing Indian variant, now accounts for 10% of cases in the UK

Figure 9: SARS-COV-2 virus variants of Interest and Variants of Concern -*10-5-2021*

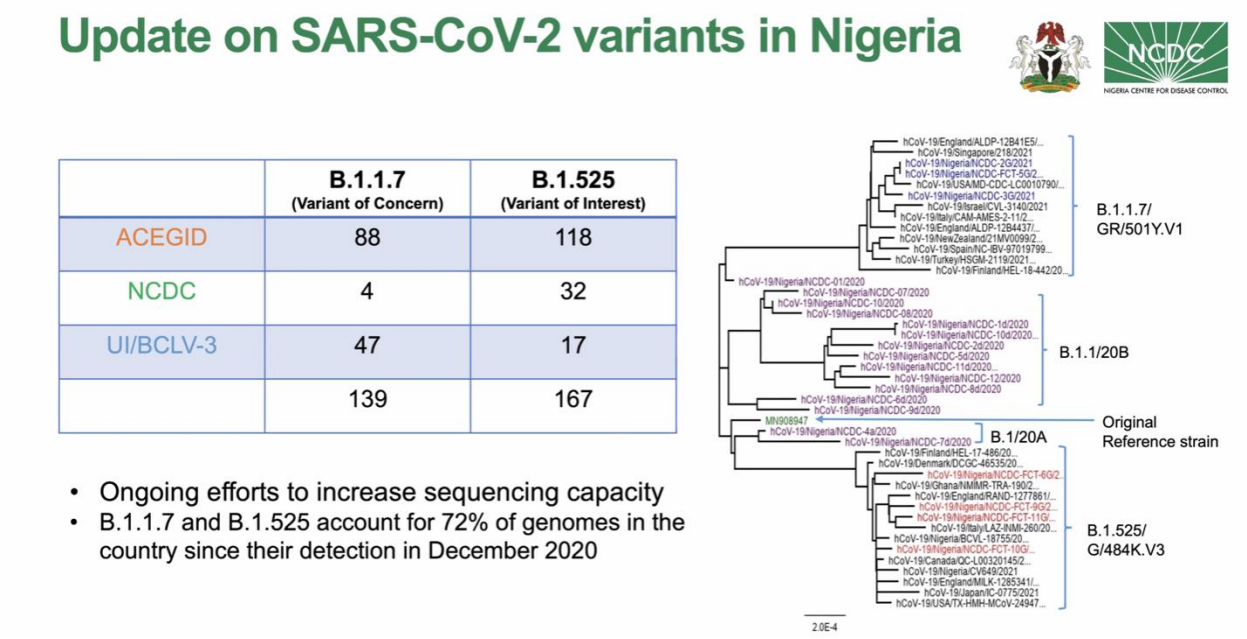


Figure 10: SARS-COV-2 virus variants of Interest and Variants of Concern in Nigeria *-10-5-2021 (DG-NCDC with permission)*

To make the challenges more complex, the world of science has not been remarkably successful with therapeutics for COVID-19. Nonetheless, tremendous, concerted efforts are still ongoing. One such effort is ongoing at the Department of Pharmacology & Therapeutics, Usmanu Danfodiyo University, Sokoto.

The Department started staff development efforts towards in-silico drug repurposing and De novo drug discovery using high performing but free source software since 2010 and has reached a high level of proficiency in this effort. Two staffs have earned MSCdegrees,one has earned a Ph.D. degree on this pathway. Also, successful repurposing efforts had been undertaken by our team for HIV[53], Lassa-Fever, and Hepatitis viruses[54]. In the earlier period of this development, we had to do wet laboratory experiments at DNA-Laboratories, Kaduna, and sequencing in South Africa- all of which constituted logistic and financial nightmares. It was with great joy and relief that the necessary manpower and tools became available at the Centre for Advanced Medical Research and Training (CAMReT) of this University.

Special COVID-19 grant from TETFund became available in October 2020 and between the Department of Pharmacology & Therapeutics, CAMReT,and Usmanu Danfodiyo University Teaching Hospital (UDUTH), we raised a team of Pharmacologist, Molecular biochemists, Virologist, and Infectious disease clinician to pursue, boldly, through re-purposing and/or de novo discoveries, what may be described as a *Magic bullet*for COVID-19.

Briefly, the team initially identified 11 such targetsthat cover the spectrum of COVID-19 pathogenies (Figure 11) and dynamically updated these to 14 targets as world research gained more knowledge(Figure 12 and 13).

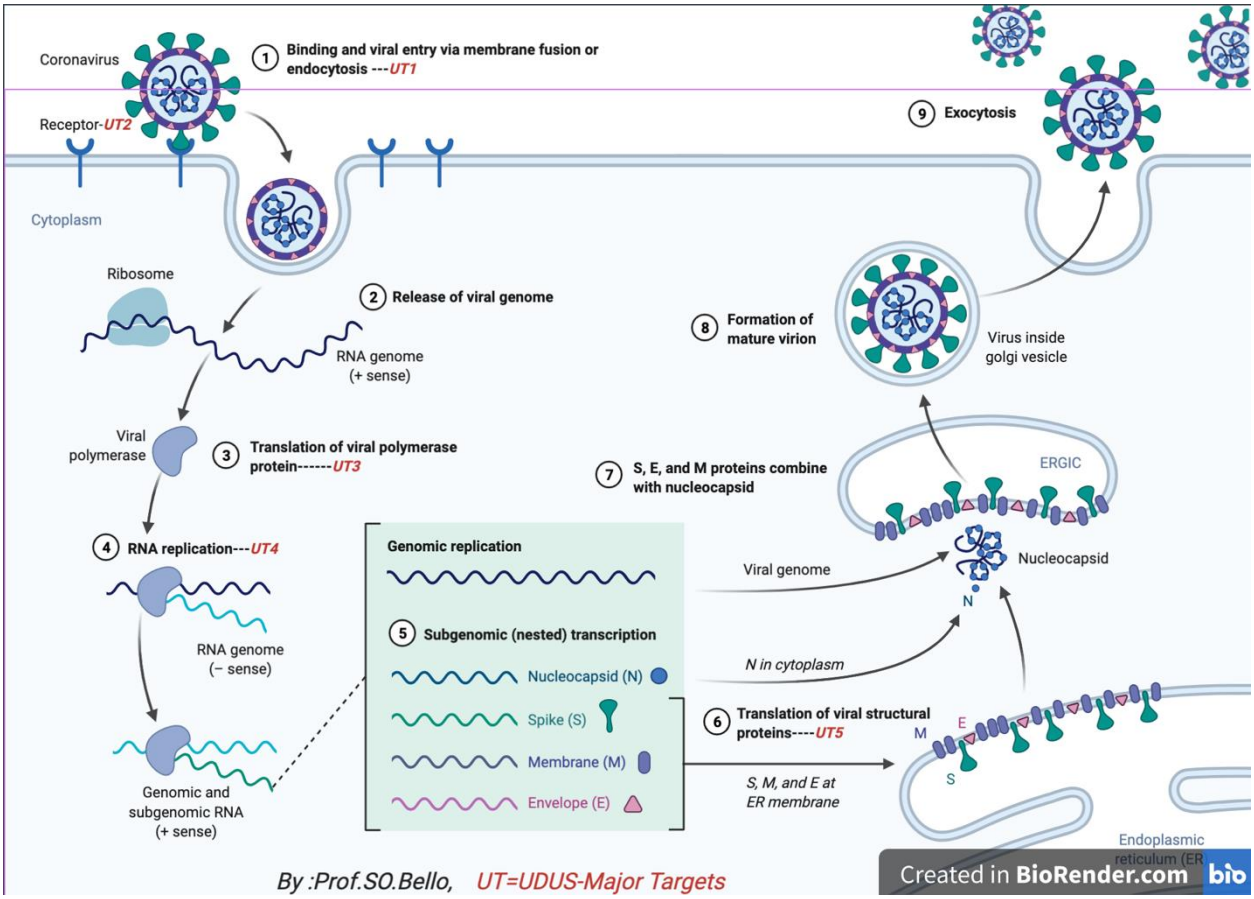


Figure 11: SARS-COV-2 virus targets used in our screening

We subsequently purchased and achieved high-level proficiency in the use of industry-standard drug discoverysoftware (Schrodinger), Tissue drug distribution prediction software (Open Systems Pharmacology), and Clinical Trials design and simulation software (FACTS). We are the only team in Nigeria, thus far, with these capabilities. We have also added a unique phase-contrast inverted microscope with computer interphase to the existing high-level wet laboratory capacity in CAMReT that includes newer generation sequencing systems (e.g., MinIon).

We screened over 1,300 drugsand have identified 106 candidates with all the properties defined above, 7 of which are high potential front runners. Twoof the front runners are easily available and accessible herbal agents and 5 are re-purposed drugs. Wet laboratory validation is in its very final days. We continue to screen over 7,512 other compounds and intend to screen over a

million compounds on the international Academic Drug Discovery Consortium(ADDC) [55],[56]vault where we are members and we have deposited a novel compound-*all in the span of October 2020 to date*. A rather rapid process given theusual long time-track of drug discovery, but nevertheless, wekept the process very thorough.

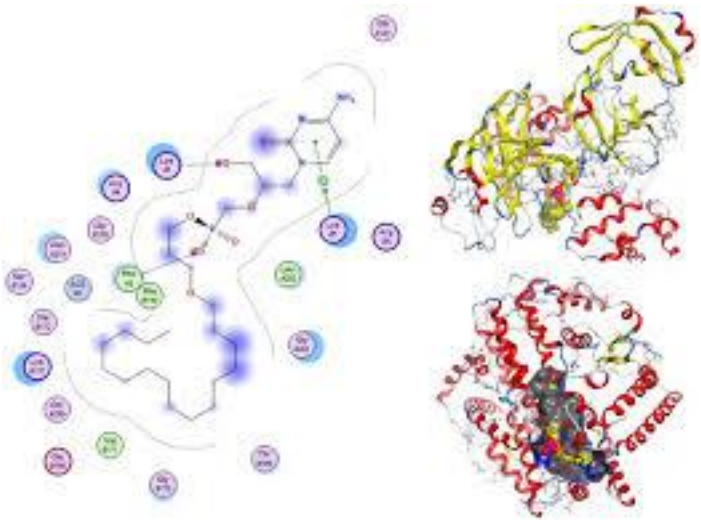


Figure 12: Ligand interaction plot identified by docking[57]

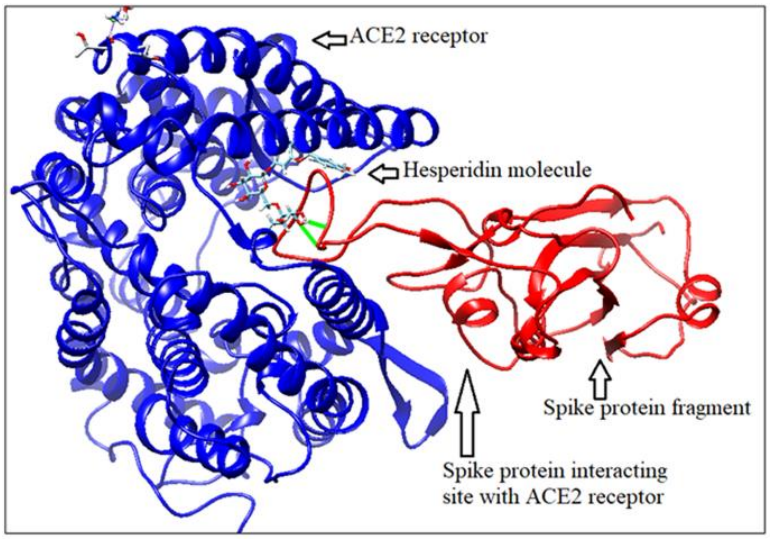
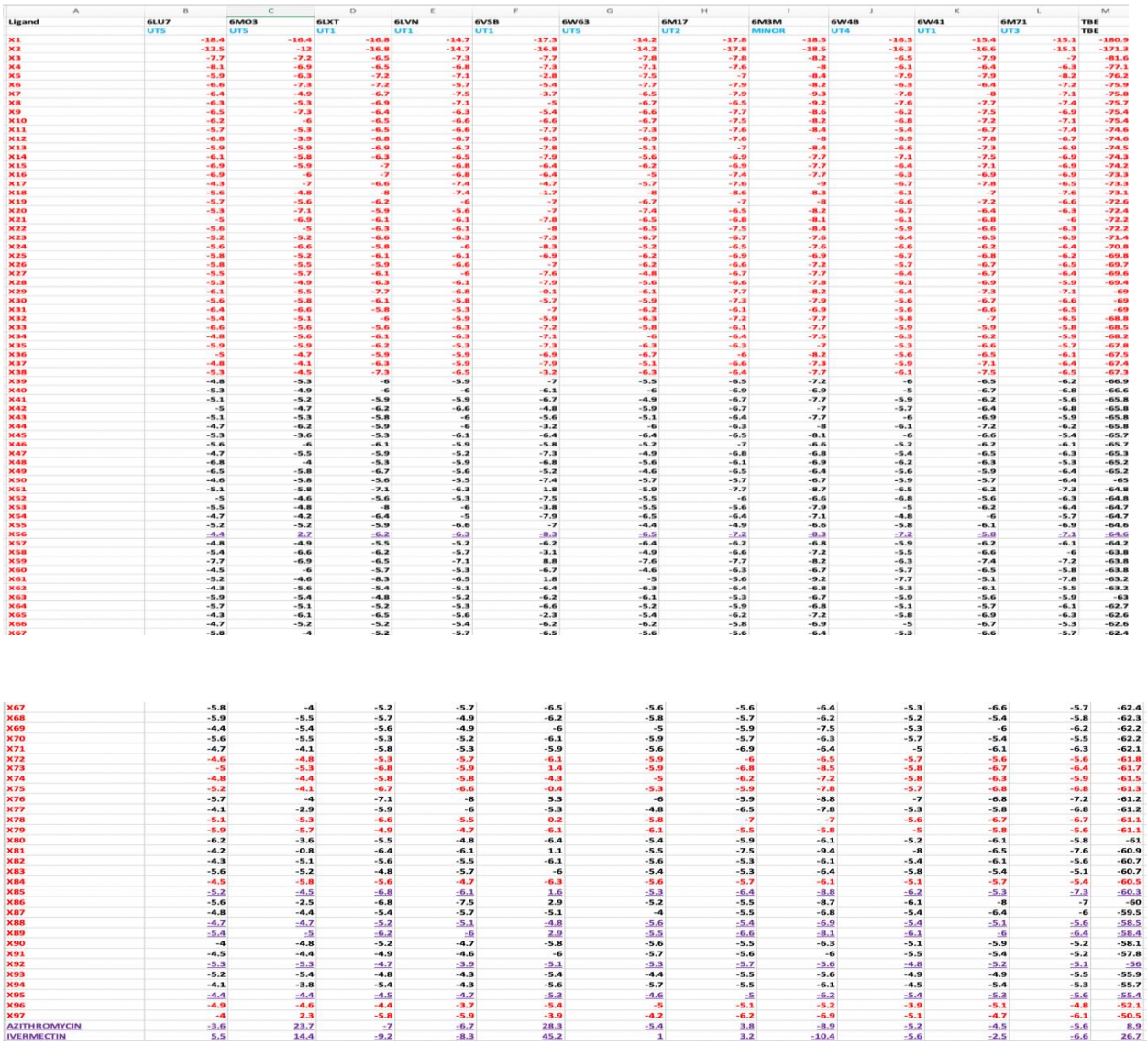


Figure 13: Spike protein and ACE2 interaction blocking[58]

In our screening, Ivermectin and Azithromycin were taken as base compounds for comparison because they are both known to have invitro anti-SARS-COV-2 activity and have anti-inflammatory activity. A positive hit was predicted to be substantially (>3x) more active than these two drugs because the drugs (ivermectin and Azithromycin) at basal activity have not proven substantially effective against COVID-19 on RCTs.

Two of the drugswe identified (X1 and X2) were predicted to be at least 8 times more effective than ivermectin while the next 25 drugs were at least 4times more effective than ivermectin(Figure 14).

Two herbal agents we identified (H1 and G1) were predicted to be even more potent than the best orthodox medicines we screened. These two herbs already have well-documented anti-inflammatory activities equal to or better than Dexamethasone and have well-characterized chemical compositions. It is these components that were used in the screening studies. Furthermore, they are easily available and very cheap. *I hope you appreciate that we cannot publicly declare what exactly they are at this point, mainly to avoid 'press sciences' or run ahead of ourselves.*
Our approach appears unique and the results are exciting, but we are still in the early days. Granted, we have tools that should help us overcome the challenges faced byprevious researchers in this effort, but these tools do not replace RCTs as the final arbiter but tremendously increases the chance of success and reduce the chance of futility of RCTs.



Ligand	6LU7	6MO3	6LXT	6LVN	6VSB	6W63	6M17	6M3M	6W4B	6W41	6M71	TBE
	UT5	UT5	UT1	UT1	UT1	UT5	UT2	MINOR	UT4	UT1	UT3	TBE
X1	-18.4	-16.4	-16.8	-14.7	-17.3	-14.2	-17.8	-18.5	-16.3	-15.4	-15.1	-180.9
X2	-12.5	-12	-16.8	-14.7	-16.8	-14.2	-17.8	-18.5	-16.3	-16.6	-15.1	-171.3
X3	-7.7	-7.2	-6.5	-7.3	-7.7	-7.8	-7.8	-8.2	-6.5	-7.9	-7	-81.6
X4	-8.1	-6.9	-6.5	-6.8	-7.3	-7.1	-7.6	-8	-6.1	-6.4	-6.3	-77.1
X5	-5.9	-6.3	-7.2	-7.1	-2.8	-7.5	-7	-8.4	-7.9	-7.9	-8.2	-76.2
X6	-6.6	-7.3	-7.2	-5.7	-5.4	-7.7	-7.9	-8.2	-6.5	-6.4	-7.2	-75.9
X7	-6.4	-4.9	-6.7	-7.5	-3.7	-6.5	-7.9	-9.3	-7.8	-8	-7.1	-75.8
X8	-6.3	-5.3	-6.9	-7.1	-5	-6.7	-6.5	-9.2	-7.6	-7.7	-7.4	-75.7
X9	-6.5	-7.3	-6.4	-6.3	-5.4	-6.6	-7.7	-8.6	-6.2	-7.5	-6.9	-75.4
X10	-6.2	-6	-6.5	-6.6	-6.6	-6.7	-7.5	-8.2	-6.8	-7.2	-7.1	-75.4
X11	-5.7	-5.3	-6.5	-6.6	-7.7	-7.3	-7.6	-8.4	-5.4	-6.7	-7.4	-74.6
X12	-6.8	-3.9	-6.8	-6.7	-6.5	-6.9	-7.6	-8	-6.9	-7.8	-6.7	-74.6
X13	-5.9	-5.9	-6.9	-6.7	-7.8	-5.1	-7	-8.4	-6.6	-7.3	-6.9	-74.5
X14	-6.1	-5.8	-6.3	-6.5	-7.9	-5.6	-6.9	-7.7	-7.1	-7.5	-6.9	-74.3
X15	-6.9	-5.9	-7	-6.8	-6.4	-6.2	-6.9	-7.7	-6.4	-7.1	-6.9	-74.2
X16	-6.9	-6	-7	-6.8	-6.4	-5	-7.4	-7.7	-6.3	-6.9	-6.9	-73.3
X17	-4.3	-7	-6.6	-7.4	-4.7	-5.7	-7.6	-9	-6.7	-7.8	-6.5	-73.3
X18	-5.6	-4.8	-8	-7.4	-1.7	-8	-8.6	-8.3	-6.1	-7	-7.6	-73.1
X19	-5.7	-5.6	-6.2	-6	-7	-6.7	-7	-8	-6.6	-7.2	-6.6	-72.6
X20	-5.3	-7.1	-5.9	-5.6	-7	-7.4	-6.5	-8.2	-6.7	-6.4	-6.3	-72.4
X21	-5	-6.9	-6.1	-6.1	-7.8	-6.5	-6.8	-8.1	-6.1	-6.8	-6	-72.2
X22	-5.6	-5	-6.3	-6.1	-8	-6.5	-7.5	-8.4	-5.9	-6.6	-6.3	-72.2
X23	-5.2	-5.2	-6.6	-6.3	-7.3	-6.7	-6.7	-7.6	-6.4	-6.5	-6.9	-71.4
X24	-5.6	-6.6	-5.8	-6	-8.3	-5.2	-6.5	-7.6	-6.6	-6.2	-6.4	-70.8
X25	-5.8	-5.2	-6.1	-6.1	-6.9	-6.2	-6.9	-6.9	-6.7	-6.8	-6.2	-69.8
X26	-5.8	-5.5	-5.9	-6.6	-7	-6.2	-6.6	-7.2	-5.7	-6.7	-6.5	-69.7
X27	-5.5	-5.7	-6.1	-6	-7.6	-4.8	-6.7	-7.7	-6.4	-6.7	-6.4	-69.6
X28	-5.3	-4.9	-6.3	-6.1	-7.9	-5.6	-6.6	-7.8	-6.1	-6.9	-5.9	-69.4
X29	-6.1	-5.5	-7.7	-6.8	-0.1	-6.1	-7.7	-8.2	-6.4	-7.3	-7.1	-69
X30	-5.6	-5.8	-6.1	-6.8	-5.7	-5.9	-7.3	-7.9	-5.6	-6.7	-6.6	-69
X31	-6.4	-6.6	-5.8	-5.3	-7	-6.2	-6.1	-6.9	-5.6	-6.6	-6.5	-69
X32	-5.4	-5.1	-6	-5.9	-5.9	-6.3	-7.2	-7.7	-5.8	-7	-6.5	-68.8
X33	-6.6	-5.6	-5.6	-5.3	-7.2	-5.8	-6.1	-7.7	-5.9	-5.9	-5.8	-68.5
X34	-4.8	-5.6	-6.1	-6.3	-7.1	-6	-6.4	-7.5	-6.3	-6.2	-5.9	-68.2
X35	-5.9	-5.9	-6.2	-5.3	-7.3	-6.3	-6.3	-7	-5.3	-6.6	-5.7	-67.8
X36	-5	-4.7	-5.9	-5.9	-6.9	-6.7	-6	-8.2	-5.6	-6.5	-6.1	-67.5
X37	-4.8	-4.1	-6.3	-5.9	-7.9	-5.1	-6.6	-7.3	-5.9	-7.1	-6.4	-67.4
X38	-5.3	-4.5	-7.3	-6.5	-3.2	-6.3	-6.4	-7.7	-6.1	-7.5	-6.5	-67.3
X39	-4.8	-5.3	-6	-5.9	-7	-5.5	-6.5	-7.2	-6	-6.5	-6.2	-66.9
X40	-5.3	-4.9	-6	-6	-6.1	-6	-6.9	-6.9	-5	-6.7	-6.8	-66.6
X41	-5.1	-5.2	-5.9	-5.9	-6.7	-4.9	-6.7	-7.7	-5.9	-6.2	-5.6	-65.8
X42	-5	-4.7	-6.2	-6.6	-4.8	-5.9	-6.7	-7	-5.7	-6.4	-6.8	-65.8
X43	-5.1	-5.3	-5.8	-6	-5.6	-5.1	-6.4	-7.7	-6	-6.9	-5.9	-65.8
X44	-4.7	-6.2	-5.9	-6	-3.2	-6	-6.3	-8	-6.1	-7.2	-6.2	-65.8
X45	-5.3	-3.6	-5.3	-6.1	-6.4	-6.4	-6.5	-8.1	-6	-6.6	-5.4	-65.7
X46	-5.6	-6	-6.1	-5.9	-5.8	-5.2	-7	-6.6	-5.2	-6.2	-6.1	-65.7
X47	-4.7	-5.5	-5.9	-5.2	-7.3	-4.9	-6.8	-6.8	-5.4	-6.5	-6.3	-65.3
X48	-6.8	-4	-5.3	-5.9	-6.8	-5.6	-6.1	-6.9	-6.2	-6.3	-5.3	-65.2
X49	-6.5	-5.8	-6.7	-5.6	-5.2	-4.6	-6.5	-6.4	-5.6	-5.9	-6.4	-65.2
X50	-4.6	-5.8	-5.6	-5.5	-7.4	-5.7	-5.7	-6.7	-5.9	-5.7	-6.4	-65
X51	-5.1	-5.8	-7.1	-6.3	1.8	-5.9	-7.7	-8.7	-6.5	-6.2	-7.3	-64.8
X52	-5	-4.6	-5.6	-5.3	-7.5	-5.5	-6	-6.6	-6.8	-5.6	-6.3	-64.8
X53	-5.5	-4.8	-8	-6	-3.8	-5.5	-5.6	-7.9	-5	-6.2	-6.4	-64.7
X54	-4.7	-4.2	-6.4	-5	-7.9	-6.5	-6.4	-7.1	-4.8	-6	-5.7	-64.7
X55	-5.2	-5.2	-5.9	-6.6	-7	-4.4	-4.9	-6.6	-5.8	-6.1	-6.9	-64.6
X56	-4.4	2.7	-6.2	-6.3	-8.3	-6.5	-7.2	-8.3	-7.2	-5.8	-7.1	-64.6
X57	-4.8	-4.9	-5.5	-5.2	-6.2	-6.4	-6.2	-6.8	-5.9	-6.2	-6.1	-64.2
X58	-5.4	-6.6	-6.2	-5.7	-3.1	-4.9	-6.6	-7.2	-5.5	-6.6	-6	-63.8
X59	-7.7	-6.9	-6.5	-7.1	8.8	-7.6	-7.7	-8.2	-6.3	-7.4	-7.2	-63.8
X60	-4.5	-6	-5.7	-5.3	-6.7	-4.6	-6.3	-6.7	-5.7	-6.5	-5.8	-63.8
X61	-5.2	-4.6	-8.3	-6.5	1.8	-5	-5.6	-9.2	-7.7	-5.1	-7.8	-63.2
X62	-4.3	-5.6	-5.4	-5.1	-6.4	-6.3	-6.4	-6.8	-5.3	-6.1	-5.5	-63.2
X63	-5.9	-5.4	-4.8	-5.2	-6.2	-6.1	-5.3	-6.7	-5.9	-5.6	-5.9	-63
X64	-5.7	-5.1	-5.2	-5.3	-6.6	-5.2	-5.9	-6.8	-5.1	-5.7	-6.1	-62.7
X65	-4.3	-6.1	-6.5	-5.6	-2.3	-5.4	-6.2	-7.2	-5.8	-6.9	-6.3	-62.6
X66	-4.7	-5.2	-5.2	-5.4	-6.2	-6.2	-5.8	-6.9	-5	-6.7	-5.3	-62.6
X67	-5.8	-4	-5.2	-5.7	-6.5	-5.6	-5.6	-6.4	-5.3	-6.6	-5.7	-62.4
X68	-5.9	-5.5	-5.7	-4.9	-6.2	-5.8	-5.7	-6.2	-5.2	-5.4	-5.8	-62.3
X69	-4.4	-5.4	-5.6	-4.9	-6	-5	-5.9	-7.5	-5.3	-6	-6.2	-62.2
X70	-5.6	-5.5	-5.3	-5.2	-6.1	-5.9	-5.7	-6.3	-5.7	-5.4	-5.5	-62.2
X71	-4.7	-4.1	-5.8	-5.3	-5.9	-5.6	-6.9	-6.4	-5	-6.1	-6.3	-62.1
X72	-4.6	-4.8	-5.3	-5.7	-6.1	-5.9	-6	-6.5	-5.7	-5.6	-5.6	-61.8
X73	-5	-5.3	-6.8	-5.9	1.4	-5.9	-6.8	-8.5	-5.8	-6.7	-6.4	-61.7
X74	-4.8	-4.4	-5.8	-5.8	-4.3	-5	-6.2	-7.2	-5.8	-6.3	-5.9	-61.5
X75	-5.2	-4.1	-6.7	-6.6	-0.4	-5.3	-5.9	-7.8	-5.7	-6.8	-6.8	-61.3
X76	-5.7	-4	-7.1	-8	5.3	-6	-5.9	-8.8	-7	-6.8	-7.2	-61.2
X77	-4.1	-2.9	-5.9	-6	-5.3	-4.8	-6.5	-7.8	-5.3	-5.8	-6.8	-61.2
X78	-5.1	-5.3	-6.6	-5.5	0.2	-5.8	-7	-7	-5.6	-6.7	-6.7	-61.1
X79	-5.9	-5.7	-4.9	-4.7	-6.1	-6.1	-5.5	-5.8	-5	-5.8	-5.6	-61.1
X80	-6.2	-3.6	-5.5	-4.8	-6.4	-5.4	-5.9	-6.1	-5.2	-6.1	-5.8	-61
X81	-4.2	-0.8	-6.4	-6.1	1.1	-5.5	-7.5	-9.4	-8	-6.5	-7.6	-60.9
X82	-4.3	-5.1	-5.6	-5.5	-6.1	-5.6	-5.3	-6.1	-5.4	-6.1	-5.6	-60.7
X83	-5.6	-5.2	-4.8	-5.7	-6	-5.4	-5.3	-6.4	-5.8	-5.4	-5.1	-60.7
X84	-4.5	-5.8	-5.6	-4.7	-6.3	-5.6	-5.7	-6.1	-5.1	-5.7	-5.4	-60.5
X85	-5.2	-4.5	-6.8	-6.1	1.6	-5.3	-6.4	-8.8	-6.2	-5.3	-7.3	-60.3
X86	-5.6	-2.5	-6.8	-7.5	2.9	-5.2	-5.5	-8.7	-6.1	-8	-7	-60
X87	-4.8	-4.4	-5.4	-5.7	-5.1	-4	-5.5	-6.8	-5.4	-6.4	-6	-59.5
X88	-4.7	-4.7	-5.2	-5.1	-4.8	-5.6	-5.4	-6.9	-5.4	-5.1	-5.6	-58.5
X89	-5.4	-5	-6.2	-6	2.9	-5.5	-6.6	-8.1	-6.1	-6	-6.4	-58.4
X90	-4	-4.8	-5.2	-4.7	-5.8	-5.6	-5.5	-6.3	-5.1	-5.9	-5.2	-58.1
X91	-4.5	-4.4	-4.9	-4.6	-6	-5.7	-5.6	-6	-5.5	-5.4	-5.2	-57.8
X92	-5.3	-5.3	-4.7	-3.9	-5.1	-5.3	-5.7	-5.6	-4.8	-5.2	-5.1	-56
X93	-5.2	-5.4	-4.8	-4.3	-5.4	-4.4	-5.5	-5.6	-4.9	-4.9	-5.5	-55.9
X94	-4.1	-3.8	-5.4	-4.3	-5.6	-5.7	-5.5	-6.1	-4.5	-5.4	-5.3	-55.7
X95	-4.4	-4.4	-4.5	-4.7	-5.3	-4.6	-5	-6.2	-5.4	-5.3	-5.6	-55.4
X96	-4.9	-4.6	-4.4	-3.7	-5.4	-5	-5.1	-5.2	-3.9	-5.1	-4.8	-52.1
X97	-4	2.3	-5.8	-5.9	-3.9	-4.2	-6.2	-6.9	-5.1	-4.7	-6.1	-50.5
AZITHROMYCIN	-3.6	23.7	-7	-6.7	28.3	-5.4	3.8	-8.9	-5.2	-4.5	-5.6	8.9
IVERMECTIN	5.5	14.4	-9.2	-8.3	45.2	1	3.2	-10.4	-5.6	-2.5	-6.6	26.7

Figure 14: Predicted drug efficacy compared to Ivermectin using Schrodinger.

5.0 Conclusion.

I like to end this lecture by reminding you that every drug you encounter can be of benefit or harm to your body. Indulgence in medicines, even vitamins, analgesics, and so-called natural herbs more often result in harm to the body thanbenefit. Left on its own, the body heals itself. When the capacity of the body to heal is challenged, then drugs will be of benefit. It takes long and intense training to be able to identify when the drug would be of benefit to the body, rather

than harm. This is why you need a prescription for drugs that are identified as ‘’prescription drugs’-and these constitute the vast majority of drugs. Drugs classified as over-the-counter(OTC) may be purchased and ingested directly but usually, such use is strictly restricted to few doses for few days (typically 2-3), and if symptoms persist the usual advice is to consult a physician. Pandemics are usually associated with lots of anxiety and people may be tempted to try out remedies they have heard from friends, televisions, and newspapers. These ‘press or google’ remedies usually turn out to be harmful. It is, therefore, prudent that even in such circumstances, consulting a physicism is the safest route.

Drug discovery and development is not an easy endeavor. It is usually and necessarily undertaken with clear goals, methodical fidelity, and a conservative declaration of success. The success rate is usually extremely low and requiresa high level of innovation. Declarations of discovering a cure by ‘fiat’ are usually based on haste, poor data, and low scientific rigor and therefore do not usually turn out to be true but are frequently harmful.

6.0 Concluding Tributes

It is extremely important to express gratitude to those who have contributed to who I am and what I have been blessed with.

I thank my mother, Hajia Raliyatu Otaru Suleiman, who carried and nursed me and who still frets over me to this date. May Allah have mercy on my Late Father, Mallam Oricha Bello, and grant him Al-Jannah Firdaus. May Allah have mercy on my Late Grandmother, with whom I grew up, MallamaAishatu Otaru, and grant her Al-Jannah Firdaus. May Allah have mercy on all my late family members and the Muslim Umma and grant us Al-Jannah Firdaus.

I wish to express myprofound gratitude to my wives, Hajiya Ummulkahiri John Itopa, Hajiya Huraira Musa, Dr Aishatu Yahaya and Mallama Habiba Sani. They have been chosen for me by my Lord and I testify that they have been excellent in their love, support, tolerance, and duties.

I wish to express my gratitude to my Children, My sisters and brothers, and my entire family for their love and support.

I wish to thank my teachers and colleagues in this University and abroad for their love, support, and mentoring. I express my gratitude to my research team members, Professor Chika Aminu, Associate Professor Mustapha Iman, Dr. Tukur Mohammad, Dr. Yunusa AbdulMajeed, Dr.Bashir Mohammad Bello, Dr. Adamu Ahamed Adamu, and Dr. Sirajuddin Tambuwal.

References

1. H.P., Rang; M.M, D. *'What is Pharmacology'*. (Churchill Livingstone, 2011).
2. Obu, H. A., Chinawa, J. M., Ubesie, A. C., Eke, C. B. & Ndu, I. K. *Paracetamol use (and/or misuse) in children in Enugu, South-East, Nigeria*. *BMC Pediatrics* vol. 12 http://www.biomedcentral.com/1471-2431/12/103 (2012).
3. NAFDAC. Cooking with paracetamol causes liver, kidney failure, NAFDAC warns. *The Guardian Nigeria* https://guardian.ng/news/cooking-with-paracetamol-causes-liver-kidney-failure-nafdac-warns/ (2020).
4. Bello, S. O. The Pharmacological Impact of Restricted or non-variant diet. **2**, 121–128 (2010).
5. Kuo, P.-C. molecules Food and Drug Analysis. *Molecules***25**, (2020).
6. S Cotton. The Top 5 Deadliest Poisons on The Planet. *Science Alert* (2016).
7. EVALUATION OF ANTIDEPRESANT ACTIVITY OF SPINACIA OLERACEAE BY USING ALBINO RATS | INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH. https://ijpsr.com/bft-article/evaluation-of-antidepresant-activity-of-spinacia-oleraceae-by-using-albino-rats/?view=fulltext.
8. Cheavegatti-Gianotto, A. *et al.* Sugarcane (Saccharum X officinarum): A Reference Study for the Regulation of Genetically Modified Cultivars in Brazil. *Tropical Plant Biology* vol. 4 62–89 (2011).
9. Bergfeld, F. A. C. P. ; *et al.Safety Assessment of Saccharum officinarum (Sugarcane)-Derived Ingredients as Used in Cosmetics The Expert Panel for Cosmetic Ingredient Safety members are: Chair, Wilma F*. http://www.cir-safety.org/supplementaldoc/preliminary-search-engines-and-.
10. ZONDEK, H. Paul Ehrlich. *Harefuah* vol. 46 115–117 (1954).
11. World Health Organization. List of National Regulatory Authorities (NRAs) operating at maturity level 3 (ML3)1 and maturity level 4 (ML4)2 (as benchmarked against WHO Global Benchmarking Tool (GBT)3. *Who* (2020).
12. De Rycker, M., Baragaña, B., Duce, S. L. & Gilbert, I. H. Challenges and recent progress

in drug discovery for tropical diseases. (2018) doi:10.1038/s41586-018-0327-4.

13. Tally, F. P. & Sullivan, C. E. Metronidazole: In Vitro Activity, Pharmacology and Efficacy in Anaerobic Bacterial Infections. *Pharmacother. J. Hum. Pharmacol. Drug Ther.***1**, 28–38 (1981).
14. Freeman, C. D., Klutman, N. E. & Lamp, K. C. Metronidazole. A therapeutic review and update. *Drugs* vol. 54 679–708 (1997).
15. Singh, A. Hierarchy Of Evidence. *MedicoWsome* https://www.medicowesome.com/2019/04/hierarchy-of-evidence.html (2019).
16. Newman, D. the NNT. *The NNT Group* http://www.thennt.com/nnt/statins-for-heart-disease-prevention-without-prior-heart-disease/ (2013).
17. Coronavirus: Outcry after Trump suggests injecting disinfectant as treatment - BBC News. https://www.bbc.com/news/world-us-canada-52407177.
18. Stella Immanuel - the doctor behind unproven coronavirus cure claim - BBC News. https://www.bbc.com/news/world-africa-53579773.
19. Covid-19: In Cameroon, chloroquine therapy hailed by French expert becomes state protocol. https://www.france24.com/en/20200503-covid-19-in-cameroon-a-chloroquine-therapy-hailed-by-french-expert-becomes-state-protocol.
20. Home | FLCCC | Front Line COVID-19 Critical Care Alliance. https://covid19criticalcare.com/.
21. STEVE STECKLOW AND ANDREW MACASKILL. The ex-Pfizer scientist who became an anti-vaccination hero. *The Japan Times* https://www.japantimes.co.jp/news/2021/03/20/world/science-health-world/pfizer-employee-anti-vaxxer-covid/ (2021).
22. Coronavirus Misinformation and science literacy | ProfMoosa. https://profmoosa.com/coronavirus-misinformation-and-science-literacy/.
23. Greenhalgh, T. Will COVID-19 be evidence-based medicine's nemesis? *PLoS Medicine* vol. 17 (2020).
24. Pearson, H. How COVID broke the evidence pipeline. *Nature***593**, 182–185 (2021).
25. Dexamethasone in Hospitalized Patients with Covid-19. *N. Engl. J. Med.***384**, 693–704 (2021).
26. Beigel, J. H. *et al.* Remdesivir for the Treatment of Covid-19 — Final Report. *N. Engl. J.*

*Med.***383**, 1813–1826 (2020).

27. What is the role of the antiviral drug remdesivir in the treatment of coronavirus disease 2019 (COVID-19)? https://www.medscape.com/answers/2500114-197451/what-is-the-role-of-the-antiviral-drug-remdesivir-in-the-treatment-of-coronavirus-disease-2019-covid-19.
28. Ader, F. Protocol for the DisCoVeRy trial: multicentre, adaptive, randomised trial of the safety and efficacy of treatments for COVID-19 in hospitalised adults. *BMJ Open* (2020) doi:10.1136/bmjopen-2020-041437.
29. Kumar, S. *et al.* An evolutionary portrait of the progenitor SARS-CoV-2 and its dominant offshoots in COVID-19 pandemic. *Mol. Biol. Evol.* (2021) doi:10.1093/molbev/msab118.
30. Bianco, M. *et al.* COVID-19 therapies and their impact on QT interval prolongation: A multicentre retrospective study on 196 patients. *IJC Hear. Vasc.***30**, (2020).
31. Maraolo, A. E. & Grossi, A. Safety of hydroxychloroquine for treatment or prevention of SARS-CoV-2 infection: A rapid systematic review and meta-analysis of randomized clinical trials. *Immunity, Inflammation and Disease* vol. 9 31–36 (2021).
32. Bauer, S. R., Kapoor, A., Rath, M. & Thomas, S. A. What is the role of supplementation with ascorbic acid, zinc, vitamin D, or N -acetylcysteine for prevention or treatment of COVID-19? . *Cleve. Clin. J. Med.* (2020) doi:10.3949/ccjm.87a.ccc046.
33. Bae, M. & Kim, H. Mini-Review on the Roles of Vitamin C, Vitamin D, and Selenium in the Immune System against COVID-19. *Molecules (Basel, Switzerland)* vol. 25 (2020).
34. Wu, R. *et al.* An Update on Current Therapeutic Drugs Treating COVID-19. *Current Pharmacology Reports* vol. 6 56–70 (2020).
35. Dexamethasone in Hospitalized Patients with Covid-19 — Preliminary Report. *N. Engl. J. Med.* (2020) doi:10.1056/nejmoa2021436.
36. Samudrala, P. K. *et al.* Virology, pathogenesis, diagnosis and in-line treatment of COVID-19. *Eur. J. Pharmacol.***883**, (2020).
37. Jin, Y. *et al.* Virology, epidemiology, pathogenesis, and control of covid-19. *Viruses* vol. 12 (2020).
38. Wiersinga, W. J., Rhodes, A., Cheng, A. C., Peacock, S. J. & Prescott, H. C. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. *JAMA - Journal of the American Medical Association* vol. 324

782–793 (2020).

39. Liu, Y. *et al.* Viral dynamics in mild and severe cases of COVID-19. *The Lancet Infectious Diseases* vol. 20 656–657 (2020).
40. Ye, Q., Wang, B. & Mao, J. The pathogenesis and treatment of the 'Cytokine Storm'' in COVID-19'. *Journal of Infection* vol. 80 607–613 (2020).
41. Nile, S. H. *et al.* COVID-19: Pathogenesis, cytokine storm and therapeutic potential of interferons. *Cytokine and Growth Factor Reviews* vol. 53 66–70 (2020).
42. Bello, S. O., Igumbor, E., Deeni, Y. Y., Ochu, C. L. & Ayodele, P. M. Differences in innate Intracellular viral suppression competencies may explain variations in morbidity and mortality from SARS-CoV-2 infection. *medRxiv* 2020.09.13.20193524 (2020) doi:10.1101/2020.09.13.20193524.
43. Nchioua, R. *et al.* The Zinc Finger Antiviral Protein restricts SARS-CoV-2. *MBio* (2020) doi:10.1101/2020.06.04.134379.
44. Agrawal, S., Goel, A. D. & Gupta, N. Emerging prophylaxis strategies against COVID-19. *Monaldi Archives for Chest Disease* vol. 90 169–172 (2020).
45. Silva-Júnior, E. F., Aquino, T. M. & Araújo-Júnior, J. X. Quantum Mechanical (QM) Calculations Applied to ADMET Drug Prediction: A Review. *Curr. Drug Metab.***18**, (2017).
46. Huang, H. *et al.* Reverse Screening Methods to Search for the Protein Targets of Chemopreventive Compounds. *Front. Chem.***6**, 138 (2018).
47. Zhao, J. *et al.* Cell morphological analysis of SARS-CoV-2 infection by transmission electron microscopy. *J. Thorac. Dis.***12**, 4368–4373 (2020).
48. Hoffman, J. & Hoffman, A. Understanding COVID-19: the virus. *COMMUNITY EYE Heal. J.***33**, 5–9 (2020).
49. Worldometers. Covid-19 Coronavirus Pandemic. https://www.worldometers.info/coronavirus/ (2020).
50. B Lee. What are the chances that this pandemic could end the human race? *COVID-19 Human Impact* (2021).
51. South India's N440K COVID variant 15 times more lethal. https://www.businesstoday.in/latest/trends/south-india-n440k-covid-variant-15-times-more-lethal/story/438271.html.

52. WHO reviewing Seychelles data after fully vaccinated get COVID | Coronavirus pandemic News | Al Jazeera. https://www.aljazeera.com/news/2021/5/12/who-reviewing-seychelles-data-after-fully-vaccinated-get-covid.
53. Yunusa, * & Bello, A. *IDENTIFICATION OF FDA APPROVED DRUGS WITH ACTIVITY FOR HIV-A COMPUTATIONAL DRUG REPOSITIONING APPROACH*. www.rcsb.org (2019).
54. Yunusa, A., Bello, S. O., Chika & Yakubu A. *An Ativiral Drug Combinational Studies Against HIV-A Computational Drug Repositioning approach*. https://www.who.int/medicines/areas/regulation/nras_ml3_ml4/en/#.X5qzDWTljPQ.mendeley (2019).
55. Leray, M., Knowlton, N., Ho, S. L., Nguyen, B. N. & Machida, R. J. GenBank is a reliable resource for 21st century biodiversity research. *Proc. Natl. Acad. Sci. U. S. A.* (2019) doi:10.1073/pnas.1911714116.
56. Langley, G. R. *et al.* Towards a 21st-century roadmap for biomedical research and drug discovery: consensus report and recommendations. *Drug Discovery Today* vol. 22 327–339 (2017).
57. Hussien, M. A. & Abdelaziz, A. E. M. Molecular docking suggests repurposing of brincidofovir as a potential drug targeting SARS-CoV-2 ACE2 receptor and main protease. *Netw. Model. Anal. Heal. Informatics Bioinforma.***9**, 56 (2020).
58. Basu, A., Sarkar, A. & Maulik, U. Molecular docking study of potential phytochemicals and their effects on the complex of SARS-CoV2 spike protein and human ACE2. (2020) doi:10.1038/s41598-020-74715-4.

Curriculum Vitae-*Abridged*

Personal Particulars

Name: Bello Shaibu Oricha.
Age: 58 yrs.
Sex: Male
Marital Status: Married
State of Origin: Kogi State
Local Government: Okene LGA

Educational Background**(from most recent)**

1. **Postgraduate Certificate in Health Professional Education**: Assessments and Accreditations (Keele University)—**2018-2019**
2. **Fellowship in Medical Education** (Philadelphia)-**2017-2019**
3. **Certified Assisted Reproduction Specialist:** In-vitro fertility Unity, Saed Galal and Hussein Teaching Hospital Complex, Cairo, Egypt: **2005- 2006**
4. **PhD** (Pharmacology-*drug discovery-development/Clinical pharmacology*), Usmanu Danfodiyo University: **1998-2003**
5. **MBChB**, Obafemi Awolowo University, Ile-Ife: **1980-1987**
6. **BSC** (Health Sciences), Obafemi Awolowo University, Ile-Ife :**1980-1984** (Intercalated)

Administration & Leadership

Academic Leadership

1. **Provost,College of Health Sciences**, Usmanu Danfodiyo University, Sokoto, Nigeria. **23rd June 2017 to date .**
2. **Member, Board of Expert (BOE) ,** Central Bank of Nigeria Healthcare Sector Research and Development Grant Scheme (HSRDIS).**Jan 2021-Date**
3. **Member, Governing Council,** Medical and Dental Council of Nigeria**. January 2019-Date**
4. **Member, Ministerial Expert Advisory Committee** on COVID-19-Health System Response (MEACoC-HSR)-**March 2020-Date**
5. **Chairman, Research and Clinical Trial, Vaccines & Medicines subcommittee-** MEACoC-HSR- **March 2020-Date**
6. **Member, Clinical Management subcommittee-** MEACoC-HSR- **March 2020-Date**

7. **Member, National Research Consortium on COVID-19**-NCRC-19-March 2020-**Date**

8. **Coordinator (Lead): Candidate Therapeutics R&D workgroup-NCRC-19**- March 2020**-Date**

9. **Member, Candidate Vaccines R&D Subcommittee,** -NCRC-19-March 2020-**Date**

10. **Member, Ethics Consideration for Research Subcommittee, -**NCRC-19-March 2020-**Date**

11. **Member, Clinical Management Subcommittee,** -NCRC-19-March 2020-**Date**

12. **Member, Virus natural history, transmission and diagnostics Subcommittee, -** NCRC-19-March 2020-**Date**

13. **Member, Governing Board of Management**, Usmanu Danfodiyo University Teaching Hospital, Sokoto.**5th March 2018-Date**

14. **Deputy Provost (BMS),** College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria. **10th August 2011- 3rd September 2014**

15. **Dean, Faculty of Basic Medical Sciences**, College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria. **4th September 2014-22nd June 2017**

16. **Head of Department**, Department of Pharmacology and Toxicology, **Faculty of Pharmaceutical Sciences**, Usmanu Danfodiyo University, Sokoto, Nigeria. **10th February 2010-9th February 2014**

17. **Head of Department,** Department of Pharmacology & Therapeutics, **College of Health Sciences**, Usmanu Danfodiyo University, Sokoto, Nigeria. **13th February 2012-12th February 2016**

18. **Head, Department of Medical Education,** Faculty of Basic Medical Sciences, College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria**, July 2019-Date**

19. **Complex Coordinator -UDUTH & CITY campus complexes,** Usmanu Danfodiyo University. **1st August 2018-Date .**

20. **Member**, **Management Committee,** City Campus Central Research Laboratory, Usmanu Danfodiyo University, Sokoto. **14th December 2010-13th December 2014**

21. **Member**, University Bioethics committee, Usmanu Danfodiyo University, Sokoto. **11th April 2012 to date**

22. **Member**, University PhD Thesis Prize Award Committee, UDUS. **2014-date.**

23. **Chairman**, Committee on NUC at 50+1: Exhibition by Nigerian Universities. **16th July 2013**

Community Leadership

1. **Chairman,** Sokoto State Chapter, **Nigerian Red Cross. 1994-1995**
2. **State Vice Chairman,** Sokoto State Chapter, **Nigerian Red Cross. 1993-1994**
3. **Member, National executive Council**, **Nigerian Red Cross** Society,**1995**.
4. **Chairman (Amir),** Usmanu Danfodiyo **University Muslim Community. 2012-date**
5. **Chairman (Amir), Islamic Medical Association,** Sokoto State Chapter. **2010-2014**
6. **Member, University Mosque Committee,** Usmanu Danfodiyo University**. 2012-2014**
7. **Secretary, Caretaker Committee**, Nigerian Medical Association, Sokoto.1997
8. **Member, Committee for support of the Needy**, Specialist Hospital Sokoto. - .1999 to 2001.

Academic Post

1. **Professor of Pharmacology**, Department of Pharmacology & Therapeutics, College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria—**1st October 2010 to Date**
2. **Lecturer & Researcher**, Department of Pharmacology & Therapeutics, College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria- **10th October 1998-30th September 2010**

Journal Editor

1. **Senior Managing Editor.** *Drug Discovery*. Kanyakumari District, Tamilnadu, India **(http://www.discoveryjournals.org/drugdiscovery/Editorial_Board/index.htm)**
2. **Editorial Board Member.** *International Journal of Drug Development and Research.*iMedPub LTD 483, Green Lanes. London. N13 4BS, **UK (http://www.ijddr.in/editors.php)**
3. **National Executive Editor.** *Sahel Medical Journal.* Sokoto**. (www.smjonline.org/editorialboard.asp)**
4. **Mentor. UNESCO Booklets for midwifery students in Low and Medium Resources. (unesco.ijs.si/project/booklets)**

Academic Visits & International Collaborations

1. Department of Cardiovascular Clinical Pharmacology, Cardiovascular Biology, Franklin-Wilkins Building, Kings College London. **June 2011-August 2011.**

2. Department of Cardiovascular Clinical Pharmacology, Guys & St Thomas Hospitals, London. **June 2011-August 2011.**

3. Department of Obstetrics &Gynaecology, Nottingham City Hospital, Nottingham. **August 2010.**

4. Department of Pharmacology, London School of Pharmacy, **September 2010.**

Ongoing Research Collaborations

1. **Bello S.O and Ferro Albert. The role of monocyte-platelets aggregates in Cardiovascular pathophysiology.** A collaboration with Professor Albert Ferro of the Department of clinical pharmacology, Unit of cardiovascular clinical pharmacology, **King's College London**. *Current Status: Ongoing*

2. **Bello SO, James Hallock.Enhancing Medical Education community responsiveness through the platform of Medical Education Department**. - A FAIMER project in collaboration with Professor James Hallock of **Thomas Jefferson University. Philadelphia USA**. -*Completed. Awaiting publication*

3. **Bello S.O. Exploration of small interfering RNAs for target validity in drug developments: a focus on anti-tuberculous agents** *Current Status: Ongoing*

4. **Bello S.O and Chika A. In silico-metabolic exploration of herbal structures derived from herb versus in-Vivo rat metabolic exploration with HPLC assays.** *Current Status: Ongoing*

5. **Bello S.O. From Lab-to-Market, exploration of dedicated but fuzzy pathways for developing drugs for orphan diseases— with focus on Anti-helminthic and anti-malarial:** *Current Status: Ongoing*

Publications

1. Tukur Mohammad**, Bello So (**2021**).** A preliminary study on cytochrome 2e1 gene single nucleotide polymorphisms among ethnic Fulani in north western Nigeria. **International Journal Of Scientific Research**. *10,3,1-3. DOI : 10.36106/ijsr*

2. **Bello SO**, Igumbor E, Deeni YY, Ochu CL, Popoola MA(2020). Differences in innate Intracellular viral suppression competencies may explain variations in morbidity and mortality from SARS-CoV-2 infection. **medRxiv**; 2020. DOI: 10.1101/2020.09.13.20193524.

3. Ugwah-Oguejiofor CJ, Okoli CO, Ugwah MO, Okolo RU, **Bello SO** (2020).Assessment of reproductive impact of the aerial parts of Carallumadalzielii N. E. Br in female Wistar rats. **Heliyon**. 2020 Oct 17;6(10):e05199. doi: 10.1016/j.heliyon.2020.e05199.

4. MT Umar, **SO Bello**, A Chika, Y Abdulmumini(2020). Plasma chlorzoxazone as a probe for cytochrome 2E1 activity among Hausa/Fulani in northwest Nigeria: Determination of acetaminophen metabolic phenotypes. **Journal of Health Research and Reviews** 7 (1), 18

5. Umarudeen, A. M., Magaji, M. G., **Bello, O. S**., Aminu, C., & Abdullahi, M. I. (2020). Pharmacological Investigation of Serial Anxiety Tests in the Mouse: A Pilot Study. ***Journal of Advances in Medical and Pharmaceutical Sciences,*** *22*(4), 25-31.

6. Umar MT, **Bello SO**, Chika A, Abdulmumini Y. (2020). Plasma chlorzoxazone as a probe for cytochrome 2E1 activity among Hausa/Fulani in northwest Nigeria: Determination of acetaminophen metabolic phenotypes. **J Health Res Rev**. 7:18-23.doi.org/10.4103/jhrr.jhrr_59_19

7. C J. Ugwah-Oguejiofor , C O. Okoli , M O. Ugwah , R U. Okolo, **S O. Bello**. (2020). Assessment of reproductive impact of the aerial parts of Carallumadalzielii N. E. Br in female Wistar rats. **Heliyon**. doi.org/10.1016/j.heliyon.2020.e05199

8. Dikko, M; **Bello, SO**; Chika, A; Mungadi, IA; Sarkingobir, Y;5umar, AI, (2020). Effect of Tamsulosin Use on Plasma Insulin Status in Benign Prostatic Hyperplasia Patients in Sokoto, **Nigeria. J. Appl. Sci. Environ. Manage**. Vol. 24 (4) 543- 548

9. Dikko, M; **Bello, SO**; Chika, A; Mungadi, IA; Sarkingobir, Y; 5umar, AI, 2020. Determination of Oral Glucose Tolerance (OGT) of Benign Prostatic Hyperplasia Patients Treated with Tamsulosin in Sokoto State, Nigeria. **Nigerian Journal of Pharmaceutical and Applied Science Research**, 9(2): 33-39

10. MT Umar, **SO Bello**, A Chika, Y Abdulmumini (2020). Assessment of cytochrome P450 2E1 activity in Hausa/Fulani of northwest Nigeria using chlorzoxazone as a probe determination of polymorphism. **Egyptian Pharmaceutical Journal**, 19 (1), 62

11. A Yunusa, **SO Bello**, A Chika, A Yakubu (2019). An antiviral drug combinational studies against HIV-A computational drug repositioning approach. **Asian Journal of Science and Technology** 10 (08), 9978-9984.

12. A Yunusa, **SO Bello** (2019). Identification of FDA approved drugs with activity for HIV-A computational drug repositioning approach**. Asian Journal of Science and Technology** 10 (08), 9985-9996

13. MO Ugwah, CJ Ugwah-Oguejiofor, EU Etuk, **SO Bello**, AA Aliero (2019). Evaluation of the antiulcer activity of the aqueous stem bark extract of Balanites aegyptiaca L Delile in Wistar rats. **Journal of ethnopharmacology** 239, 111,931

14. A Chika, **SO Bello** (2019). Phenotype Analysis as Plant Selection Strategy in Drug Discovery from Plants for Obesity. **International Journal of Recent Innovations in Academic Research** 3 (10), 53-65

15. A Chika, **SO Bello** (2019). Hepatoprotective and body weight lowering effects of the aqueous leaf extract of Phyllanthus pentandrusSchumach. and Thonn (Phyllanthaceae) in non-alcoholic fatty liver disease. **National Journal of Physiology, Pharmacy and Pharmacology** 9 (12), 1251-1256

16. Ottah C. U., Etuk E. U., **Bello S. O**., Bilbis L. S., Ndodo N. D. and Ottah V. E (2018). Antioxidant Capacity And DNA Damage Protective Activity Of The Root Extract Of Nauclea Latifolia. **World Journal of Pharmaceutical Research** . 7(9), 22-32

17. A Chika, D.C. Onyebueke, **S.O. Bello (2018).** Phytochemical analysis and evaluation of antidiabetic effects in alloxan-induced diabetic rats treated with aqueous leaf extract of Acanthospermumhispidum. **African Journal of Biomedical Research.** 21;81-85

18. Umar MT, **Bello SO,** Zauro R (2018) . Burn Out Syndrome an Emerging Formidable Challenge to Health Care Delivery: Physicians Perspectives in a Recessive Economy. **Acta Scientific Medical Sciences**. 2 ; 26-29.

19. Aminatu A. Sani, **Bello S. Oricha**, Emmanuel U. Etuk, Aishatu Y. Bello(2017).Effect of Aqueous Extract of Guiera Senegalensis on Milk Production in Wistar Rats. **Alexandria Journal of Veterinary Sciences**. 2017; 53(1): 95-99.

20. Bello S.O, Alani IA(2017). Memoryless Markov modelling as selection criteria for herbal agents in syndromic diseases: A case study of dioscorea prehensile& Zingiber Officinalis in Rats models of pre-eclampsia **Tropical Journal of Obstetrics &Gynaecology. 34 (Suppl.1). S34.**

21. Bello S.O, Chika A, Yunusa A, Adamu AA(2017). Further Evidence for the Off-Label use of Chloroquine for Ebola Virus Disease. **Tropical Journal of Obstetrics & Gynecology. 34 (Suppl.1). S62.**

22. Bello S.O. (2017). Medical education scholarship in Nigeria: Professional Identity Formation and Classroom management. **Tropical Journal of Obstetrics & Gynecology. 34 (Suppl.1). S61.**

23. Bello S.O, Bello AY**(2017).**Patients sometimes celebrate adverse effects as evidence of potency and efficacy in Africa .**Biochem Pharmacol** (Los Angel) 6.2 (Suppl)

24. Adamu, Ahmed Adamu, **Bello, shaibu Oricha**, Chika, Aminu (2017). Evaluation Of Some Generic Drugs For Reversal Of Multidrug-Resistance In Pseudomonas Aeruginosa Using Computer-Aided Drug Design. **International Journal of Latest Research in Science and Technology**. 6 (5):60-66.

25. Romano Demicheli , Erhabor Osaro, Michael Retsky ,Forget Patrice,Vaidya Jayant S , **Bello SO**. (2016). Protocol For A Randomised, Multicentre, Double Blinded Phase III Study Of Perioperative Ketorolac In Women Of African Descent With Operable Breast Cancer. **J J Intern Medicine**. 2(1): 1-13

26. Yunusa, Abdulmajeed; **Bello, shaibu Oricha**;Chika, Aminu (**2015**). Computational Drug Re-Positioning: An Approach To Discover Novel Antimalarials. **International Journal of Latest Research in Science and Technology** . 4 (4) : 119-127

27. Chika, A., **Bello, S. O**. (**2016**). Optimizing community effectiveness of antimalarial drugs in malaria-endemic areas of Africa: Issues, challenges, and proposed actions. **African Journal of Pharmacy and Pharmacology**, 10(9), 121-131.

28. Umar MT, **Bello SO**, Jimoh AO, Sabeer AA,Ango UM(**2016**). Perception of injections in semi-urban communities in Sokoto,northwest Nigeria. **Ann Trop Med Public Health**; 9:241-4.

29. Umar MT, **Bello SO,** Chika A, Oche OM (**2016**). Attitude of nurses and pharmacists on adverse drug reactions reporting in selected hospitals in Sokoto, Northwest Nigeria. **J Res Pharm Pract** :219-21.

30. Bello SO, Muhammad BY, Bello AY, Ukatu AI, Ahmad BM, Adeneye AA and Cherima JY (**2016**). A study of the clinical effectiveness of Chloroquine in North-western Nigeria. **African Journal of Malaria and Tropical Diseases**, 4 (2), pp. 266-268.

31. Abubakar Kabiru, Danjuma Nuhu Muhammad, Maiha Balkisu Bello, Anuka Joseph Akpojo, Yam Mun Fei, **Bello Shaibu Oricha**, YusoffAdlin, Hor Sook Yee, Mariam Ahmad and Zaini Muhammad Asmawi (**2015**). A 28- Day Oral Toxicity Study of Pseudocedrelakotschyi Methanol Extract in Sprague-Dawley Rats. **European Journal of Medicinal Plants** 10(3): 1-11,

32. Ugwah-Oguejiofor, C. J., Eze, U. A., **Bello, S. O**., & Etuk, E. U(**2015**). Anticonvulsant and sedative activities of aqueous leave extract of Leucas martinicensis (Jacq.) R. Br. **Nigerian Journal of Basic and Applied Sciences**, 23(2), 87-91.

33. Yunusa A, **Bello SO**. (**2015**). Computational drug design: an approach in drug re-positioning-a review. **International Journal of Scientific Research Engineering & Technology** (IJSRET), 4(8), 860-863.

34. Yunusa A, **Bello SO**, Chika A. (**2015**). Computational drug re-positioning: an approach to discover novel antimalarials. **International Journal of Latest Research in Science and Technology)**, 4(4), 119-127

35. Maxwell O. Egua, Emmanuel U. Etuk, Shaibu **O. Bello,** Sanusi W Hassan (**2015).**Isolation and Structural Characterization of the Most Active Antidiabetic Fraction of Corchorus olitorius Seed Extract. **Journal of Advances in Medical and PharmaceuticalSciences, 2(3): 75-88, 2015**

36. Chinenye Jane Ugwah-Oguejiofor, **Shaibu Oricha Bello**, Raymond U Okolo, Emmanuel U Etuk, Michael OguejioforUgwah, Vincent Ugochukwu Igbokwe, Mohammed Umar(**2014**).Effect of aqueous extract of Ficus platyphylla on female Wistar rats with estradiol valerate-induced polycystic ovarian syndrome**. International Journal of Phytomedicine.**2014. Vol. 6 (3). e-published.

37. Araromi Ebisola Jonathan, Emmanuel Udo Etuk, **S. O.Bello (2014)**, M.S.Gwarzo and Maxwell OsaronowenEgua. Antidiarrhoeal Effects of Aqueous Stem Bark Extract of BrideliaferrugineaBenth. Using Castor Oil Diarrhoea Induction Model. **Int. J. Curr. Res. Biosci. Plant Biol**., 1(4): 15-20

38. Araromi Ebisola Jonathan, Emmanuel Udo Etuk, **S. O. Bello (2014)**, M.S.Gwarzo and Maxwell OsaronowenEgua. In vitro Antibacterial Activities of Aqueous and Ethanolic Stem Bark Extracts of BrideliaferrugineaBenth**. Int. J. Curr. Res. Biosci. Plant Biol**. 1(5): 28-31

39. Mohammad T.Umar, **Bello S.O**, Aminu C, AbdulGafar O.J (**2014**). Attitude of university students towards fake drugs in Sokoto north-western Nigeria. **International Journal of Innovative Research and Development.** Vol 3(9).pg 158-159:

40. Bello S.O., Chika A(**2014**). Phenotype Analysis As Plant Selection Criteria In Drug Discovery From Natural Products For Syndromic Diseases 2: Methanolic Leaf Extract Of LeptadeniaHastata Pers. (Decne) [Lh] For Metabolic Syndrome.**Basic & Clinical Pharmacology & Toxicology**, 115 (Suppl. 1), 140,

41. Bello S.O., Chika A(**2014**). Phenotype Analysis As Plant Selection Criteria In Drug Discovery From Natural Products For Syndromic Diseases 1: A Case Study Of Metabolic Syndrome. **Basic & Clinical Pharmacology & Toxicology**, 115 (Suppl. 1), 139-140.

42. Bello S.O., Chika A., AbdulMajeed Y(**2014**). Exploiting Secondary Pharmacology in Drug Discovery: In Silico guided Wet Laboratory Screening of Generic Drugs for Antimalarial Activity. **Basic & Clinical Pharmacology & Toxicology**, 115 (Suppl. 1), 161.

43. Etuk E., Egua M., **Bello S.O(2014)**. Stereological Quantification of Pancreatic Cells Reactions Following Treatment with ethanolic Seed extract of Corchorus olitarious in Alloxan Induced Diabetic Rats. **Basic & Clinical Pharmacology & Toxicology**, 115 (Suppl. 1), 245.

44. Maxwell O. Egua, Emmanuel U. Etuk, **Shaibu O. Bello,** Sanusi W Hassan (**2014**).Anti diabetic potential of Liquid-Liquid partition fractions of ethanolic extract of Corchorus olitorius. **Journal of Pharmacognosy and Phytotherapy.Vol. 6(1), pp. 4-9**.

45. Maxwell O. Egua, Emmanuel U. Etuk, **Shaibu O. Bello,** Sanusi W Hassan (**2013**).Anti diabetic Activity Of Ethanolic Seed Extract Of Corchorus olitorius.**International Journal of Sciences: Basic and Applied Research.Volume 12, No 1, pp 8-21**

46. Ezeh, U.A., **Bello, S.O**., Etuk, E.U., Ameh, G.I., Ugwah, O.M. and Ugwah-Oguejiofor, C.J.(**2013**) . Phytochemical and preliminary toxicological studies of the aqueous leaveextract of Leucas martinicensis in wistar rats. **International Journal of Medicinal PlantsResearch,** 2:166-169.

47. Bello SO, Chika A, Jimoh AO, Abubakar K, Adebisi I. (**2013**).Evaluation of hypoglycaemic and antihyperglycaemic activity of methanolic wholeplant extract of *Schwenckiaamericana* (Solanacae) in normal and alloxan-induced diabeticrats. **African Journal of Pharmacy and Pharmacology** Vol.7(39), pp. 2662-2666

48. Michael O. Ugwah, Emmanuel U. Etuk, **Shaibu O. Bello**, Adamu A. Aliero andChinenye J. Ugwah-Oguejiofor (**2013**). Comparative studies of anti-ulcerogenic activities of three Nigerian medicinal plants: A preliminary evaluation.**Journal of Medicinal Plants Research** Vol. 7(9), pp. 490-495,

49. Nurudeen O. Raji, Iyabo M. Adebisi, **Shaibu O. Bello (2013)**.Ethnobotanical Survey Of Antihypertensive Agents In Sokoto, Northwest Nigeria.**International Journal Of Innovative Research & Development**. Vol 5(2),pp.1820-1834

50. Bello SO, Ekele BA(**2012**). On the safety of diagnostic ultrasound in pregnancy: Have we handled the available data correctly.**Ann Afr Med** 2012;11:1-4

51. H.Ighodaro, SO Bello, EU Etuk and MJ Ladan (2012). The acute and subchronic toxicity of the aqueous stem bark extract of amblygonocarpusandogensis in albino rats. **Continental J. Pharmacology and Toxicology Research** 5 (1): 1-6, 2012

52. Bello S.O, Tukur Umar (**2011**). Knowledge and attitudes of physicians relating to reporting of adverse drug reactions in Sokoto, north-western Nigeria. **Annals of African Medicine**. 2011 Jan-Mar;10(1):13-8

53. H. Ighadora and **S.O.Bello(2011)**. The antinociceptive effect of the aqueous stem bark extract of amblygonocarpusandogensis in albino rats. **Continental J. Pharmacology and Toxicology Research** 4 (1): 11 – 17.

54. Chinenye J. Ugwah-Oguejiofor, **Shaibu O. Bello**, Emmanuel U. Etuk, Vincent U. Igbokwe, Oguejiofor M. Ugwah, Raymond U. Okolo.(**2011**).Preliminary toxicity and phytochemical studies of the aqueous extract of *Ficus platyphylla*in female albino rats.

International Research Journal of Pharmacy and Pharmacology (ISSN: 2251-0176) Vol. 1(5) pp. 086-092

55. Chinenye J Ugwah-Oguejiofor, **Shaibu O Bello**, Raymond U Okolo, Emmanuel U Etuk, Michael O Ugwah andVincent U Igbokwe. (**2011**). Ficus platyphylla promotes fertility in female Rattus norvegicus Wistar strain: a preliminary study. **Reproductive Biology and Endocrinology.** 2011, **9**:145 .

56. Iyabo Mobolawa Adebisi1 and **Shaibu Oricha Bello** (**2011**)An ethnobotanical survey of herbal male contraceptives used in south-west Nigeria**African Journal of Pharmacy and Pharmacology** Vol. 5(2), pp. 289-291, February 2011**.**

57. Ameh, I.G, Adebisi ,M.I, Etuk.E, **Bello,S.O**, Shehu,R, Dangogo, S, Yahaya,A. **(2011)** Causative Agents and Antimicrobial Sensitivity of Urinary Tract Infection in Sokoto, Northwest Nigeria**.International Journal of Biological Science**Volume 3, Number1, 2011

58. Abdulgafar .O. Jimoh, **Shaibu .O. Bello**, Emmanuel .U. Etuk, Solomon .A. Adeleye, Vincent .U. Igbokwe (**2011**) Comparative Pharmacokinetics of Intramuscular ceftriaxone Co-Administered with Acetaminophen in Healthy and Infected Sokoto Red Goats. **International Journal of Pharmacology** DOI:10.3923/ijp.2011

59. O.J. Abdulgafar**, Bello S.O**, U.E. Emmanuel (**2011**) Effects of Salmonella thyphymurium Infection on the Pharmacokinetics of ceftriaxone in Sokoto Red Goats. **Nigerian Journal of Basic and Applied Science** 19(1): 49-54

60. A. Chika, **S.O. Bello**,A.O. Jimoh**,** M.T. Umar (**2011**) The Menace of Fake Drugs: Consequences, Causes and Possible Solution. **Research Journal of Medical Sciences** 5(5): 257-261

61. Bello SO. (2010) Cross Platform In Silico Design And Evaluation Of Small Interfering Rnas That Target The Expression Of Plasmodium Falciparum Heat Shock Protein 90 (pfhsp90) Gene .WebmedCentral**Bioinformatics** 2010;1(10):WMC001005

62. Bello S.O, Shuaibu A(**2010**). Computer assisted design and in-silica metabolic exploration of a hemoglobin docking molecule-early steps of a novel antiplasmodial agent. . WebmedCentral **Pharmaceutical Sciences.** 2010;1(9):WMC00753

63. Bello S.O (**2010**) The Pharmacological impact of restricted or non-variant diet. **International Journal of Drug Development & Research**. 2(1):121-128.

64. Bello S.O, Hayyau Umar. (**2010**) The pharmacokinetics of amoxicillin in healthy adult Nigerians. **Res. J Pharm Biol Chem Sci**. 1(3):799-807.

65. Bello, S.O., Bashar, I., Muhammad, B.Y., Onyeyili, P.(**2010**).Acute toxicity and

uterotonic activity of aqueous extract of Lawsoniainermis (Lythraceae). **Res. J Pharm Biol Chem Sci.** 1(3):790-798.

66. Bello S.O. (**2010**). Cosmeceutical- A mini review. **African Journal of Pharmacy and Pharmacology**. 4(4): 127-129.

67. Bello S.O. Chika A, Bello A. (**2010**). Is Chloroquine better than Artemisinin Combination therapy as first line treatment in adult Nigerians with uncomplicated malaria? -A Cost effectiveness analysis. **African Journal of Infectious Disease**. 4(2): 29 – 42.

68. Bello S.O. Chika A, Jimoh A.(**2010**). Artesunate plus Amodiaquine (AS+AQ) versus Artemether -Lumefantrine (AL) for the treatment of uncomplicated plasmodium falciparum malaria in Sub-Saharan Africa-A meta-analysis. **African Journal of Infectious Disease**. 4(2): 20 – 28.

69. Bello S.O, Chika A. (2010). Influence of Vitamin B-12 complex injection (ELDERVIT-12) on gentamicin nephrotoxicity in rats: a preliminary study. **Global Journal of pure and applied science**. VOL 16, NO. 1, 2010: 169-172

70. Etuk, E.U, **Bello, S.O**, Isezuo, S.A., Mohammed, B.J. (**2010**). Ethnobotanical Survey of Medicinal Plants used for the Treatment of Diabetes Mellitus in the North Western Region of Nigeria. **Asian J. Exp. Biol. Sci**. 1 (1):55-59

71. Chika A, **Bello S.O**.(**2010**) Antihyperglycaemic activity of aqueous leaf extract of Combretum micranthum (Combretaceae) in normal and alloxan-induced diabetic rats. **Journal of Ethnopharmacology**. 129 : 34–37.

72. Aminu C, Isezuo SA, Etuk E, **Bello SO**(**2010**). Utilization of antihypertensive drugs: A comparison of tertiary and secondary health care institutions in northwestern Nigeria. **Nigerian Medical Practitioner**. 57:50-54

73. S. M. Maaji, B. A. Ekele, **S. O. Bello,** I. O. Morhason-Bello (**2010**) .Do women want disclosure of fetal gender during prenatal ultrasound scan? **Annals of African Medicine** Vol. 9, No. 1; 2010

74. Bello S.O, Chika A. (**2009**). Gentamicin and Erythromycin modify post prandrial Glucose excursion in New Zealand Rabbits. **African Journal of Pharmacy and Pharmacology**. 3(5):202-206

75. C Livinus, M.O Ibrahim, S Isezuo**, S O Bello (2009)**. The impact of training on malaria treatment practices: a study of patent medicine vendors in Birnin-kebbi. **Sahel Medical Journal.** 12(2): 151-158

76. Bello S.O, Chika A. (**2009**). Dose dependent amelioration of Gentamicin nephrotoxicity in adult Swiss albino rats by B-complex injection. **TropicalJournal of**

Pharmacotherapy Research. 8 (2): 111-116

77. Chika A, Etuk EU, **Bello SO**, Isezuo SA (**2009**). Gender disparity in antihypertensive utilization and BP control. **Sahel Medical Journal.** 12(4): 155-158

78. Bello S.O (**2009**). Pre-referral artesunate to prevent death and disability in severe malaria: a placebo control trial. **The Lancet** . Vol 373: 1762-1763

79. Bello S.O (**2009**). Herbal therapies: Are they alternative medicines or fast forward science?. **Journal of Medicinal Plants Research**. Vol. 3(6), pp. 454-456 **.**

80. Ekele, Bissallah A.; Maaji, Sadisu M.; **S O Bello**, Imran O Morhason-Bello.(**2008**). Profile of Women Seeking Fetal Gender at Ultrasound in a Nigerian Obstetric Population. **Ultrasound**;16(4): 199-202.

81. YY Cherima, **Bello S.O** (**2008**). Eclampsia Complicating molar pregnancy at 8 weeks gestation- A case report. **Trends in Applied Sciences Research** 3(1):113-114

82. Bello S.O, Isezuo S.A, Chika A. (**2008**). Cost-Effectiveness Analysis of Microscopy, Culture and Sensitivity Study as a Decision Tool in Choice of Antibiotics in Clinical Practice. **Afr. J. Infect. Dis.** 2(2): 63 – 67

83. Mojiminiyi FB, Dikko M, Muhammad BY, Ojobor PD, Ajagbonna OP, Okolo RU, Igbokwe UV, Mojiminiyi UE, Fagbemi MA, **Bello SO**, Anga TJ(**2007**) Antihypertensive effect of an aqueous extract of the calyx of Hibiscus sabdariffa. **Fitoterapia**. 78(4):292-7.

84. Ekele BA, **Bello S.O**, Adamu N (**2007**): Clusters Of Eclampsia In A Northwestern Nigerian Teaching Hospital. **International Journal of Obstetrics and Gynecology**. 96:62-68.

85. Bello SO (**2007**). On Zebra and horses in clinical medicine. **Trends in Medical Research**. 2(4):215-216

86. Etuk E.U, Onyeyili P.A, **Bello S.O** (**2006**). The effect of sulphamethiazine combination on the plasma kinetics of chloramphenicol in Sokoto Red Goats. **International Journal of Pharmacology**. 2(3):320-323.

87. Adeneye AA, Ajagbonna OP, Adeleke TI, **Bello S.O.** (**2006**). Preliminary toxicity and phytochemical studies of the stem bark aqueous extract of Musangacecropioides in rats. **J Ethnopharmacol**. 105(3):374-9

88. Bello S.O (**2006**) How we may be missing some harmful effects of ultrasound-a hypothesis. **Medical Hypotheses.** 67(4):765-7.

89. Bello S.O (**2006**) Aspirin therapy in preeclampsia: More questions than answers.

Croatian Medical Journal.47:176-178.

90. Bello S.O (**2006**) "Trace, contact and Teach" sonography: How a little good may help millions in Sub-Saharan Africa. **Journal of Ultrasound In Medicine** 25: S46-47.

91. Bello, S.O et al (**2005**): Breast Cancer and Food: A Quasi-epidemiological Evidence of a Role for Dietary Phytoestrogens in Northwestern Nigerian Women. **International Journal of Cancer Researc**h 1(1): 21-24

92. Bello, S.O et al (**2005**) The pattern of infection and in vivo response to Chloroquine by uncomplicated Plasmodium falciparum malaria in northwestern Nigeria. **African Journal of Biotechnology**4 (1):79-82

93. Bello SO et al (**2005**) Food items may be compliant high throughput drug library waiting to be tapped: a proof of concept study. **Journal of Applied Sciences Research**. 1(1):30-34, 2005.

94. Bello SO et al (**2005**) Preliminary evaluation of the toxicity and some pharmacological properties of the aqueous crude extract of Solanum melongena. **Research Journal of Agriculture and Biological Sciences**. 1(1): 1-9,2005

95. Isezuo, SA, **Bello, S.O** et al (**2005**) Acute Limb Ischemia and Gangrene associated with peripartum cardiomyopathy. **Nigerian Postgraduate Medical Journal**. 12(3): 237-40.

96. Bello S.O (**2005**) Selective head cooling after neonatal hypoxic-Ischaemic encephalopathy: statistically insignificant but clinically important **The Lancet** - Vol. 365, 1619.

97. Bello S.O (**2005**): Saline Infusion Sonohysterography In A Resource Poor Setting: A Testimony To An Eureka. **Journal of Ultrasound In Medicine** 24: S10

98. Bello, S.O et al (**2004**) Randomized Double Blind Placebo Controlled Clinical Trial of Solanum melongena L. Fruit in Moderate to Severe Asthmatics. **Journal of Medical Sciences**4(4): 263-269

99. Bello, S.O and Muhammad B.Y. (**2003**) Dipyrone (Novalgin, Metamizole): Banned And Unbanned: The Dilemma Of A Commonly Prescribed And Over The Counter Analgesic**.** **Annals of African Medicine** 2(2): 101-102.

100. Bello SO and Muhammad BY (**2003**) Doxycycline Induced Intracranial Hypertension In Africa: The drug, the diseases and the doctor. **British Medical Journal**: 326/7390

101. Bello, S.O and Muhammad BY (**2003**). Uncertainty Principle Versus Clinical Equipoise In Clinical Trials In Sub -Saharan Africa: Are They Really Tenable? **Annals**

of African Medicine 2(2): 99-100

102. **Bello, S.O.** and Muhammad, B.Y. (**2002**). The Pharmacology of Venoms. **Sokoto J. of Vet. Sciences**, 4: 1, S18-S20.

103. **Bello S.O.** (**2002**) shouldn't there be compulsory veterinary consultation in the management of animal bites? **Sokoto J. of Vet. Sciences**,4 :1,S33-S35

104. Muhammad, B.Y. and **Bello, S.O.** (**2002**) Pharmacotherapeutic Management of Pain in Animal Bite: The Involvement of Opioid and Non-Opioid Mechanisms. **Sokoto J. of Vet. Sciences**, 4 : 1, S21-S25.

105. Nwosu, S.A., Muhammad, B.Y. and **Bello, S.O**. (**2002**.) Some Ethno Pharmacological Approach in the Management of Animal Bites**. Sokoto J. of Vet. Sciences**,4 :1,S26-S28.

106. **Bello SO**and Muhammad BY (**2002**) Children as missing factors in toxicological evaluations and the fallacy of a "placental barrier" **British Medical Journal** 325/7373 **.**

107. **Bello S O** (**2002**) HIV and TB. **Thorax**. 57/5/442 **.**

108. **Bello SO** (**2001**) It is still a man's world: Even to spread diseases like HIV. **British Medical Journal** 323/7311/472 **.**

109. **Bello SO** (**2001**) Bacterio-therapy? How do we get the bacteria out afterwards? **British Medical Journal** 323/7309/353 **.**

110. **Bello SO** (**2001**) The deprivation of doctors doctoring deprived areas. **British Medical Journal** 323/7310/409.